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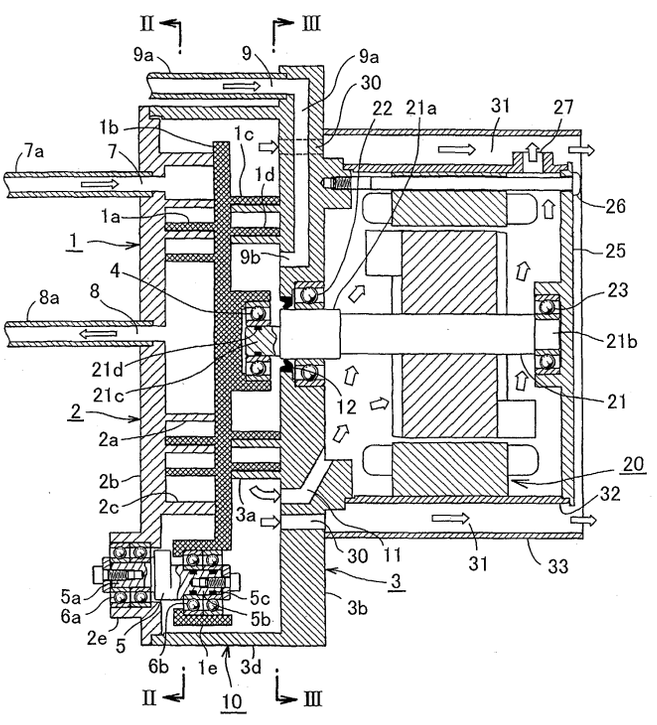
Remarks:
Amended claims in accordance with Rule 86 (2) EPC.

(54) Scroll fluid machine

(57) A scroll fluid machine comprises an orbiting scroll 1 and a stationary scroll 3. The orbiting scroll 1 is driven by a driving shaft 21 and has an orbiting scroll wrap 1c. The stationary scroll 3 has a stationary scroll wrap 3a. The orbiting scroll 1 is eccentrically revolved by the driving shaft 21 with respect to the stationary scroll 3 while the orbiting scroll wrap 1c is engaged with the stationary scroll wrap 3a to create an expanding section. Fluid expanded and cooled in the expanding section flows to a circumferential path 31 around the electric motor 20 to cool it effectively.

FIG.1



EP 1 529 959 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a scroll fluid machine comprising compressing and expanding sections and especially to a scroll fluid machine used to feed air into and discharge it from a fuel cell.

BACKGROUND ART

[0002] In a fuel cell, there is electrolyte between an anode and a cathode, and hydrogen is fed as cathode active material to the cathode. Hydrogen from which electrons are taken away at the cathode becomes hydrogen ions which move to the anode through the electrolyte. Oxygen is fed as anode active material to the anode and receives electrons from the cathode through an external circuit to allow the hydrogen ions to react with oxygen to form water. Hence electrons flow from the cathode to the anode or an electric current flows from the anode to the cathode. Generally oxygen-containing air is fed to the anode, so that unreactive oxygen and nitrogen as main component of air exist on the anode in addition to water. Combination of hydrogen and oxygen is exothermic reaction and its temperature rises from supplied air. The gas which contains nitrogen as main component should be discharged from the anode.

[0003] Air pressurized by a compressor is fed to the anode, and the gas at the anode has higher pressure than atmospheric pressure. If the gas is released to air, it will become loss without doing work. Energy of the gas is retrieved through an expander. Thus, the fuel cell may preferably have a compressor and an expander.

[0004] US 6,506,512 B1 to Mori et al. discloses a compression regenerative machine for a fuel cell as fluid machine having compression and regenerative mechanisms. The scroll fluid machine has an orbiting scroll each side of which has a scroll wrap, one scroll wrap compressing sucked fluid, while the other expands sucked fluid to do work.

[0005] In the compression regenerating machine, fluid expanded and fallen in temperature in a regenerative chamber cools the orbiting scroll from the regenerative chamber, and fluid is expanded from the center to the circumference. However, no consideration is paid on cooling an electric motor for driving the orbiting scroll. Thus, in a small space such as an automobile engine room isolated from outside, surrounding temperature rises to lead poor heat radiation for a long time operation to raise temperature of the electric motor thereby decreasing its life. Also, the electric motor is noisy to involve adverse effect to the surroundings.

