



(11) **EP 2 236 833 A1**

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

(43) Date of publication:
06.10.2010 Bulletin 2010/40

(51) Int Cl.:
F04C 18/52 (2006.01)

(21) Application number: **08867336.3**

(86) International application number:
PCT/JP2008/073759

(22) Date of filing: **26.12.2008**

(87) International publication number:
WO 2009/084641 (09.07.2009 Gazette 2009/28)

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

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(30) Priority: **28.12.2007 JP 2007340540**
24.12.2008 JP 2008328297

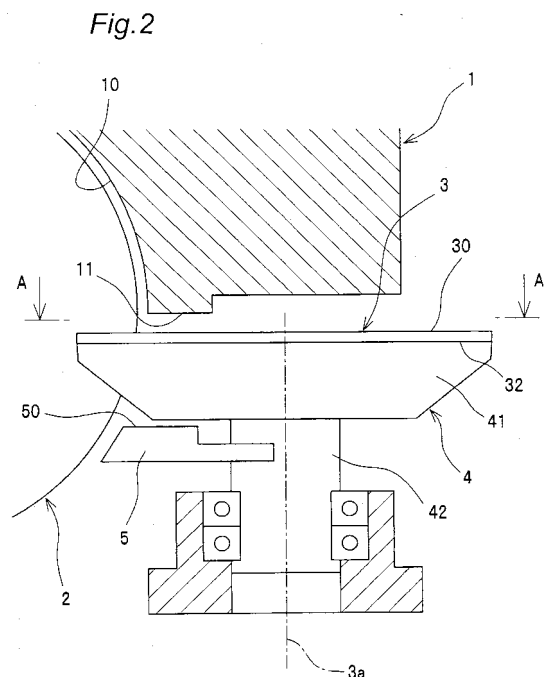
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(54) **SCREW COMPRESSOR**

(57) A screw compressor is capable of reducing gas leakage from a space between neighboring tooth portions of the gate rotor so that the compression performance can be improved. A seal portion 5 is placed on the other surface 32 side of the gate rotor 3. The seal portion 5 blocks the space between neighboring tooth portions of the gate rotor.



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Description

TECHNICAL FIELD

[0001] The present invention relates to a screw compressor for compressing a refrigerant gas or other gases.

BACKGROUND ART

[0002] Conventionally, there has been provided a screw compressor in which, as shown in an enlarged sectional view of Fig. 4, a screw rotor 102 is housed in a cylinder 110 of a casing 101, and a gate rotor 103 is engaged with the screw rotor 102, where a gas is compressed by a compression chambers defined by mutual engagement of the screw rotor 102 and the gate rotor 103 (JP 3731399 A).

[0003] More specifically, as shown in Fig. 5, which is a view taken along the line B-B of Fig. 4, groove portions 121 of the screw rotor 102 and tooth portions 131 of the gate rotor 103 are engaged with each other, respectively, to define the compression chambers. Then, from a suction side of one end of the screw rotor 102 in a direction along its shaft 102a, a low-pressure gas is sucked into the compression chambers, the low-pressure gas being compressed by the compression chambers. Then, the compressed high-pressure gas is discharged from a discharge side of the other end of the screw rotor 102 in the direction of the shaft 102a.

[0004] In Fig. 5, left side of the screw rotor 102 in drawing-sheet is assumed as the suction side for sucking the gas to the compression chambers, while right side of the screw rotor 102 in drawing-sheet is assumed as the discharge side for discharging the gas from the compression chambers.

[0005] As shown in Figs. 4 and 5, not on compression chambers-side of one surface 130 of the gate rotor 103 but on the other surface side opposite to the one surface 130 side of the gate rotor 103, there is no member that blocks a space S between neighboring tooth portions 131.

SUMMARY OF INVENTION

Technical Problem

[0006] However, in the above-described conventional screw compressor, as shown in Fig. 5, since on the other-surface side of the gate rotor 103 is no member that blocks the space S between neighboring tooth portions 131, there has been a problem that the gas within the compression chambers on the discharge side of the screw rotor 102 may leak out from the one surface 130 of the gate rotor 103 through the space S to the low-pressure space for housing of the gate rotor 103 on the other-surface side of the gate rotor 103 as indicated by arrow 'm'.

[0007] Accordingly, an object of the present invention

is to provide a screw compressor which can be improved in compression performance by reducing leakage of the gas through a space between the tooth portions of the gate rotor.

Solution to Problem

[0008] In order to achieve the above object, a screw compressor according to the present invention comprises:

a casing having a cylinder;
 a cylindrical-shaped screw rotor which is fitted to the cylinder and which has a plurality of spiral-shaped groove portions in its outer peripheral surface;
 a gate rotor having, in its outer peripheral surface, a plurality of tooth portions which are engaged with the groove portions of the screw rotor, and, respectively, to define compression chambers; and
 a seal portion placed not on compression chambers-side of one surface of the gate rotor but on the other surface side of the gate rotor opposite to the one surface side, wherein
 the seal portion blocks a space between neighboring tooth portions of the gate rotor.

[0009] According to the screw compressor of this invention, the seal portion is placed on the other surface side of the gate rotor, and the seal portion blocks the space between neighboring tooth portions. Therefore, the seal portion blocks the gas within each of the compression chambers from passing through the space between the neighboring tooth portions and going out from the one surface of the gate rotor to the other surface side.

[0010] Thus, gas leakage from the space between neighboring tooth portions of the gate rotor can be reduced, so that the compression performance can be improved.

[0011] In one embodiment of the screw compressor,

the casing has a seal surface faced to the one surface of the gate rotor, and
 one surface of the seal portion faced to the seal surface has a shape substantially corresponding to a shape of part of the seal surface faced to the seal portion with the gate rotor interposed therebetween.

