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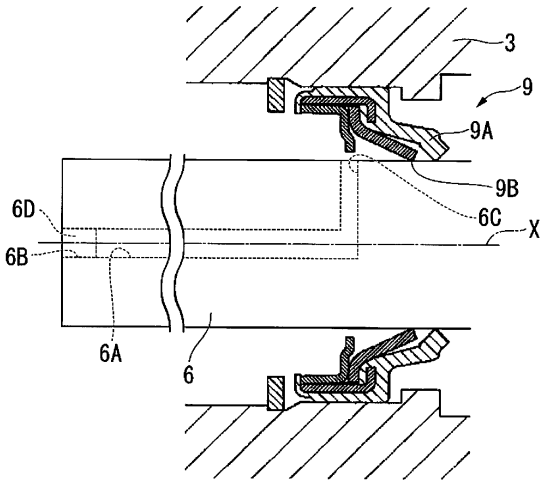
(54) OPEN TYPE COMPRESSOR

(57) Provided is an open type compressor (1), which includes: a compressor main body (1A) that has a driving shaft (6) rotated about an axis (X) and compresses a fluid; and a seal part (9) that comes into contact with an outer circumferential surface of the driving shaft (6) to seal leakage of the fluid from the compressor main body (1A). The seal part (9) has a first lip part (9A) provided close to the compressor main body (1A) in a direction of the axis (X), and a second lip part (9B) provided across the first lip part (9A) on a side opposite to the compressor main body (1A) in the direction of the axis (X). A feed hole (6C) is formed in the outer circumferential surface of the driving shaft (6), and feeds a lubricant to the outer circumferential surface at a position opposite to the compressor main body (1A) on the basis of the first lip part (9A).

FIG. 2



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

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

Description of Related Art

[0002] A machine called an open type compressor is known as a type of compressor. In an open type compressor, one end of a driving shaft that is rotatably supported inside a housing projects outside the housing, and a driving force from outside is applied to the one end. For this reason, a differential pressure occurs between the inside and outside of the housing along a driving shaft. To suppress leakage of a fluid based on this differential pressure, a seal part is provided on an outer circumferential surface of the driving shaft (e.g., see Patent Literature 1 below). In the open type compressor disclosed in Patent Literature 1, a lip seal is adopted as the seal part. Furthermore, a lubricant included in a fluid circulating in the housing is fed to the lip seal via a lubrication hole and a lubricating groove in a mist form. Thereby, abrasion of the lip seal is reduced.

[0003] Here, the lip seal generally adopts a dual structure. To be specific, the lip seal has a first lip formed of rubber, and a second lip formed of a resin.

[Patent Literature 1] Japanese Unexamined Patent Application, First Publication No. 2016-156310

SUMMARY OF THE INVENTION

[0004] However, in the compressor according to Patent Literature 1, the lubrication hole for the lubricant is only provided in the first lip side. For this reason, the lubricant does not sufficiently spread to the second lip side, and abrasion caused by poor lubrication occurs at the second lip. Especially, when the inside of the compressor has a negative pressure according to operating conditions, or when a suction pressure is low and a circulation amount of the lubricant is small, lubrication to the second lip is obstructed, and a likelihood of the poor lubrication is raised.

[0005] The present invention is directed to providing an open type compressor capable of being more stably operated.

[0006] According to a first aspect of the present invention, an open type compressor includes: a compressor main body configured to have a driving shaft rotated about an axis and driven to compress a fluid in association with the rotation of the driving shaft; and a seal part configured to come into contact with an outer circumferential surface of the driving shaft and to seal leakage of the fluid from the compressor main body. The seal part has a first lip part provided close to the compressor main body in a direction of the axis, and a second lip part provided across the first lip part on a side opposite to the compressor main body in the direction of the axis. A feed hole is formed in the outer circumferential surface of the driving shaft, and feeds a lubricant to the outer circumferential surface at a position opposite to the compressor main body on the basis of the first lip part.

[0007] According to this constitution, since the feed hole is formed at the position opposite to the compressor main body on the basis of the first lip part, the lubricant can also be spread to the second lip part in addition to the first lip part. Thereby, lubrication can be sufficiently performed between the driving shaft and the seal part.

[0008] According to a second aspect of the present invention, the feed hole may be formed in the outer circumferential surface of the driving shaft at a position opposite to the compressor main body on the basis of the second lip part.

