There is provided an open type compressor 1 including: a scroll compression mechanism 5, a lip seal 9 that prevents leakage of fluid, a sub bearing 8 disposed on a side closer to the scroll compression mechanism 5 than the lip seal 9, and supporting the drive shaft 6, a cylindrical housing 2 housing the scroll compression mechanism 5, and a front housing 3 mounted so as to block an opening part 2a of the housing 2 and holding the sub bearing 8 and the lip seal 9 on an axis X, characterized in that the front housing 3 is formed with an oil supply groove 3a for communicating a first space S1, which is located on a side of the scroll compression mechanism 5 with respect to the sub bearing 8 and communicated with the suction port 25, with a second space S2, which is located on a side of the lip seal 9 with respect to the sub bearing 8.
Description

(Technical Field)

[0001] The present invention relates to an open type compressor applicable to a compressor, a pump, an expander, and the like.

(Background Art)

[0002] Conventionally, there is known an open type compressor driven by protruding, to the outside of a housing, an end of a drive shaft rotatably supported in a housing through a bearing, and obtaining power from the outside (e.g., refer to PTL 1).

[0003] In an open type compressor of PTL 1, a crankshaft for driving a turning scroll is rotatably supported by a main bearing and a sub bearing. In the outside of the main bearing and the inside of the sub bearing with respect to a housing, a mechanical seal for preventing leakage of fluid along the crankshaft is disposed.

[0004] The open type compressor of PTL 1 is a compressor provided with a lubricant oil supply passage for supplying high-pressure lubricant oil to a seal chamber in which the mechanical seal is provided.

(Summary of Invention)

(Technical Problem)


(Solution to Problem)

[0006] In a case where the mechanical seal is disposed inside the sub bearing like the open type compressor of PTL 1, leakage of fluid is prevented by mechanical seal. Mist-like lubricant oil contained in compressed fluid is not supplied to the sub bearing, and therefore grease sealing type bearing in which grease is previously sealed is employed in order to enhance lubricity of the sub bearing.

[0007] In order to increase a dynamic rated load of the sub bearing, increase in a diameter of the sub bearing or the like is required. However, in the grease sealing type bearing, lubricity cannot be sufficiently enhanced with this increase. In this case, in order to enhance the lubricity of the sub bearing, it is desirable that the sub bearing is disposed inside the mechanical seal, and the lubricity is enhanced by mist-like lubricant oil contained in compressed fluid (refrigerant gas).

[0008] However, when the sub bearing is disposed inside the mechanical seal, supply of lubricant oil to the mechanical seal is disturbed by the sub bearing. When the supply of the mist-like lubricant oil to the mechanical seal becomes insufficient, abrasion of the mechanical seal becomes significant, and sealing performance cannot be sufficiently ensured.

[0009] The present invention has been made in view of the above circumstances, and an object of the invention is to provide an open type compressor capable of suppressing abrasion of a seal part to sufficiently ensure sealing performance, in a configuration in which a bearing part is disposed on a side closer to a compression mechanism than the seal part for preventing leakage of fluid.

[0010] In order to solve the above problem, an open type compressor of the present invention employs the following solutions.

[0011] An open type compressor of a first aspect of the present invention includes: a compression mechanism that is driven by a drive shaft for rotating around an axis, and compresses fluid flowing into from a suction port to discharge the compressed fluid from a discharge port; a seal part that is in contact with an outer peripheral surface of the drive shaft, and prevents leakage of fluid along the drive shaft; a bearing part that is disposed on a side closer to the compression mechanism than the seal part, and supports the drive shaft; a cylindrical first housing that houses the compression mechanism, and has an outer peripheral surface formed with the suction port and the discharge port therein; and a second housing that is mounted so as to block an opening part of the first housing, and holds the bearing part and the seal part on the axis, characterized in that the second housing is formed with an oil supply groove for communicating a first space with a second space, the first space being communicated with the suction port and located on a side of the compression mechanism with respect to the bearing part, the second space being located on a side of the seal part with respect to the bearing part.