[0012] According to the screw compressor of this embodiment, the one surface of the seal portion faced to the seal surface with the gate rotor interposed therebetween has a shape substantially corresponding to a shape of part of the seal surface faced to the seal portion with the gate rotor interposed therebetween. Therefore, by making the shape of the seal portion corresponding to the shape of the seal surface, gas leakage can be prevented efficiently.

[0013] In one embodiment of the screw compressor,

gas is sucked from a suction side of one end of the screw rotor in its shaft direction, while the gas within each of the compression chambers is discharged from a discharge side of the other end of the screw rotor in the direction of the shaft, and the seal portion is provided more on the discharge side in the shaft direction of the screw rotor than a plane containing a shaft of the gate rotor and perpendicular to the shaft of the screw rotor.

[0014] According to the screw compressor of this embodiment, the seal portion is provided more on the discharge side in the shaft direction of the screw rotor than a plane containing a shaft of the gate rotor and perpendicular to the shaft of the screw rotor. Therefore, the seal portion can be made smaller, so that space for mounting the seal portion can be reduced.

[0015] In one embodiment of the screw compressor, a material of the seal portion is polyphenylene sulfide resin.

[0016] According to the screw compressor of this embodiment, the material of the seal portion is polyphenylene sulfide resin. Therefore, even if the seal portion is brought into contact with the screw rotor or the gate rotor shaft, the seal portion is cut or chopped off so that mechanical damage thereof can be reduced.

Advantageous Effects of Invention

[0017] According to the screw compressor of this invention, since the seal portion is placed on the other surface side of the gate rotor and the seal portion blocks the space between neighboring tooth portions, gas leakage from the space between neighboring tooth portions of the gate rotor can be reduced so that the compression performance can be improved.

BRIEF DESCRIPTION OF DRAWINGS

[0018] Fig. 1 is a cross-sectional view showing an embodiment of the screw compressor according to the present invention;

Fig. 2 is an enlarged sectional view of the screw compressor;

Fig. 3 is a view taken along the line A-A of Fig. 2;

Fig. 4 is an enlarged sectional view of a screw compressor according to a prior art;

Fig. 5 is a view taken along the line B-B of Fig. 4;

Fig. 6 is a cross-sectional view showing another embodiment of the screw compressor according to the present invention; and

Fig. 7 is an enlarged sectional view of Fig. 6.

DESCRIPTION OF EMBODIMENTS

[0019] Hereinbelow, the present invention will be described in detail by way of embodiments thereof illustrat-

ed in the accompanying drawings.

[0020] Fig. 1 is a cross-sectional view showing an embodiment of a screw compressor according to the invention. This screw compressor is a single screw compressor, which includes a casing 1 having a cylinder 10, a cylindrical-shaped screw rotor 2 fitted to the cylinder 10, and a gate rotor 3 engaged with the screw rotor 2.

[0021] The screw rotor 2 has, on its outer peripheral surface, a plurality of spiral-shaped groove portions 21. The gate rotor 3 is disc-shaped and has, on its outer peripheral surface, a plurality of tooth portions 31 in a gear-like form. The groove portions 21 of the screw rotor 2 and the tooth portions 31 of the gate rotor 3 are engaged with each other, respectively.

[0022] By mutual engagement of the screw rotor 2 and the gate rotor 3, compression chambers C are defined. That is, these compression chambers C are spaces defined by the groove portions 21 of the screw rotor 2, the tooth portions 31 of the gate rotor 3, and an inner surface of the cylinder 10 of the casing 1.

[0023] The gate rotor 3 is placed in one pair on the right and left hands of the screw rotor 2 in left-and-right point symmetry with respect to a shaft 2a of the screw rotor 2. The casing 1 has a through hole 12 extending through the cylinder 10, and the gate rotor 3 is coming into the cylinder 10 through this through hole 12.

[0024] The screw rotor 2 rotates in an arrow R direction about the shaft 2a, and along with this rotation of the screw rotor 2, the gate rotor 3 rotates to compress the gas within each of the compression chambers C. The screw rotor 2 is rotated by a (not shown) motor housed in the casing 1.

[0025] Into each of the compression chambers C, a low-pressure gas is sucked from the suction side of one end of the screw rotor 2 in the shaft 2a direction, and the low-pressure gas is compressed in the compression chamber C, and then the compressed high-pressure gas is discharged from a discharge hole 13 provided on the discharge side at the other end of the screw rotor 2 in the shaft 2a direction.

[0026] As shown in an enlarged sectional view of Fig. 2 and Fig. 3, which is a view taken along the line A-A of Fig. 2, a seal surface 11 of the casing 1 faces the compression chambers C-side of one surface 30 of the gate rotor 3.

[0027] In Fig. 3, left side of the screw rotor 2 in drawing-sheet is assumed as the suction side for sucking the gas to the compression chambers C, while right side of the screw rotor 2 in drawing-sheet is assumed as the discharge side for discharging the gas from the compression chambers C.

[0028] The seal surface 11 of the casing 1 is a surface which adjoins the inner surface of the cylinder 10. The seal surface 11 of the casing 1 extends in a direction parallel to the shaft 2a of the screw rotor 2.

[0029] The one surface 30 of the gate rotor 3 forms part of inner surface of each of the compression chambers C. Between the seal surface 11 of the casing 1 and

the one surface 30 of the gate rotor 3 is a gap of, for example, about 60 μm .

[0030] With regard to the width of the seal surface 11 of the casing 1, width on a gas-discharge side of the screw rotor 2 is larger than width on the gas-suction side of the screw rotor 2. In addition, with regard to the width of the seal surface 11, width on the gas-discharge side of the screw rotor 2 may be equal to width on the gas-suction side of the screw rotor 2.

[0031] The gate rotor 3 is mounted on a gate rotor shaft 4. The gate rotor shaft 4 has a base portion 41, and a shaft portion 42 attached to the base portion 41. The one surface 30 of the gate rotor 3 and the other surface 32 are attached to the base portion 41.