[0009] According to this constitution, since the feed hole is formed at the position opposite to the compressor main body on the basis of the second lip part, the lubricant can be sufficiently fed to the second lip part. Furthermore, since there is no need to form the feed hole in a narrow space between the first lip part and the second lip part, the apparatus can be easily designed and manufactured.

[0010] According to a third aspect of the present invention, a plurality of feed holes may be formed in the outer circumferential surface of the driving shaft at intervals in a circumferential direction of the axis.

[0011] According to this constitution, since the plurality of feed holes may be formed at intervals in the circumferential direction of the axis, lubrication can be sufficiently performed between the outer circumferential surface of the driving shaft and the seal part over the whole region in the circumferential direction.

[0012] According to a fourth aspect of the present invention, the feed hole may communicate with a lubrication hole formed in an end of the driving shaft which is opposite to the compressor main body.

[0013] According to this constitution, the lubricant can be easily fed from the outside through the lubrication hole formed in the end of the driving shaft. Thereby, lubrication is possible without disassembling the entire compressor, and maintenance can be easily performed.

[0014] According to a fifth aspect of the present invention, the open type compressor may further include a lid mounted during an operation of the compressor main body and configured to block the lubrication hole.

[0015] According to this constitution, since the feed hole is blocked by the lid during the operation, the outer circumferential surface of the driving shaft can be kept smooth. Thereby, the driving shaft is smoothly rotated, and the open type compressor can be stably operated.

[0016] According to the open type compressor, a more stable operation is possible.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

FIG. 1 is a cross-sectional view illustrating a constitution of an open type compressor according to an embodiment of the present invention.

FIG. 2 is an enlarged view schematically illustrating key parts of the open type compressor according to the embodiment of the present invention.

FIG. 3 is a cross-sectional view illustrating a driving shaft of the open type compressor according to the embodiment of the present invention in an axial direction.

FIG. 4 is a cross-sectional view illustrating a modification of the open type compressor according to the embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0018] Hereinafter, an embodiment of the present invention will be described with reference to FIGS. 1 to 3. As illustrated in FIG. 1, an open type scroll compressor (an open type compressor) 1 according to the present embodiment includes a housing 2, a front housing 3, a compressor main body 1A, and a seal part 9.

[0019] The housing 2 has a cylindrical shape that extends in a direction of an axis X. A front housing 3 is mounted in an opening 2a formed on one side of the housing 2 by blocking the opening 2a. The front housing 3 is mounted on the housing 2, and thereby a sealed space is formed in the housing 2. The compressor main body 1A is housed in the sealed space. A suction port 25 that introduces a fluid (a refrigerant gas) into the sealed space and a discharge port 24 that discharges the fluid compressed by the compressor main body 1A from the sealed space to the outside are formed in an outer circumferential surface of the housing 2.

[0020] The compressor main body 1A has a columnar driving shaft 6 that extends along the axis X and a scroll compression section 5 that is coupled to the driving shaft 6. The driving shaft 6 is rotatably supported by the front housing 3 via a main bearing 7 and a sub-bearing 8. One end of the driving shaft 6 protrudes from the front housing 3 to the outside via the seal part 9. A pulley 11 that is rotatably installed on an outer circumferential portion of the front housing 3 via a bearing 10 is coupled to the one end of the driving shaft 6 via an electromagnetic clutch 12. Power that drives the pulley 11 via the electromagnetic clutch 12 is transmitted from the outside to the driving shaft 6, and the driving shaft 6 is rotated about the axis X. A crank pin 13 that is eccentric in a radial direction of the axis X is integrally provided on the other end of the driving shaft 6. A orbiting scroll 16 of the scroll compression section 5 (to be described below) is coupled to the other end of the driving shaft 6 via the crank pin 13.

[0021] As illustrated in FIGS. 2 and 3, a flow passage 6A for feeding a lubricant to the seal part 9 (to be described below) is formed inside the driving shaft 6. The flow passage 6A extends along the axis X. A lubrication hole 6B that opens into the end of the driving shaft 6 is formed close to one end of the flow passage 6A. The lubrication hole 6B is formed in the end of the driving shaft 6 which is opposite to the compressor main body 1A. A feed hole 6C that opens into an outer circumferential surface of the driving shaft 6 is formed close to the other end of the flow passage 6A. In the present embodiment, only one feed hole 6C is formed in the outer circumferential surface of the driving shaft 6, is orthogonal to the lubrication hole 6B and extends in a radial direction. However, without being limited thereto, the feed hole 6C may extend to be inclined with respect to the radial direction, or may extend to be curved.