SUMMARY OF THE INVENTION

[0006] In view of the foregoing disadvantages, it is an object to provide a scroll fluid machine having a compressing section and an expanding section at both sides of an orbiting scroll end plate, fluid which is fallen in temperature with expansion in the expanding section being applied to cool an electric motor effectively, noise from the electric motor being prevented.

[0007] According to the present invention, there is provided a scroll fluid machine comprising a driving shaft: an orbiting scroll that has an orbiting scroll wrap; a stationary scroll that has a stationary wrap; and an electric motor for driving the driving shaft, the orbiting scroll being driven by the driving shaft and eccentrically revolved with respect to the stationary scroll while the orbiting scroll wrap is engaged with the stationary scroll wrap to create an expanding section, characterized in that the expanding section communicates via an outer outlet with an circumferential path around the electric motor between an inner circumferential wall and an outer circumferential wall.

DESCRIPTION OF DRAWING

[0008]

Fig. 1 is a vertical sectional view of the first embodiment of a scroll fluid machine according to the present invention;

Fig. 2 is a vertical sectional view taken along the line II-II in Fig. 1, removing an auxiliary crank shaft and a bearing therefor;

Fig. 3 is a vertical sectional view taken along the line III-III in Fig. 1;

Fig. 4 is a vertical sectional side view of the second embodiment of a scroll fluid machine according to the present invention; and

Fig. 5 is a vertical sectional side view of the third embodiment of a scroll fluid machine according to the present invention

DETAILED DESCRIPTION

[0009] Fig. 1 illustrates the first embodiment of a scroll fluid machine according to the present invention, comprising a scroll portion 10 and an electric motor 20. A front orbiting scroll wrap 1 a and a rear orbiting scroll wrap 1c are provided on both sides of an orbiting end plate 1b of an orbiting scroll 1. On a stationary end plate 2b of a front stationary scroll 2, there are provided a front stationary scroll wrap 2a engaged with the front orbiting scroll wrap 1a, and an annular partition wall 2c. The rear stationary scroll 3 has an outer peripheral wall 3d and a stationary end plate 3b on which a rear stationary scroll wrap 3a engaged with the rear orbiting scroll wrap 1c is provided. The outer peripheral wall 3d is fixed to the stationary end plate 2b of the front stationary scroll 2. The front stationary and orbiting scroll wraps 2a, 1a constitute a compressing section, and the rear stationary and orbiting scroll wraps 3a,1c constitute an expanding section. The compressing and expanding sections are par-

titioned by the annular partition wall 2c of the front stationary scroll end plate 2b.

[0010] An electric motor 20 is fixed to the rear stationary scroll end plate 3b by a bolt 26. A driving shaft 21 of the electric motor 20 is supported at journals 21a,21b by rear stationary scroll end plate 3b and a rear cover 25 via bearings 22,23. A seal 12 seals the electric motor at the center of the compressing section of the scroll portion.

[0011] An eccentric portion 21c at the front end of the driving shaft 21 is supported by a bearing 4 in a boss 1 d at the center of the rear surface of the orbiting scroll.

[0012] At the outer circumference of the orbiting scroll 1, three bosses 1e are projected at three vertexes of an equilateral triangle. An eccentric pin 5b of an auxiliary crank 5 is supported by the boss 1e via a bearing 6b. A journal 5a of the auxiliary crank 5 is rotatably supported via a bearing 6a by a boss 2e on the outer circumference of the front stationary scroll end plate. These prevent the orbiting scroll from rotating on its own axis.

[0013] Eccentricity of the driving shaft 21 with respect to an axis of the eccentric portion 21c is equal to that of the auxiliary crank eccentric pin 5b with respect to an axis of the journal 5a. Thus, when the driving shaft 21 rotates, the orbiting scroll 1 revolves around the axis of the driving shaft 21. The revolving mechanism may be a known Oldham coupling.

[0014] Numerals 21d,5c are elastic rings. When an inner ball of the bearing is loosened from the eccentric pin so as to enable the bearing 4 of the orbiting scroll to insert into the eccentric pin 21, the elastic ring 21d prevents corrosion owing to rotation of the inner ball to the pin. For example, when an elastic ring such as rigid rubber is fitted in a groove of the eccentric pin, the elastic material reduces resistance during fitting of the inner ball, but its friction prevents the inner ball from rotating on the eccentric pin.