[0032] The base portion 41 has a shape corresponding to the shape of the gate rotor 3. That is, the tooth portions of the base portion 41 has a shape corresponding to the tooth portions 31 of the gate rotor 3 and also corresponding to a space S between neighboring tooth portions 31. The shaft portion 42 is supported by the casing 1.

[0033] On the other surface 32 side of the gate rotor 3 is placed a seal portion 5. That is, the seal portion 5 is faced to the seal surface 11 with the gate rotor 3 and the base portion 41 interposed therebetween. The seal portion 5 blocks the space S between neighboring tooth portions 31.

[0034] The seal portion 5 is a platy member fitted to the casing 1. The seal portion 5 is slightly apart from the base portion 41. A material of the seal portion 5 is, for example, polyphenylene sulfide resin.

[0035] One surface 50 of the seal portion 5 is faced to the seal surface 11 with the gate rotor 3 interposed therebetween. The one surface 50 has a shape substantially corresponding to part of the seal surface 11 faced to the seal portion 5 with the gate rotor 3 interposed therebetween. That is, with regard to the width of the one surface 50 of the seal portion 5, width on a gas-discharge side of the screw rotor 2 is larger than width on the gas-suction side of the screw rotor 2. In addition, with regard to the width of the one surface 50 of the seal portion 5, width on the gas-discharge side of the screw rotor 2 may be equal to width on the gas-suction side of the screw rotor 2.

[0036] The seal portion 5 is provided more on the discharge side in the shaft 2a direction of the screw rotor 2 than a plane P containing a shaft 3a of the gate rotor 3 and perpendicular to the shaft 2a of the screw rotor 2.

[0037] According to the screw compressor constructed as described above, the seal portion 5 is placed on the other surface 32 side of the gate rotor 3, and the seal portion 5 blocks the space S between neighboring tooth portions 31. Therefore, the seal portion 5 blocks the gas within each of the compression chambers C from passing through the neighboring tooth portions 31 and going out from the one surface 30 of the gate rotor 3 to the other surface 32 side. That is, the gas within each of the compression chambers C can be prevented from passing through the neighboring tooth portions 31 and leaking out to the low-pressure space S having the gate rotor 3

housed therein.

[0038] Thus, gas leakage from the space S between neighboring tooth portions 31 of the gate rotor 3 can be reduced, so that the compression performance can be improved.

[0039] Also, when the one surface 50 of the seal portion 5 faced to the seal surface 11 with the gate rotor 3 interposed therebetween has a shape substantially corresponding to the shape of part of the seal surface 11 faced to the seal portion 5 with the gate rotor 3 interposed therebetween, the space S can be blocked so that gas leakage can be prevented efficiently.

[0040] Also, the seal portion 5 is provided more on the discharge side in the shaft 2a direction of the screw rotor 2 than the plane P containing the shaft 3a of the gate rotor 3 and perpendicular to the shaft 2a of the screw rotor 2. Thus, the seal portion 5 can be made smaller, so that space for mounting the seal portion 5 can be reduced.

[0041] That is, since the gas pressure within the compression chambers C becomes higher on the discharge side of the screw rotor 2, most of gas leakage passing through the space S is from the discharge side (higher-pressure part in compression chamber C) of the screw rotor 2, and gas leakage from the suction side (lower-pressure part in compression chamber C) of the screw rotor 2 is small. Therefore, the seal portion 5 may be provided only on the discharge side (higher-pressure part in compression chamber C) of the screw rotor 2.

[0042] The material of the seal portion 5 is polyphenylene sulfide resin. Therefore, even if the seal portion 5 is brought into contact with the screw rotor 2 or the gate rotor shaft 4, the seal portion 5 is cut or chopped off so that mechanical damage thereof can be reduced.

[0043] The present invention is not limited to the above-described embodiment. For example, the one surface 50 of the seal portion 5 may be formed into a shape different from that of the seal surface 11. The seal portion 5 may be provided also on the suction side in the shaft 2a direction of the screw rotor 2 than the plane P. The seal portion 5 may be provided as part of the casing 1. Further, the material of the seal portion 5 may be other than polyphenylene sulfide resin. The quantity of the gate rotor 3 may be increased or decreased.

[0044] As shown in Figs. 6 and 7, it is also possible that a seal portion 5A is formed into a L-shaped cross section and this seal portion 5A is mounted with bolts in the vicinity of the through hole 12 of the casing 1A. In addition, in Figs. 6 and 7, component members designated by the same reference signs as in Figs. 1 and 2 are similar in construction to the component members of Figs. 1 and 2.

Claims

1. A screw compressor comprising:

a casing (1) having a cylinder (10);
 a cylindrical-shaped screw rotor (2) which is fitted to the cylinder (10) and which has a plurality of spiral-shaped groove portions (21) in its outer peripheral surface; 5
 a gate rotor (3) having, in its outer peripheral surface, a plurality of tooth portions (31) which are engaged with the groove portions (21) of the screw rotor (2), respectively, to define compression chambers (C); and 10
 a seal portion (5) placed not on compression chambers (C)-side of one surface (30) of the gate rotor (3) but on the other surface (32) side of the gate rotor (3) opposite to the one surface (30) side, wherein 15
 the seal portion (5) blocks a space (S) between neighboring tooth portions (31) of the gate rotor (3).