[0012] According to the open type compressor of the first aspect of the present invention, the bearing part for supporting the drive shaft is disposed on the side closer to the compression mechanism than the seal part for preventing the leakage of the fluid along the drive shaft, and the first space communicated with the suction port for fluid is formed on the side of the compression mechanism with respect to the bearing part. This first space, and the second space located on the side of the seal part with respect to the bearing part are in a state communicated by the oil supply groove.

[0013] Therefore, mist-like lubricant oil contained in the fluid flowing into from the suction port is guided from the first space to the second space by the oil supply groove, and is supplied to the seal part.

[0014] Thus, according to the open type compressor of the first aspect of the present invention, in a configuration in which the bearing part is disposed on the side closer to the compression mechanism than the seal part for preventing the leakage of the fluid, it is possible to
In the open type compressor of the first aspect, sealing performance.

In the open type compressor of the first aspect of the present invention, a third space for circulating the fluid may be formed between an outer peripheral surface of the bearing part and an inner peripheral surface of the oil supply groove, and the second housing may be formed with a first oil supply hole for communicating the first space with the third space.

Consequently, lubricant oil that exists in the first space is guided to the third space via both the first oil supply hole and the oil supply groove. Therefore, mist-like lubricant oil is reliably guided from the first space to the second space, so that it is possible to suppress the abrasion of the seal part to improve sealing performance.

In the open type compressor having the above configuration, the second housing may be formed with a straight pipe-like second oil supply hole for communicating the suction port with the first space, and the first oil supply hole having a straight pipe-like shape may be disposed on an extension line of the second oil supply hole.

Consequently, the fixed amount of fluid guided from the second oil supply hole to the first space can be reliably guided to the first oil supply hole.

In the open type compressor of the first aspect of the present invention, the bearing part may have an inner ring pressed into the drive shaft, an outer ring pressed into the second housing, and a plurality of rolling bodies disposed between the inner ring and the outer ring, and the outer ring is formed with a communication hole for guiding fluid flowing into the oil supply groove, to the plurality of rolling bodies.

Consequently, mist-like lubricant oil is reliably supplied to the plurality of rollers disposed between the inner ring and the outer ring of the bearing part, and the lubricity of the bearing part can be enhanced.

In the open type compressor having the above configuration, the rolling bodies each may be a shaft-like member extending along the axis.

Consequently, the bearing part is configured by a needle bearing using shaft-like members as rolling bodies, and a dynamic rated load for the bearing part can be increased.

(Advantageous Effects of Invention)

According to the present invention, it is possible to provide an open type compressor capable of suppressing abrasion of a seal part to sufficiently ensure sealing performance, in a configuration in which a bearing part is disposed on a side closer to a compression mechanism than the seal part for preventing leakage of fluid.

(Brief Description of Drawings)

(Fig. 1) Fig. 1 is a longitudinal sectional view illustrating an open type compressor of an embodiment of the present invention.

(Fig. 2) Fig. 2 is a perspective view illustrating a sub bearing illustrated in Fig. 1, which is partially cut out.

(Fig. 3) Fig. 3 is a partially enlarged view of the open type compressor illustrated in Fig. 1.

(Fig. 4) Fig. 4 is a sectional view taken along the A-A arrow of the open type compressor illustrated in Fig. 3.

(Fig. 5) Fig. 5 is a sectional view taken along the B-B arrow of the open type compressor illustrated in Fig. 3.

(Description of Embodiments)

Hereinafter, an open type compressor of an embodiment of the present invention will be described with reference to Fig. 1 to Fig. 5.

An open type scroll compressor (open type compressor) 1 of this embodiment includes a cylindrical housing 2 (first housing) that extends in a circumferential direction around an axis X, and a front housing 3 (second housing) mounted so as to block an opening part 2a provided on a front end side of the housing 2, as illustrated in Fig. 1.

The housing 2 is formed in a shape in which a reference to Fig. 1 to Fig. 5.

In an outer peripheral surface of the housing 2, a suction port 25 for allowing fluid (refrigerant gas) to flow into the sealed space, and a discharge port 24 for discharging fluid compressed by the scroll compression mechanism 5 from the sealed space to the outside are formed.