[0015] The elastic ring 28 enables the eccentric pin 5b of the auxiliary crank 5 to insert into the bearing 6b of the orbiting scroll 1 and prevents the inner ball of the bearing 6a from sliding.

[0016] In Fig. 2, an inlet 7 of the compressing section is formed on the stationary end plate 2b of the front stationary scroll 2 between the annular partition wall 2c and the outer circumference of the scroll wrap, and an outlet 8 is formed at the center, and pipes 7a and 8a are connected thereto. Fluid sucked into the inlet 7 is compressed towards the center by revolution of the orbiting scroll and discharged from the outlet 8.

[0017] In Fig. 3, an inlet 9 for the compressing section is formed in the outermost portion of the rear stationary scroll 3 and communicates with an opening 9b via a radial path 9a of the rear stationary scroll end plate 3b. A pipe 9a is connected to the opening 9b. Fluid which comes towards the center of the compressing section from the opening 9b is expanded outward with revolution of the orbiting scroll; introduced to the electric motor through an inner outlet 11 of the rear stationary scroll end plate; and discharged to the outside from an outlet 27 after cooling armatures etc.

[0018] In Fig. 1, the expanding section communicates via an outer outlet 30 with a circumferential path 31 formed between an inner circumferential wall 32 and an outer circumferential wall 33. The electric motor 20 is cooled by fluid that flows the circumferential path 31. Noise of the electric motor 20 during operation leaks from a bore 27, but is prevented owing to the outer circumferential wall 33.

[0019] Fig. 4 shows the second embodiment of the present invention. The same numerals are allotted to those in the first embodiment in Fig. 1, and description thereof is omitted. Only difference will be described.

[0020] An external diameter of the outer circumferential wall 33' gradually increases rearward and a sectional area of a circumferential path 31' gradually increases. Hence fluid in the circumferential path 31' is gradually depressurized and cooled rearward. An electric motor 20 and its parts are effectively cooled by fluid.

[0021] Fig. 5 shows the third embodiment of the present invention. The same numerals are allotted to those in the first embodiment in Fig. 1. and description thereof is omitted. Only difference will be described.

[0022] A spiral wall 35 is provided around an electric motor 20 between an inner circumferential wall 32 and an outer circumferential wall 33, and a spiral path 34 is defined by the spiral wall 35. A pitch of the spiral wall 35 increases rearward, so that fluid from an expanding section through an outer outlet 30 is gradually depressurized and cooled rearward.

[0023] Fluid effectively cools an electric motor 20 and its parts, and noise is prevented by the outer circumferential wall 33.

[0024] In the third embodiment, an external diameter of the outer circumferential wall 33 may increase rearward, similar to the outer circumferential wall 33' in the second embodiment.

Claims

1. A scroll fluid machine comprising:

a driving shaft 21:

an orbiting scroll 1 that has an orbiting scroll wrap 1c;
a stationary scroll 3 that has a stationary wrap 3a; and
an electric motor 20 for driving the driving shaft 21, the orbiting scroll 1 being driven by the driving shaft 21 and eccentrically revolved with respect to the stationary scroll 3 while the orbiting scroll wrap 1c is engaged with the stationary scroll wrap 3a to create an expanding section, **characterized in that**:

the expanding section communicates via an outer outlet 30 with an circumferential path 31 around the electric motor 20 between an inner circumferential wall 32 and an outer circumferential wall 33.

2. A scroll fluid machine as claimed in claim 1 wherein an external diameter of the outer circumferential wall 33' gradually increases rearward.

3. A scroll fluid machine as claimed in claim 1 or 2 wherein the circumferential path comprises a spiral path 34 defined by a spiral wall 35 formed spirally around the electric motor 20 between the inner and outer circumferential walls 32 and 33.

4. A scroll fluid machine as claimed in claim 3 wherein a pitch of the spiral wall 35 gradually increases rearward.

Amended claims in accordance with Rule 86(2) EPC.