2. The screw compressor as claimed in Claim 1, wherein 20
 the casing (1) has a seal surface (11) faced to the one surface (30) of the gate rotor (3), and one surface (50) of the seal portion (5) faced to the seal surface (11) has a shape substantially corresponding to a shape of part of the seal surface (11) faced to the seal portion (5) with the gate rotor (3) interposed therebetween. 25

3. The screw compressor as claimed in Claim 1 or 2, wherein 30
 gas is sucked from a suction side of one end of the screw rotor (2) in its shaft (2a) direction, while the gas within each of the compression chambers (C) is discharged from a discharge side of the other end of the screw rotor (2) in the direction of the shaft (2a), and 35
 the seal portion (5) is provided more on the discharge side in the shaft (2a) direction of the screw rotor (2) than a plane (P) containing a shaft (3a) of the gate rotor (3) and perpendicular to the shaft (2a) of the screw rotor (2). 40

4. The screw compressor as claimed in any one of Claims 1 to 3, wherein 45
 a material of the seal portion (5) is polyphenylene sulfide resin.

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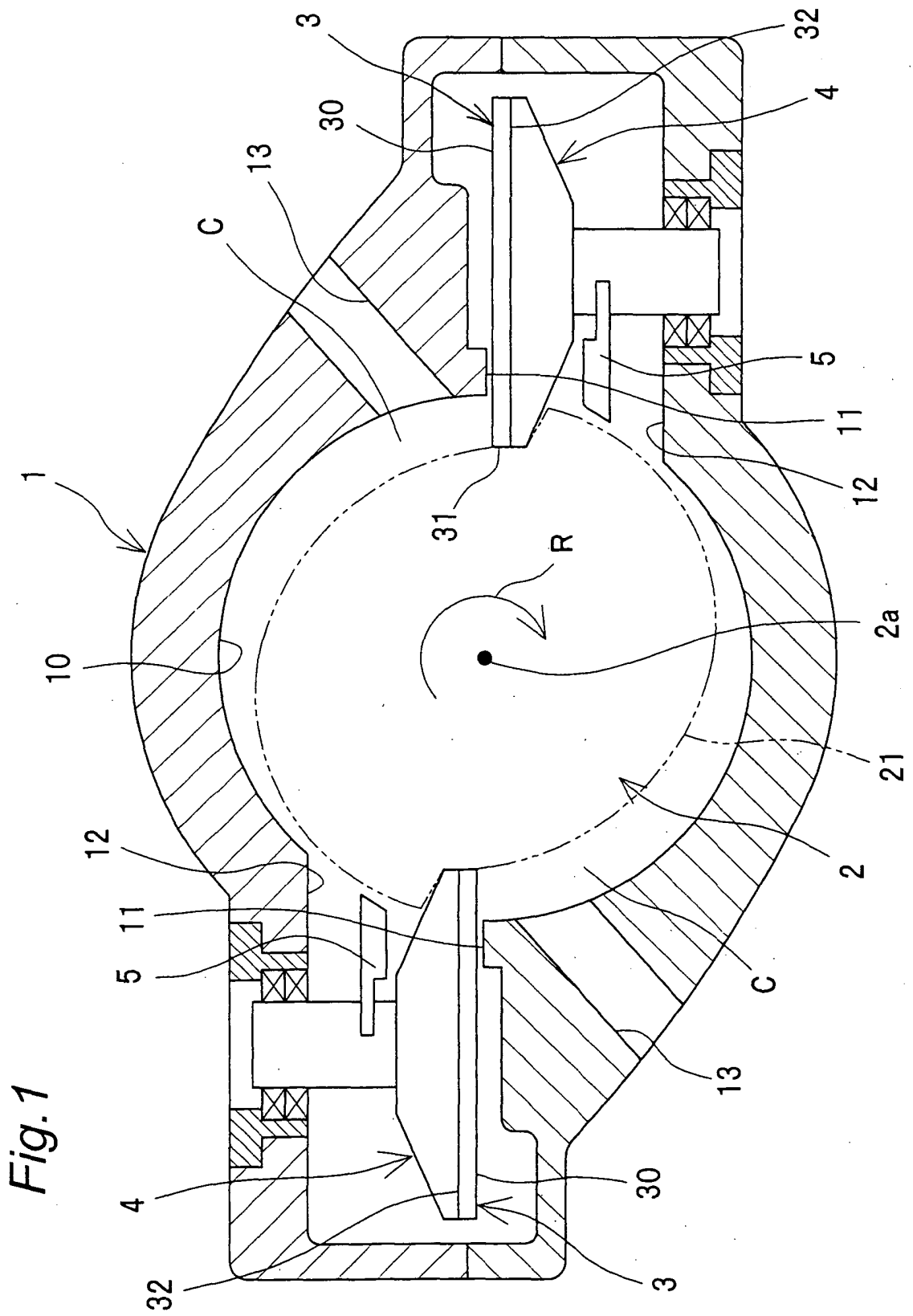