[0022] During an operation of the open type compressor 1, the lubrication hole 6B is blocked by a lid 6D. When the lubricant is fed, the lid 6D is removed. A set screw is suitably used as a specific example of the lid 6D. To prevent unexpected looseness, it is also conceivable that a set screw having reverse threads formed in a direction opposite to a rotational direction of the driving shaft 6 be used as the lid 6D. The lid 6D is not limited to the set screw, and may be a simple bolt or cap.

[0023] As illustrated in FIG. 1, the scroll compression section 5 is driven by the driving shaft 6, thereby compressing the fluid introduced from the suction port 25 and discharging the compressed fluid from the discharge port 24. In the scroll compression section 5, a fixed scroll 15 and the orbiting scroll 16 are engaged with a phase shifted by 180°, and thereby a compression chamber 17 is formed between the fixed scroll 15 and the orbiting scroll 16.

[0024] The fixed scroll 15 and the orbiting scroll 16 have end plates 15A and 16A and spiral laps 15B and 16B provided on the end plates 15A and 16A. A discharge port 18 for discharging the compressed fluid is formed in the center of the fixed scroll 15. The fixed scroll 15 is fixed to the bottom of the housing 2 via bolts 19. The orbiting scroll 16 is coupled to the crank pin 13 of the driving shaft 6 via a driven crank mechanism 14 and is supported to enable revolution and gyration relative to the fixed scroll 15.

[0025] An O-ring 21 is mounted on an outer circumferential portion of the end plate 15A of the fixed scroll 15. The O-ring 21 comes into close contact with an inner circumferential surface of the housing 2, and thereby an internal space of the housing 2 is partitioned into a discharge chamber 22 and a suction chamber 23. The discharge chamber 22 communicates with a discharge port 18. The fluid (the compressed refrigerant gas) fed from the compression chamber 17 flows into the discharge chamber 22. The suction chamber 23 communicates with a suction port 25 formed in the housing 2. A low-pressure fluid introduced through the suction port 25 is suctioned into the compression chamber 17 via the suction chamber 23.

[0026] The main bearing 7 supports the driving shaft

6 on the axis X. The main bearing 7 has an inner ring 7a press-fitted onto the driving shaft 6 and an outer ring 7b press-fitted into the front housing 3. The main bearing 7 is disposed closer to the scroll compression section 5 than the sub-bearing 8 (to be described below). The main bearing 7 is a ball bearing having a larger outer diameter than the sub-bearing 8.

[0027] The sub-bearing 8 has an inner ring 8a press-fitted onto the driving shaft 6 and an outer ring 8b press-fitted into the front housing 3. The sub-bearing 8 is disposed closer to the scroll compression section 5 than the seal part 9. The sub-bearing 8 is a needle bearing having a smaller outer diameter than the main bearing 7.

[0028] The seal part 9 is in contact with the outer circumferential surface of the driving shaft 6, thereby sealing leakage of the fluid from the compressor main body 1A. The seal part 9 is mounted on the inner circumferential surface of the front housing 3. The seal part 9 is a lip seal. To be more specific, as illustrated in FIG. 2, the seal part 9 has a first lip part 9A that is provided relatively close to the compressor main body 1A in the direction of the axis X, and a second lip part 9B that is provided adjacent to the first lip part 9A.

[0029] The second lip part 9B is provided across the first lip part 9A on a side opposite to the compressor main body 1A in the direction of the axis X. The first lip part is formed of rubber composed of butadiene or the like. For example, polytetrafluoroethylene (PTFE) is used as a material of the second lip part.

[0030] The first lip part 9A is formed in an annular shape having a cross section that obliquely extends from an outer side to an inner side of the driving shaft 6 in the radial direction as it goes from one side to the other side in the direction of the axis X. An end of the other side of the first lip part 9A is in contact with the outer circumferential surface of the driving shaft 6. The second lip part 9B is formed in an annular shape having a cross section that obliquely extends from an outer side to an inner side of the axis X in the radial direction as it goes from one side to the other side in the direction of the axis X. An end of the other side of the second lip part 9B is in contact with the outer circumferential surface of the driving shaft 6. The aforementioned feed hole 6C opens into one side (an atmosphere side) relative to the second lip part 9B in the direction of the axis X. That is, the feed hole 6C is provided on the outer circumferential surface of the driving shaft 6 at a position opposite to the compressor main body 1A on the basis of the first lip part 9A. In other words, the feed hole 6C is formed at a position opposite to the compressor main body 1A on the basis of the second lip part 9B.