The drive shaft 6 is rotatably supported by the front housing 3 through a main bearing 7 and a sub bearing 8 (bearing part). Additionally, a pulley 11 rotatably installed on an outer peripheral part of the front housing 3 is coupled to a turning scroll 16 of the scroll compression mechanism 5 described later through a publicly known driven crank mechanism 14 including a drive bush which varies the turning radius.

The drive shaft 6 is driven by the drive shaft 6, and compresses fluid (refrigerant
gas) that flows into from the suction port 25 formed on the outer peripheral surface of the housing 2, to discharge the compressed fluid from the discharge port 24 formed in the housing 2.

[0032] In the scroll compression mechanism 5, a pair of fixed scroll 15 and a turning scroll 16 are meshed with each other while shifting in phase by 180 degrees, so that a pair of compression chambers 17 is formed between both the scrolls 15 and 16, and the compression chambers 17 are moved while the capacity is gradually reduced from an outer peripheral position to the center position, thereby compressing the fluid (refrigerant gas).

[0033] The pair of fixed scroll 15 includes a discharge port 18 for discharging fluid compressed at a center part, and is fixed to a bottom wall surface of the housing 2 through a bolt 19. The turning scroll 16 is coupled to the crank pin 13 of the drive shaft 6 through the driven crank mechanism 14, and is supported on a thrust bearing surface of the front housing 3 through a publicly known rotation block mechanism (not illustrated) in such a manner as to freely revolve, turn, and drive.

[0034] At an outer periphery of an end plate 15A of the pair of fixed scroll 15, an O-ring 21 is provided. The O-ring 21 is brought into close contact with an inner peripheral surface of the housing 2, so that an internal space of the housing 2 is partitioned into a discharge chamber 22 and a suction chamber 23.

[0035] The discharge chamber 22 is communicated with the discharge port 18, and fluid (compressed refrigerant gas) from the compression chambers 17 is discharged. The fluid discharged to the discharge port 18 is discharged from the discharge port 24 formed in the housing 2 to a freezing cycle side.

[0036] The suction chamber 23 is communicated with the suction port 25 formed in the housing 2, the low-pressure fluid that circulates in the freezing cycle is sucked from the suction port 25, and the fluid is sucked in the compression chambers 17 via the suction chamber 23.

[0037] The pair of fixed scroll 15 and the turning scroll 16 are configured such that scroll laps 15B and 16B are erected on the end plate 15A and 16A, respectively. Between both the scrolls 15 and 16, the pair of compression chambers 17 partitioned by the end plates 15A and 16A and the scroll laps 15B and 16B is formed symmetrically with respect to a scroll center. Additionally, the turning scroll 16 smoothly revolves, turns, and drives around the fixed scroll 15.

[0038] As illustrated in Fig. 1, in the compression chambers 17, the axial height on the outer peripheral side of the scroll laps 15B and 16B is made to be higher than the height on an inner peripheral side of the scroll laps 15B and 16B. Consequently, the three-dimensional compressible scroll compression mechanism 5 that compresses in both the circumferential direction of the scroll laps 15B and 16B, and the lap height direction, when the compression chambers 17 moves while reducing the capacity from the outer peripheral side to the center side, and compresses the fluid, is configured.

[0039] The main bearing 7 is a member for supporting the drive shaft 6 on the axis X, an inner ring is pressed into the drive shaft 6, and an outer ring is pressed into an end on a side of the scroll compression mechanism 5 with respect to the front housing 3. The main bearing 7 is held on the axis X by the front housing 3. The main bearing 7 is disposed on a side closer to the scroll compression mechanism 5 than the sub bearing 8, and is a ball bearing having an outer diameter larger than the sub bearing 8.

[0040] The sub bearing 8 supports the drive shaft 6 on the axis X along with the main bearing 7, an inner ring 8a is pressed into the drive shaft 6, and an outer ring 8b is pressed into the front housing 3. The sub bearing 8 is held by the front housing 3 on the axis X. The sub bearing 8 is disposed on a side closer to the scroll compression mechanism 5 than the lip seal 9, and is a needle bearing having an outer diameter smaller than the main bearing 7.