Fig.2

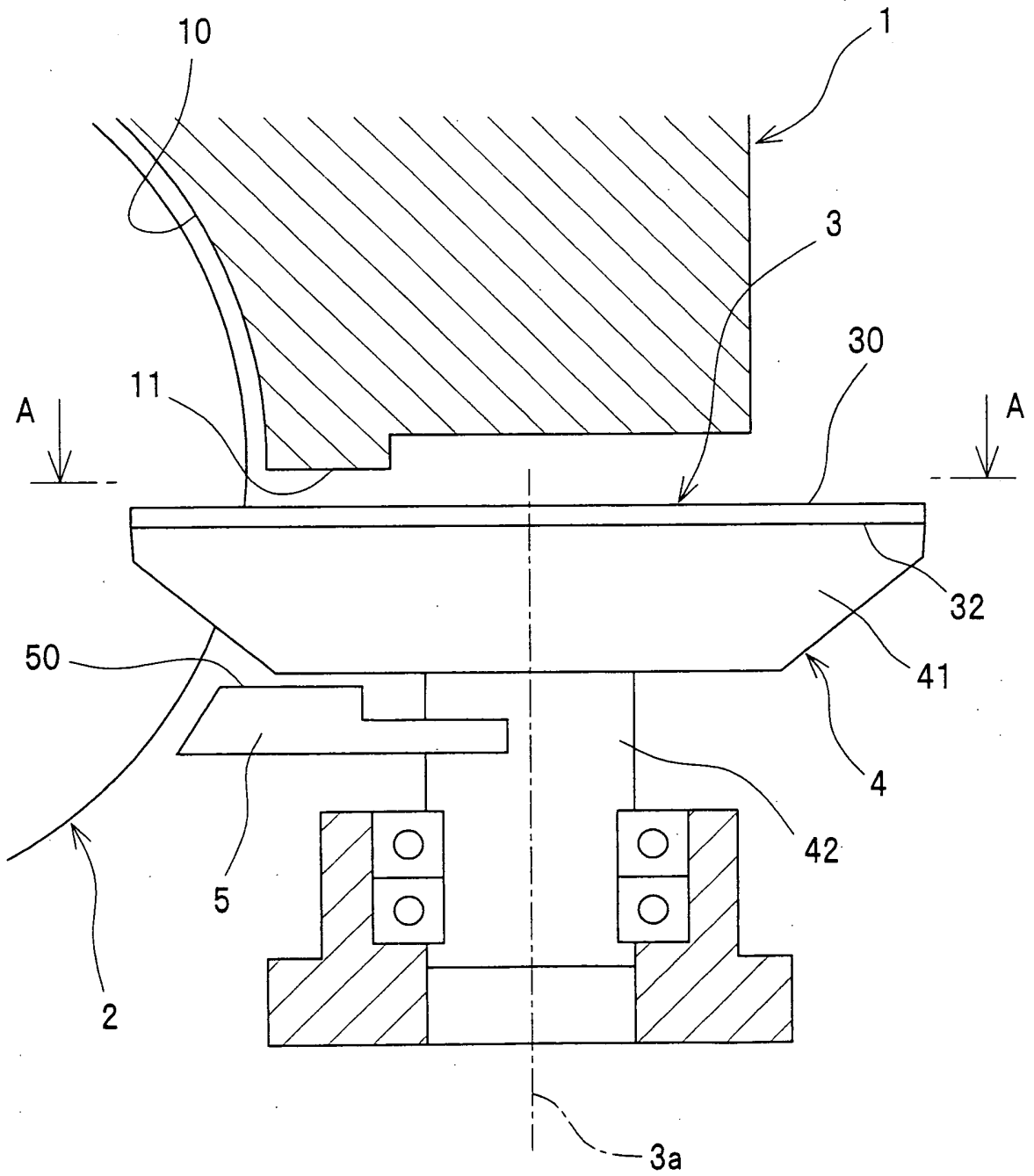


Fig.3

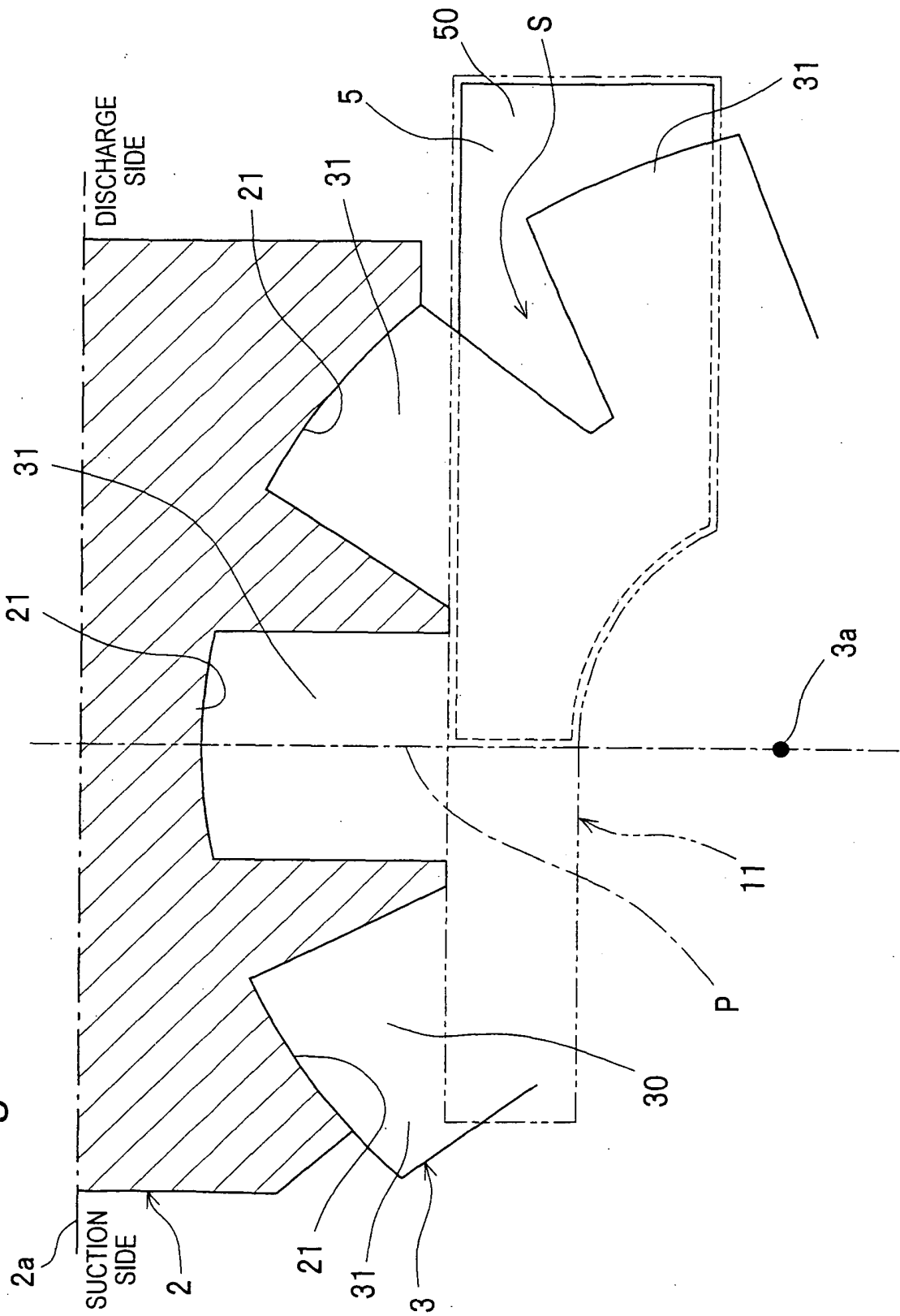