[0031] Next, a method of feeding the lubricant to the open type compressor 1 according to the present embodiment will be described.

[0032] In feeding the lubricant, the lid 6D is demounted from the feed hole 6B formed in the end of the driving shaft 6 first. Afterward, liquid lubricant is injected into the flow passage 6A through the lubrication hole 6B by a dropper. The lubricant circulating through the flow passage 6A reaches the outer circumferential surface of the driving shaft 6 via the feed hole 6C. After the lubrication is completed, the lid 6D is mounted in the feed hole 6C again. Afterward, the open type compressor 1 is operated, and thereby the lubricant is spread on the outer circumferential surface of the driving shaft 6. Lubrication is performed between the seal part 9 and the driving shaft 6.

[0033] As described above, according to the above constitution, since the feed hole 6C is formed at the position opposite to the compressor main body 1A on the basis of the first lip part 9A, the lubricant can also be spread to the second lip part 9B in addition to the first lip part 9A. Thereby, lubrication can be sufficiently performed between the driving shaft 6 and the seal part 9.

[0034] Furthermore, according to the above constitution, since the feed hole 6C is formed at a position opposite to the compressor main body 1A on the basis of the second lip part 9B, the lubricant can be sufficiently fed to the second lip part 9B. In comparison with a case in which the feed hole 6C is formed in a narrow space between the first lip part 9A and the second lip part 9B, the apparatus can be easily designed and manufactured.

[0035] In addition, according to the above constitution, the lubricant can be easily fed from the outside through the lubrication hole 6B formed in the end of the driving shaft 6. Thereby, maintenance of the apparatus can be easily performed.

[0036] The embodiment of the present invention has been described. The above constitution is an example, and various modifications or alternations can be performed on the above constitution without departing the gist of the present invention. For example, in the above embodiment, the example in which only one feed hole 6C is formed in the outer circumferential surface of the driving shaft 6 has been described. However, the number of feed holes 6C is not limited to one, and may be two or more. To be more specific, as illustrated in FIG. 4, a plurality of feed holes 6C may be formed in the outer circumferential surface of the driving shaft 6 at intervals in a circumferential direction of the axis X. According to this constitution, lubrication can be sufficiently performed between the outer circumferential surface of the driving shaft 6 and the seal part 9 over the whole region in the circumferential direction.

Industrial Applicability

[0037] The open type compressor as described in this application enables to obtain a stable operation.

EXPLANATION OF REFERENCES

[0038]

1 Open type compressor
1A Compressor main body
2 Housing

2a Opening
3 Front housing
5 Scroll compression section
6 Driving shaft
6A Flow passage
6B Lubrication hole
6C Feed hole
6D Lid
7 Main bearing
8 Sub-bearing
7a, 8a Inner ring
7b, 8b Outer ring
9 Seal part
9A First lip part
9B Second lip part
11 Pulley
12 Electromagnetic clutch
13 Crank pin
15 Fixed scroll
15A End plate
16 Orbiting scroll
16A End plate
17 Compression chamber
18 Discharge port
21 O-ring
22 Discharge chamber
23 Suction chamber
24 Discharge port
25 Suction port
X Axis

Claims

1. An open type compressor (1) comprising:

a compressor main body (1A) which comprises a driving shaft (6) configured to be rotated about an axis (X) and driven to compress a fluid in association with the rotation of the driving shaft (6); and
a seal part (9) which is arranged into contact with an outer circumferential surface of the driving shaft (6) so as to seal leakage of the fluid from the compressor main body (1A),
wherein the seal part (9) has:

a first lip part (9A) provided close to the compressor main body (1A) in a direction of the axis (X), and
a second lip part (9B) provided across the first lip part (9A) on a side opposite to the compressor main body (1A) in the direction of the axis (X), and

a feed hole (6C) is formed in the outer circumferential surface of the driving shaft (6), and feeds a lubricant to the outer circumferential surface at a position opposite to the compressor main body (1A) on the basis of the first lip part (9A).

2. The open type compressor (1) according to claim 1, wherein the feed hole (6C) is formed in the outer circumferential surface of the driving shaft (6) at a position opposite to the compressor main body (1A) on the basis of the second lip part (9B).