1. A scroll fluid machine comprising:

a driving shaft (21):
an orbiting scroll (1) that has an orbiting scroll wrap (1c);
a stationary scroll (3) that has a stationary wrap (3a); and
an electric motor (20) for driving the driving shaft (21), the orbiting scroll (1) being driven by the driving shaft (21) and eccentrically revolved with respect to the stationary scroll (3) while the orbiting scroll wrap (1c) is engaged with the stationary scroll wrap (3a) to create an expanding section, with fluid from the expanding section being introduced to the electric motor (20) through an inner outlet (11) of a rear stationary scroll end plate (2b) and discharged to the outside from an outlet (27) after cooling armatures,

characterized in that:

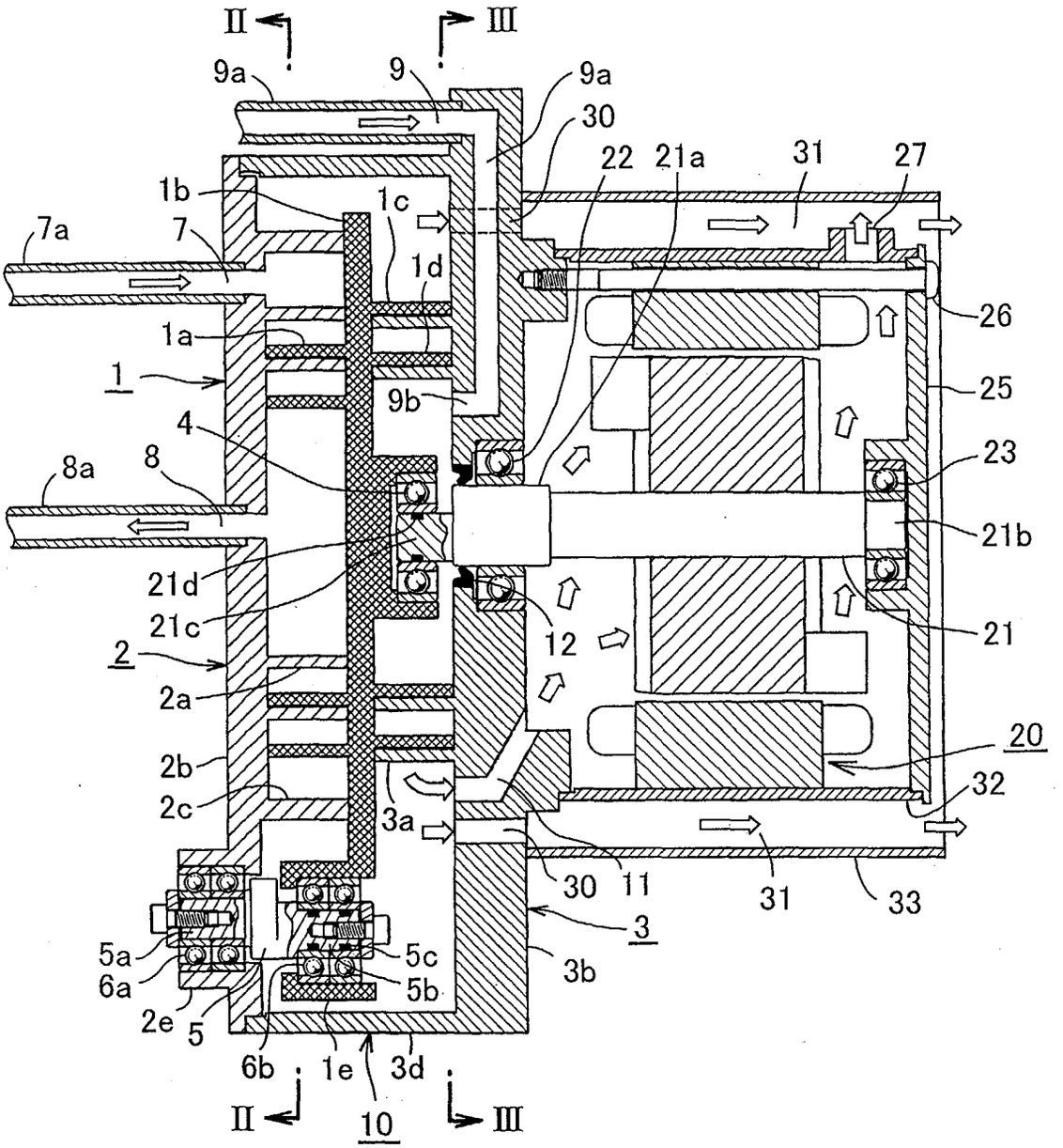
the expanding section communicates via an outer outlet (30) with an circumferential path (31) around the electric motor (20) between an inner circumferential wall (32) and an outer circumferential wall (33).