[0041] As illustrated in the perspective view of Fig. 2, the sub bearing 8 has the outer ring 8b, a plurality of rollers 8c (rolling bodies) disposed between the inner ring 8a and the outer ring 8b, and a holder 8d holding the plurality of rollers 8c. The plurality of rollers 8c each are a shaft-like member extending along the axis X.

[0042] In Fig. 2, illustration of the inner ring 8a is omitted.

[0043] The lip seal 9 (seal part) is a member that is in contact with an outer peripheral surface of the drive shaft 6, and prevents leakage of fluid along the drive shaft 6. The lip seal 9 is mounted on an inner peripheral surface of the front housing 3, and is held on the axis X.

[0044] Now, a mechanism for supplying mist-like lubricant oil contained in fluid sucked from the suction port 25, to the sub bearing 8 and the lip seal 9 will be described.

[0045] As illustrated in Fig. 1, in the front housing 3, oil supply grooves 3a, oil supply holes 3b (first oil supply holes), oil supply holes 3c (second oil supply holes) are formed. Mist-like lubricant oil contained in fluid sucked from the suction port 25 is guided to a first space S1 located on a side of the scroll compression mechanism 5 with respect to the sub bearing 8, by the oil supply holes 3c for communicating the suction port 25 with the first space S1.

[0046] The mist-like lubricant oil contained in the fluid guided to the first space S1 is supplied to the main bearing 7, and the lubricity of the main bearing 7 is enhanced. Similarly, the mist-like lubricant oil is supplied to the sub bearing 8, and the lubricity of the sub bearing 8 is enhanced.

[0047] Although the oil supply holes 3c provided at two upper and lower places of the front housing 3 are illustrated in the longitudinal sectional view of Fig. 1, the oil supply holes 3c are provided at a plurality of places (e.g., four places) in the circumferential direction around the axis X.

[0048] As illustrated in the enlarged view of a main part of Fig. 3, the mist-like lubricant oil guided to the first space
S1 is guided to a second space S2 located on a side of the lip seal 9 with respect to the sub bearing 8, by the oil supply grooves 3a for communicating the first space S1 with the second space S2.

[0049] As illustrated in Fig. 3 and Fig. 4 (sectional view taken along the A-A arrow of Fig. 3), the oil supply grooves 3a each are a groove extending along the axis X and having a substantially semicircular cross-section.

[0050] As illustrated in Fig. 4, the oil supply grooves 3a are provided at four places at 90 degree intervals in the circumferential direction of the axis X. The places to be provided are not limited to the four places, and the oil supply grooves 3a may be provided at arbitrary places (e.g., eight places at 45 degree intervals).

[0051] The oil supply grooves 3a may be previously provided when the front housing 3 is manufactured by casting. Additionally, after the oil supply grooves 3a may be formed by processing after the front housing 3 is manufactured by casting.

[0052] As illustrated in Fig. 3, a third space S3 for circulating fluid from the first space S1 to the second space S2 is formed between the outer peripheral surface of the outer ring 8b of the sub bearing 8 and the inner peripheral surfaces of the oil supply grooves 3a.

[0053] As illustrated in Fig. 3, the oil supply holes 3b formed in the front housing 3 are formed so as to communicate the first space S1 with the third space S3. As illustrated in Fig. 3, the oil supply holes 3b are formed so as to discharge the mist-like lubricant oil to an intermediate position in the axis X direction of the third space S3.

[0054] As illustrated by the arrows in Fig. 4, the oil supply holes 3b guide fluid flowing into from the first space S1, to the respective corresponding oil supply grooves 3a.

[0055] As illustrated in Fig. 1, the oil supply holes 3b and the oil supply holes 3c are each formed in a straight pipe-like shape, and the oil supply holes 3b are disposed on extension lines of the respective oil supply holes 3c. Therefore, fluid guided from the suction port 25 to each oil supply hole 3c is easily guided to each oil supply hole 3b through the first space S1. Consequently, a fixed amount of the fluid guided from each oil supply hole 3c to the first space S1 can be reliably guided to each oil supply hole 3b.