3. The open type compressor (1) according to claim 1 or 2, wherein a plurality of feed holes (6C) are formed in the outer circumferential surface of the driving shaft (6) at intervals in a circumferential direction of the axis (X).

4. The open type compressor (1) according to any one of claims 1 to 3, wherein the feed hole (6C) communicates with a lubrication hole (6B) formed in an end of the driving shaft (6) which is opposite to the compressor main body (1A).

5. The open type compressor (1) according to claim 4, further comprising a lid (6D) mounted during an operation of the compressor main body (1A) and configured to block the lubrication hole (6B).

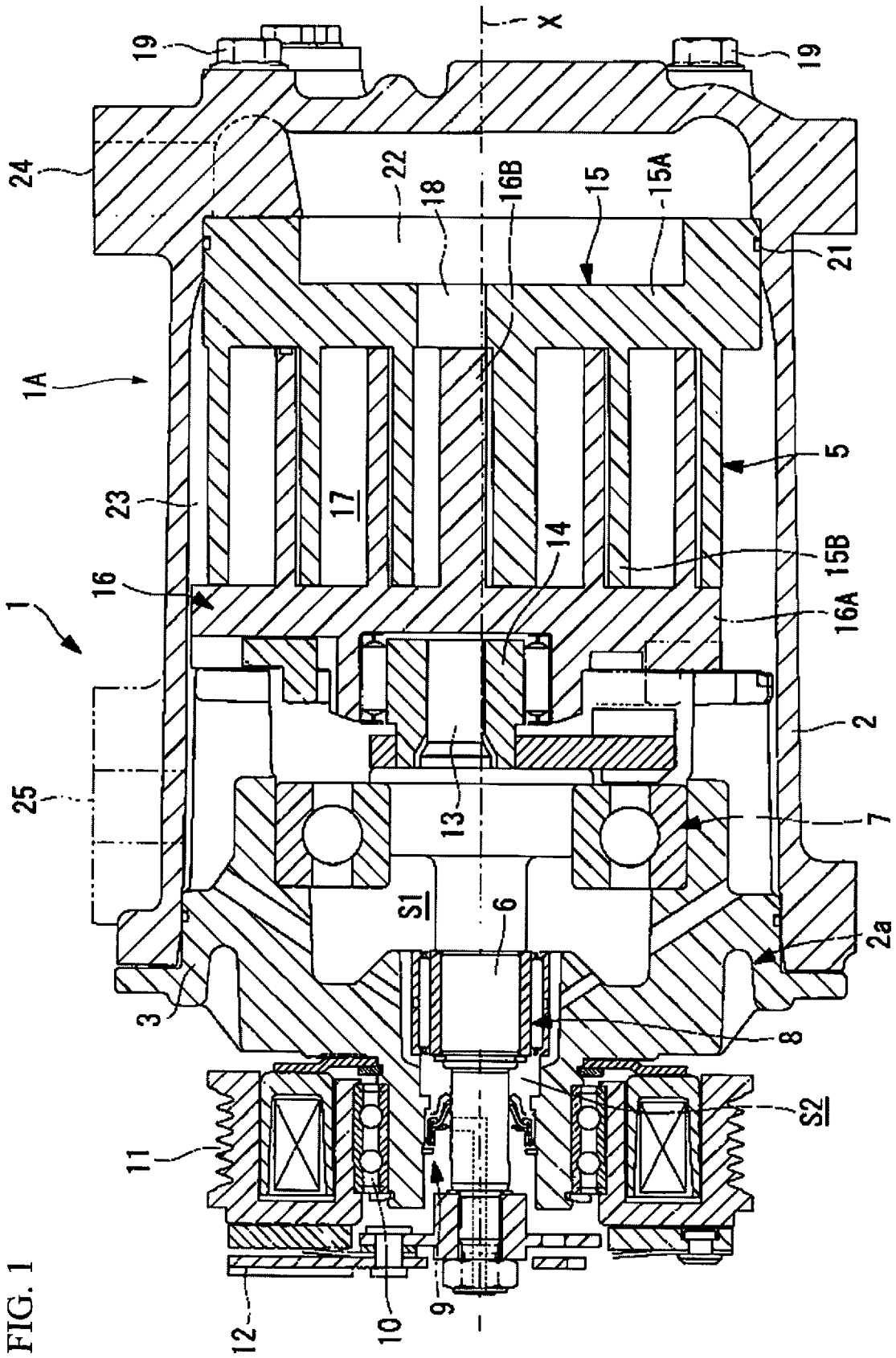

X
19
19
24
22
18
16B
15
15A
21
1A
5
23
17
14
15B
16
16A
1
2