Fig. 4

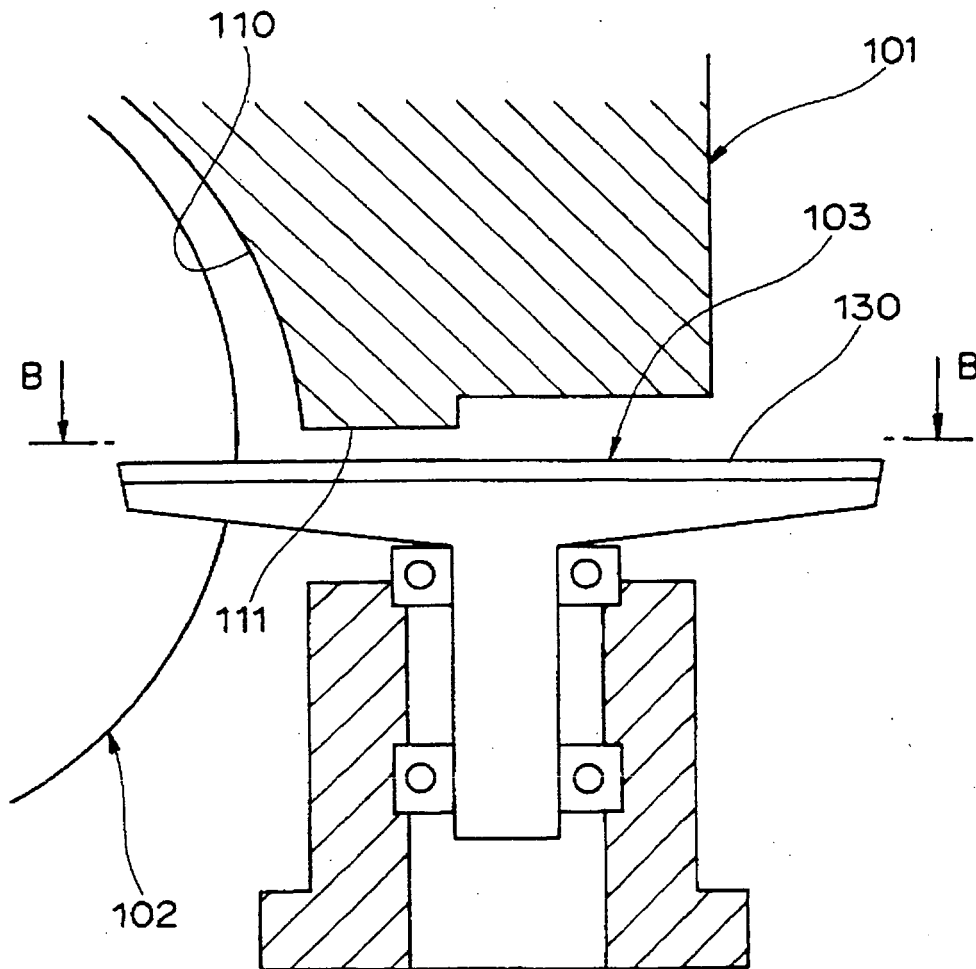
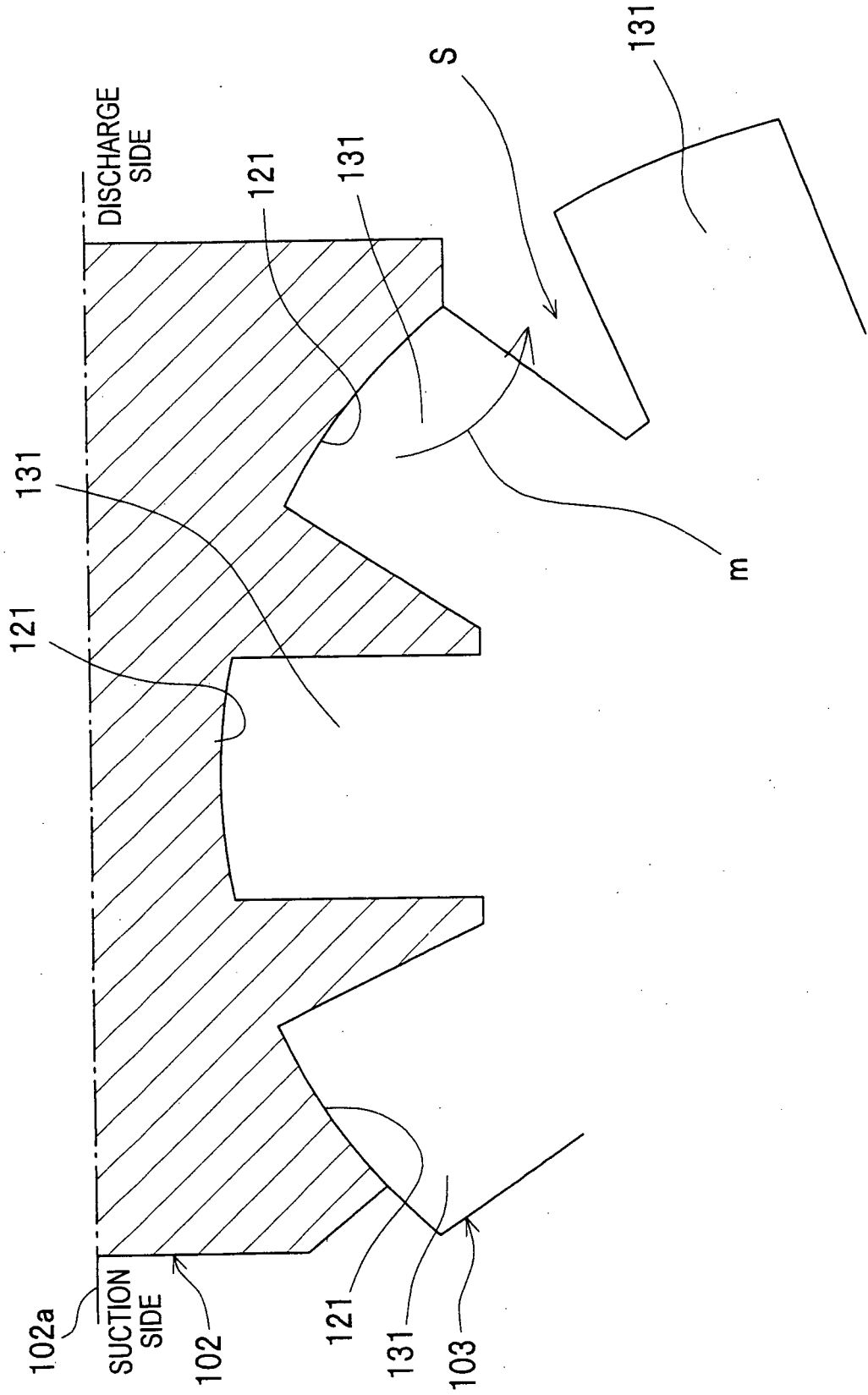