2. A scroll fluid machine as claimed in claim 1 wherein an external diameter of the outer circumferential wall (33') gradually increases rearward.

3. A scroll fluid machine as claimed in claim 1 or 2 wherein the circumferential path comprises a spiral path (34) defined by a spiral wall (35) formed spirally around the electric motor (20) between the inner and outer circumferential walls (32 and 33).

4. A scroll fluid machine as claimed in claim 3 wherein a pitch of the spiral wall (35) gradually increases rearward.

FIG.1


II
III
9a
9
9a
30
22
21a
31
27
1b
1c
7a
7
1d
26
1a
1
9b
25
4
8a
8
23
21b
21d
21c
12
21
2
2a
20
2b
32
2c
3a
30
11
31
33
3
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3b
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2e
5
6b
1e
3d
10

FIG.2

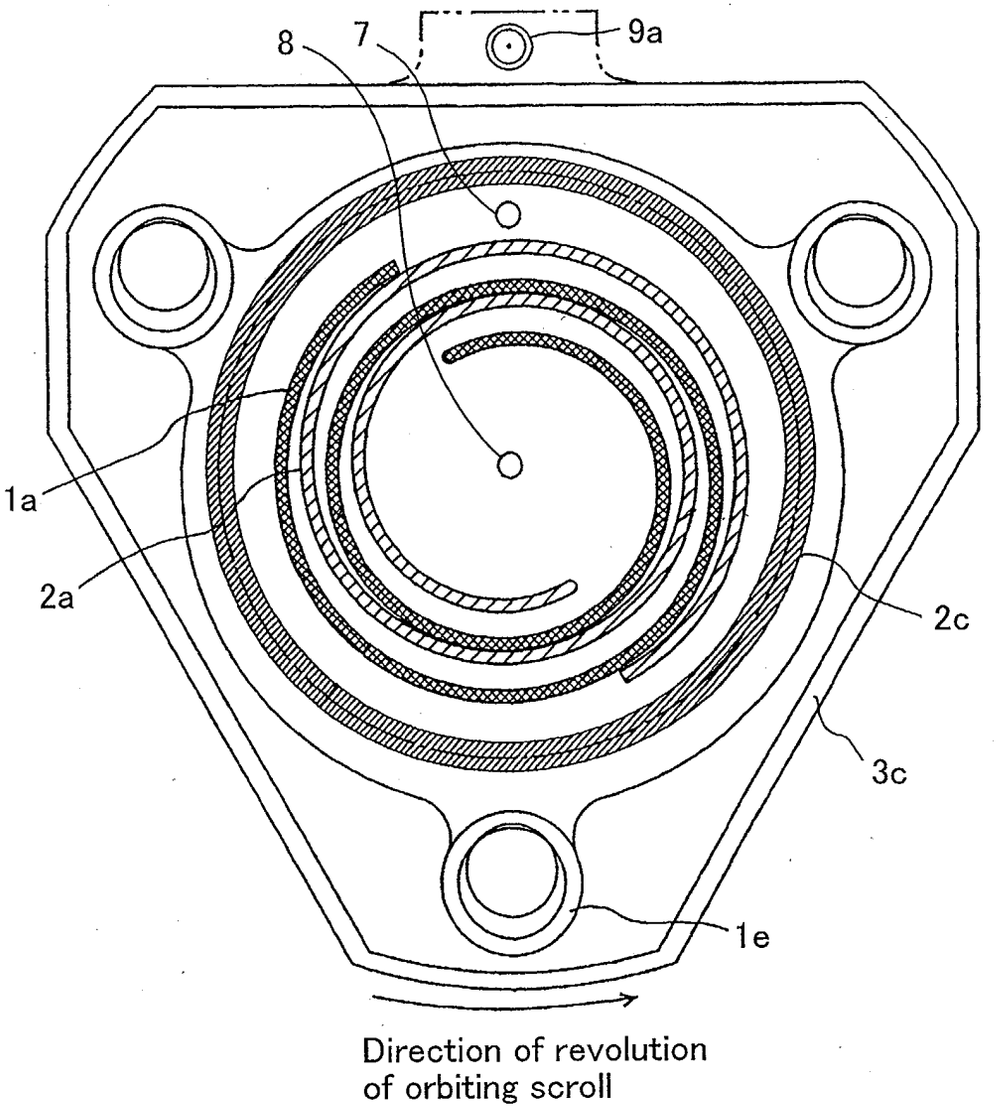

8
7
9a
1a
2a
2c
3c
1e
Direction of revolution
of orbiting scroll

FIG.3

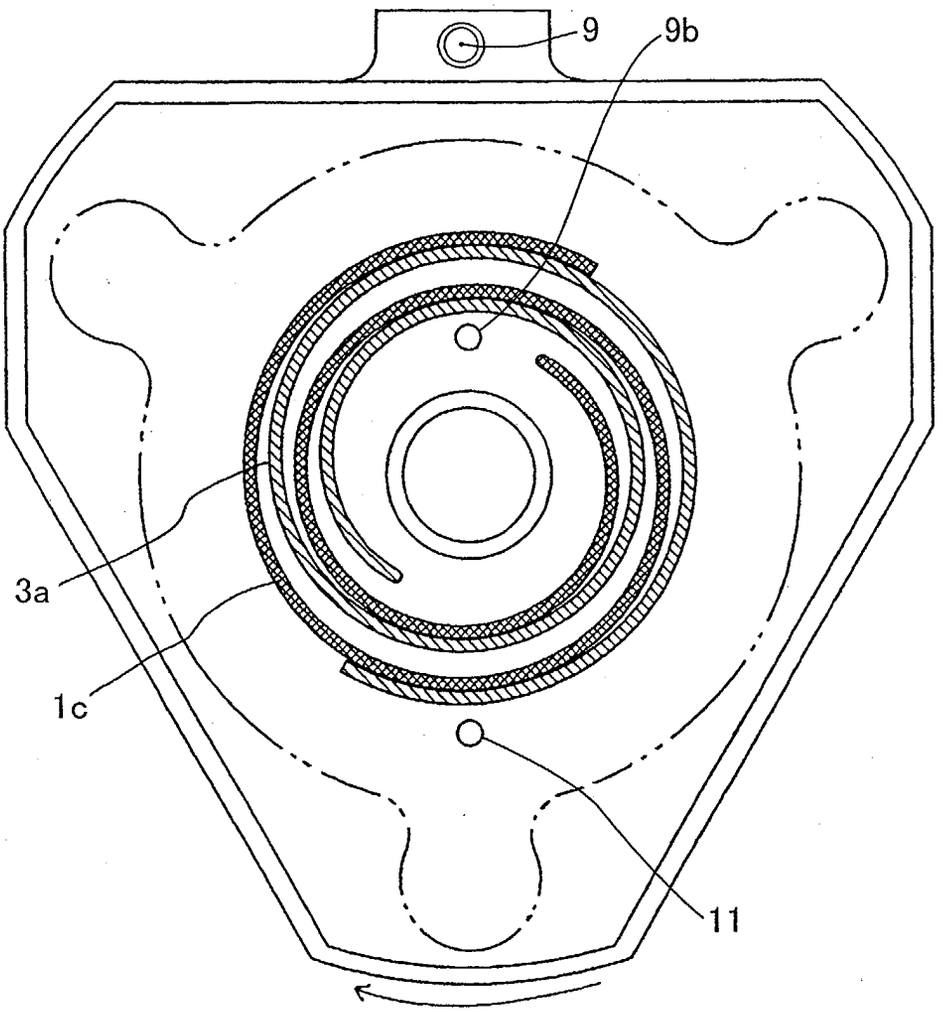
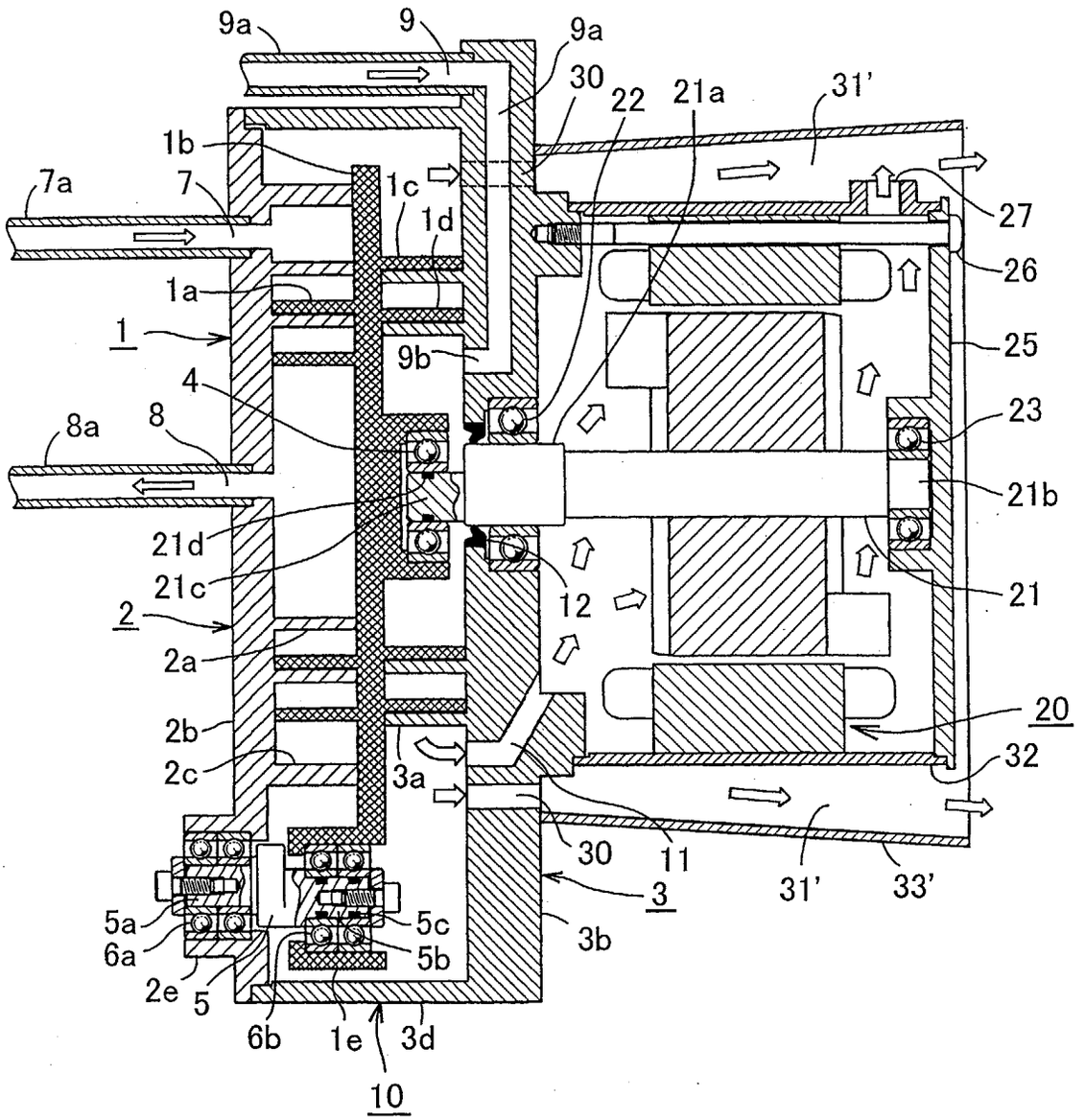