[0056] As illustrated in Fig. 1, the diameter (passage cross-section area) of each oil supply hole 3b is smaller than the diameter (passage cross-section area) of each oil supply hole 3c. Therefore, the total amount of fluid guided from the oil supply holes 3c to the first space S1 can be prevented from being guided to the oil supply holes 3b, and the fixed amount of the fluid guided from the oil supply holes 3c to the first space S1 can be reliably guided to the main bearing 7.

[0057] As illustrated in Fig. 3, communication holes 8e for guiding fluid flowing into the oil supply grooves 3a to the plurality of rollers 8c are formed in the outer ring 8b of the sub bearing 8. Mist-like lubricant oil contained in the fluid flowing into the oil supply grooves 3a through the communication holes 8e are supplied to the plurality of rollers 8c. Therefore, the lubricity of the sub bearing 8 is improved, and the flaking phenomenon (flaking phenomenon) of the sub bearing 8 is suppressed.

[0058] As illustrated in Fig. 3, positions in the axis X direction of the communication holes 8e formed in the outer ring 8b of the sub bearing 8 coincide with positions in the axis X direction where the oil supply holes 3b are connected to the oil supply grooves 3a. The fluid flowing from each oil supply hole 3b to the corresponding supply groove 3a has a velocity component in a direction flowing to the corresponding communication hole 8e, and therefore easily flows to the corresponding communication hole 8e.

[0059] As illustrated in Fig. 5, the communication holes 8e are formed at four places of the outer ring 8b of the sub bearing 8 so as to correspond to the respective four oil supply grooves 3a.

[0060] Action and effects produced by the open type compressor 1 of this embodiment, described above, will be described.

[0061] According to the open type compressor 1 of this embodiment, the sub bearing 8 for supporting the drive shaft 6 is disposed on the side closer to the scroll compression mechanism 5 than the lip seal 9 for preventing the leakage of fluid along the drive shaft 6, and the first space S1 communicated with the suction port 25 for fluid is formed on the side of the scroll compression mechanism 5 with respect to the sub bearing 8. This first space S1, and the second space S2 located on the side of the lip seal 9 with respect to the sub bearing 8 are in a state communicated by the oil supply grooves 3a.

[0062] Therefore, mist-like lubricant oil contained in fluid flowing into from the suction port 25 is guided from the first space S1 to the second space S2 by the oil supply grooves 3a, and is supplied to the lip seal 9.

[0063] Thus, according to the open type compressor 1 of this embodiment, in a configuration in which the sub bearing 8 is disposed on the side closer to the scroll compression mechanism 5 than the lip seal 9 for preventing the leakage of fluid, it is possible to suppress abrasion of the lip seal 9 to sufficiently ensure sealing performance.

[0064] In the open type compressor 1 of this embodiment, a third space S3 for circulating fluid is formed between the outer peripheral surface of the sub bearing 8 and the inner peripheral surfaces of the oil supply grooves 3a, and the oil supply holes 3b for communicating the first space S1 with the third space S3 is formed in the front housing 3.

[0065] Consequently, lubricant oil that exists in the first space S1 is guided to the third space S3 via both the oil supply holes 3b and the oil supply grooves 3a. Therefore, mist-like lubricant oil is reliably guided from the first space S1 to the second space S2, so that it is possible to suppress the abrasion of the lip seal 9 to improve sealing performance.

[0066] In the open type compressor 1 of this embodi-
ment, the straight pipe-like oil supply holes 3c for communicating the suction port 25 with the first space S1 are formed in the front housing 3, and the straight pipe-like oil supply holes 3b are disposed on the extension lines of the respective oil supply holes 3c.

[0067] Consequently, the fixed amount of fluid guided from the oil supply holes 3c to the first space S1 can be reliably guided to the oil supply holes 3b.