Fig.5



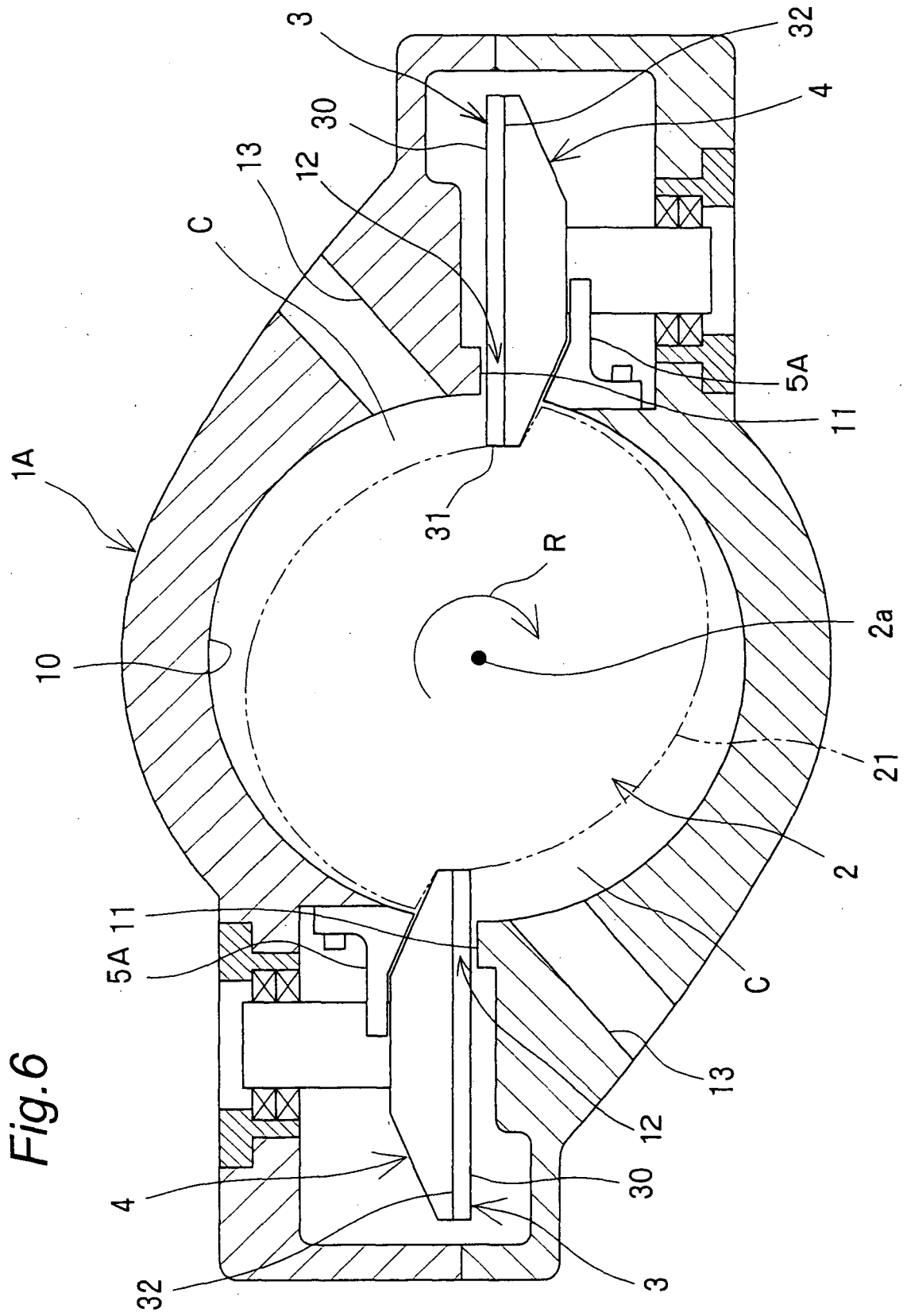
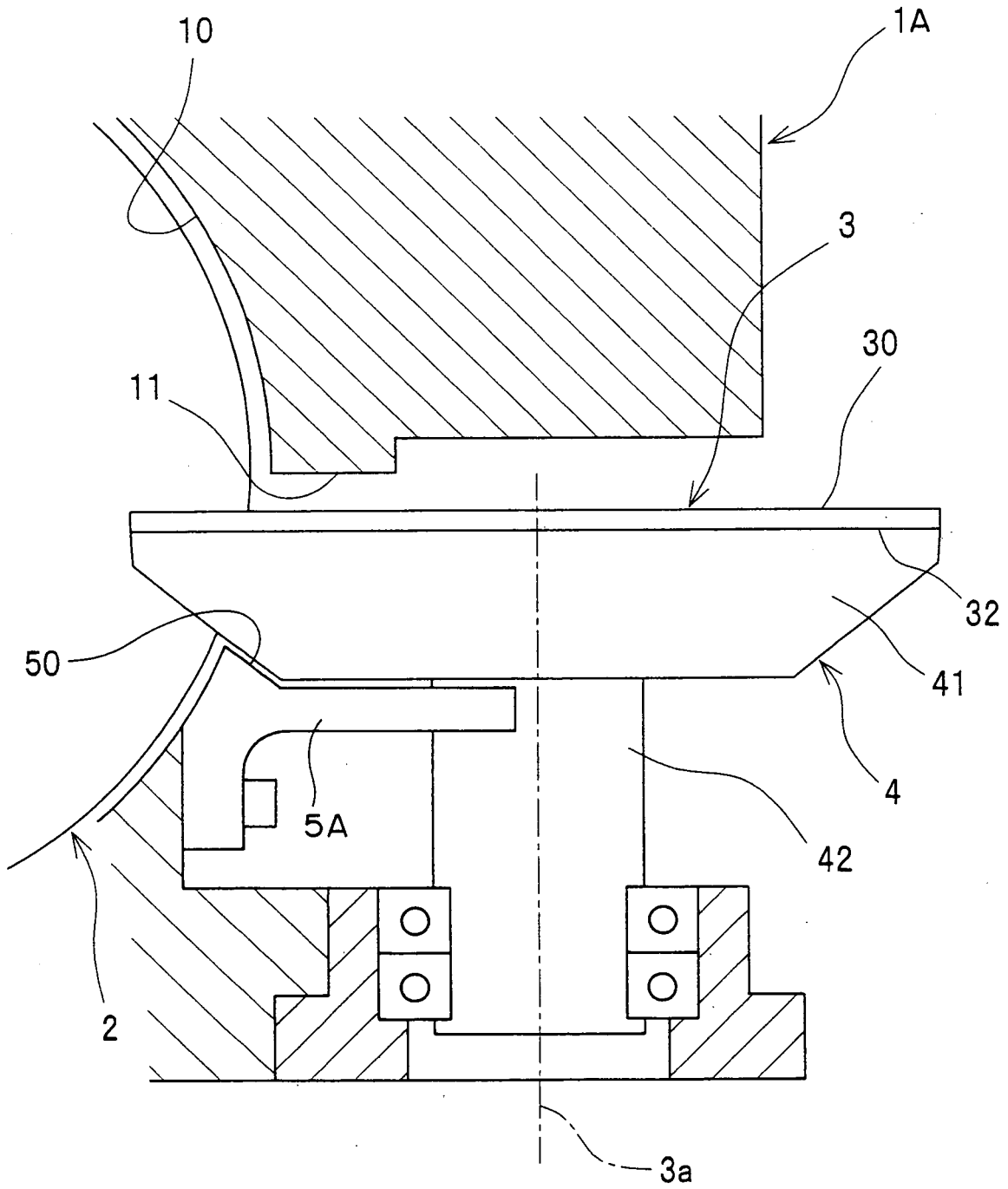