FIG.4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9
9a
30
22
21a
31'
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7a
7
1c
1d
27
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1
9b
25
4
8
23
8a
21b
21d
21c
12
21
2
2a
20
2b
32
2c
3a
30
11
31'
33'
3
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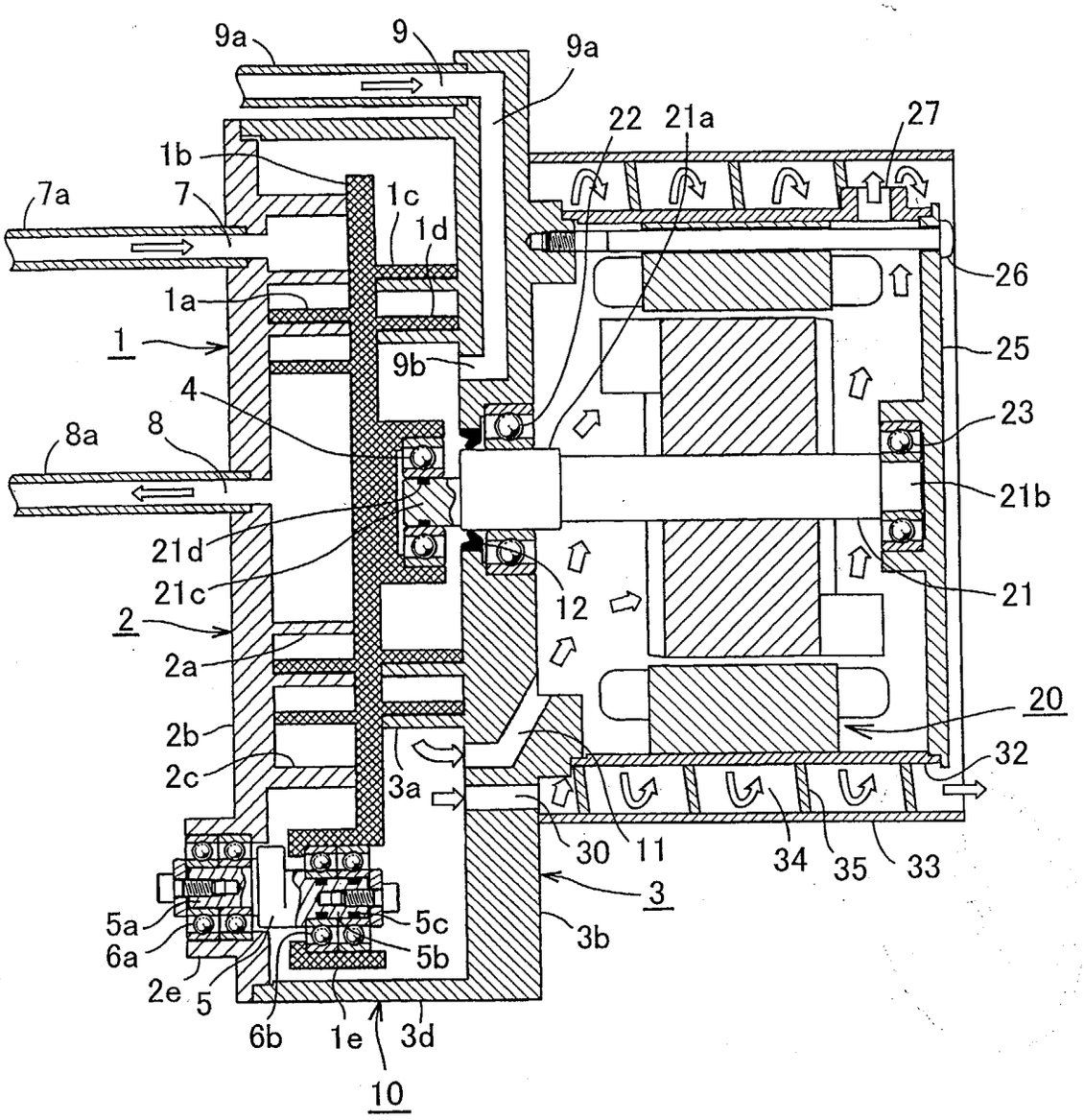
2e
5
6b
1e
3d
10