25
13
7
S1
6
2a
3
8
S2
11
12
10
9

FIG. 1

FIG. 2

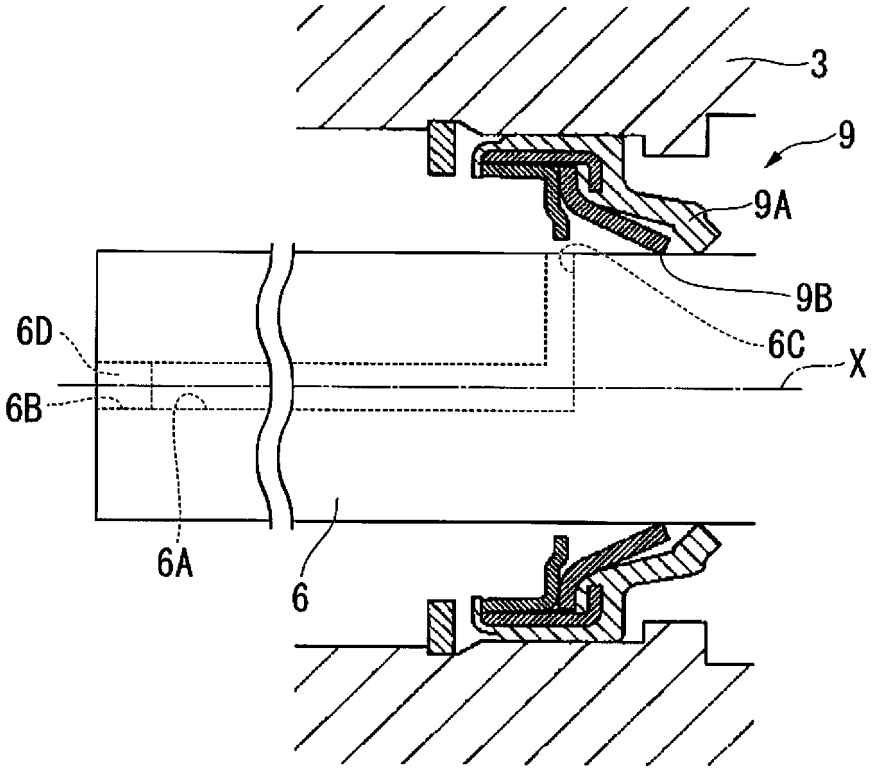


FIG. 3

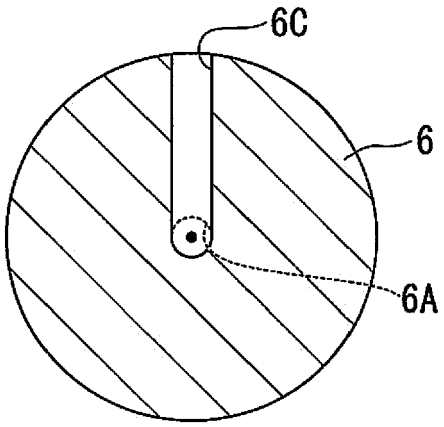
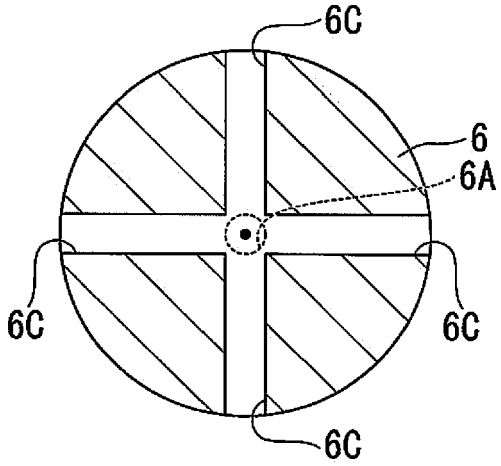


FIG. 4



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EUROPEAN SEARCH REPORT

Application Number
EP 18 19 6657

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 20 2004 019718 U1 (BURGMANN IND GMBH & CO KG [DE]) 3 March 2005 (2005-03-03) * paragraph [0013]; figure 1 * * paragraph [0019] *	1-5	INV. F01C19/12 F04C27/00 F04D29/10
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TECHNICAL FIELDS SEARCHED (IPC)

F01C
F04C
F04D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	23 November 2018	Grilli, Muzio

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