[0068] In the open type compressor 1 of this embodiment, the sub bearing 8 has the inner ring 8a that is pressed into the drive shaft 6, the outer ring 8b that is pressed into the front housing 3, and the plurality of rollers 8c that are disposed between the inner ring 8a and the outer ring 8b. Additionally, the communication holes 8e for guiding fluid flowing into the oil supply grooves 3a to the plurality of rollers 8c are formed in the outer ring 8b.

[0069] Consequently, mist-like lubricant oil is reliably supplied to the plurality of rollers 8c disposed between the inner ring 8a and the outer ring 8b of the sub bearing 8, and the lubricity of the sub bearing 8 can be enhanced.

[0070] In the open type compressor 1 of this embodiment, the sub bearing 8 is a needle bearing using shaft-like members as rolling bodies. Therefore, a dynamic rated load for supporting the drive shaft can be increased compared to a case where a ball bearing is used as the sub bearing 8.

[0071] The present invention is not limited to the invention according to the above embodiment, and can be appropriately changed and modified without departing from the scope of the present invention.

Claims

1. An open type compressor (1) comprising:

- a compression mechanism (5) that is driven by a drive shaft (6) for rotating around an axis (X), and compresses fluid flowing into from a suction port (25) to discharge the compressed fluid from a discharge port (24);
- a seal part (9) that is in contact with an outer peripheral surface of the drive shaft (6), and prevents leakage of fluid along the drive shaft (6);
- a bearing part (8) that is disposed on a side closer to the compression mechanism (5) than the seal part (9), and supports the drive shaft (6);
- a cylindrical first housing (2) that houses the compression mechanism (5), and has an outer peripheral surface formed with the suction port (25) and the discharge port (24) therein; and
- a second housing (3) that is mounted so as to block an opening part (2a) of the first housing (2), and holds the bearing part (8) and the seal part (9) on the axis (X), characterized in that the second housing (3) is formed with an oil supply groove (3a) for communicating a first space (S1) with a second space (S2), the first space (S1) being communicated with the suction port (25) and located on a side of the compression mechanism (5) with respect to the bearing part (8), the second space (S2) being located on a side of the seal part (9) with respect to the bearing part (8).

2. The open type compressor (1) according to claim 1, wherein a third space (S3) for circulating the fluid is formed between an outer peripheral surface of the bearing part (8) and an inner peripheral surface of the oil supply groove (3a), and the second housing (3) is formed with a first oil supply hole (3b) for communicating the first space (S1) with the third space (S3).

3. The open type compressor (1) according to claim 2, wherein the second housing (3) is formed with a straight pipe-like second oil supply hole (3c) for communicating the suction port (25) with the first space (S1), and the first oil supply hole (3b) having a straight pipe-like shape is disposed on an extension line of the second oil supply hole (3c).

4. The open type compressor (1) according to any one of claims 1 to 3, wherein the bearing part (8) has an inner ring (8a) pressed into the drive shaft (6), an outer ring (8b) pressed into the second housing (3), and a plurality of rolling bodies (8c) disposed between the inner ring (8a) and the outer ring (8b), and the outer ring (8b) is formed with a communication hole (8e) for guiding fluid flowing into the oil supply groove (3a), to the plurality of rolling bodies (8c).

5. The open type compressor (1) according to claim 4, wherein the rolling bodies (8c) each are a shaft-like member extending along the axis (X).
FIG. 4
### DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
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<th>Relevant to claim</th>
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<td>X</td>
<td>EP 1 059 450 A2 (MITSUBISHI HEAVY IND LTD [JP]) 13 December 2000 (2000-12-13)</td>
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<td>A</td>
<td>* paragraph [0019] - paragraph [0032] * figures 1,2 *</td>
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<td>* paragraph [0011] - paragraph [0037] * figure 1 *</td>
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The present search report has been drawn up for all claims.

PLACE OF SEARCH: Munich

DATE OF COMPLETION OF THE SEARCH: 28 September 2016

EXAMINER: Papastefanou, M
This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on 28-09-2016.

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For more details about this annex: see Official Journal of the European Patent Office, No. 12/82.
REFERENCES CITED IN THE DESCRIPTION

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