FIG.5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9
9a
22
21a
27
1b
7a
7
1c
1d
26
1a
1
9b
25
4
8
23
8a
21b
21d
21c
12
21
2
2a
20
2b
32
2c
3a
30
11
34
35
33
3
5a
5c
3b
6a
5b
2e
5
6b
1e
3d
10

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EUROPEAN SEARCH REPORT

Application Number
EP 04 25 5443

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	PATENT ABSTRACTS OF JAPAN vol. 2003, no. 12, 5 December 2003 (2003-12-05) -& JP 2003 343203 A (ANEST IWATA CORP), 3 December 2003 (2003-12-03) * abstract * * figures 1-6 * -----	1	F04C18/02 F01C1/02 F01C21/06 F01C21/10 F04C23/00 F01C11/00
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A	PATENT ABSTRACTS OF JAPAN vol. 2003, no. 02, 5 February 2003 (2003-02-05) -& JP 2002 295381 A (HITACHI LTD), 9 October 2002 (2002-10-09) * abstract * * figure 1 * -----	1	TECHNICAL FIELDS SEARCHED (Int.Cl.7) F01C F04C
A	US 2002/071779 A1 (MOROI TAKAHIRO ET AL) 13 June 2002 (2002-06-13) * figure 1 * * page 3, paragraph 36 * -----	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	31 January 2005	Lequeux, F

CATEGORY OF CITED DOCUMENTS

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31-01-2005

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