Fig.7



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2008/073759

A. CLASSIFICATION OF SUBJECT MATTER

F04C18/52 (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)

F04C18/52

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2009
Kokai Jitsuyo Shinan Koho	1971-2009	Toroku Jitsuyo Shinan Koho	1994-2009

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	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 81714/1987 (Laid-open No. 190585/1988) (Daikin Industries, Ltd.), 08 December, 1988 (08.12.88), Full text; Figs. 1 to 6 (Family: none)	1-3
Y		1-4
X	JP 43-22804 B1 (Gutsudoiya Ponpusu Ltd.), 01 October, 1968 (01.10.68), Full text; Figs. 1 to 7 (Family: none)	1-3
Y		1-4

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

* Special categories of cited documents:

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Date of the actual completion of the international search
02 March, 2009 (02.03.09)Date of mailing of the international search report
10 March, 2009 (10.03.09)Name and mailing address of the ISA/
Japanese Patent Office

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2008/073759

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 50-131113 A (Hokuetsu Industries Co., Ltd.), 17 October, 1975 (17.10.75), Full text; Figs. 1 to 12 (Family: none)	1-3 1-4
X Y	US 3133695 A (Fernand ZIMMERN), 19 May, 1964 (19.05.64), Figs. 1 to 7 (Family: none)	1-3 1-4
X Y	US 2158933 A (Paul E.GOOD, Riverton, N.J.), 16 May, 1939 (16.05.39), Figs. 1 to 9 (Family: none)	1-3 1-4
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 96188/1979 (Laid-open No. 13587/1981) (Nippon Soken, Inc.), 05 February, 1981 (05.02.81), Full text; Figs. 1 to 3 (Family: none)	1-4
Y	JP 6-179227 A (Matsushita Electric Industrial Co., Ltd.), 28 June, 1994 (28.06.94), Full text (Family: none)	4
Y	JP 9-59592 A (Denso Corp.), 04 March, 1997 (04.03.97), Full text (Family: none)	4
Y	JP 10-176682 A (Sanyo Electric Co., Ltd.), 30 June, 1998 (30.06.98), Full text (Family: none)	4

Form PCT/ISA/210 (continuation of second sheet) (April 2007)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 3731399 A [0002]