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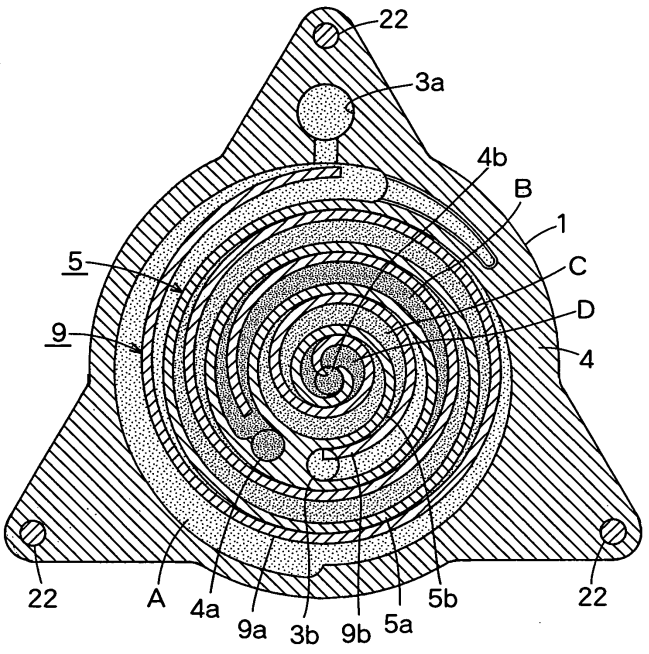
(54) Scroll compressor

(57) A scroll fluid machine comprises a stationary scroll fixed to a housing and an orbiting scroll that turns with a driving shaft. The stationary scroll comprises a stationary end plate having inner and outer stationary wraps and the orbiting scroll comprises an orbiting end plate having inner and outer orbiting wraps. Rotation of the orbiting scroll allows the inner and outer stationary wraps to engage with the inner and outer orbiting wraps respectively to form inner and outer volume-variable chambers. The two chambers have substantially the same compression ratio, so that substantially-equal low pressure gases are produced.

FIG.2



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a scroll fluid machine by which a high volume of gases are produced under relatively low pressure.

[0002] In a scroll fluid machine including a scroll compressor and a scroll decompressor, volume of a sealed chamber is gradually reduced from the beginning end of a wrap winding at the circumference to the terminating end near the center, so that a gas sucked from the circumference is compressed and discharged near the center or a gas sucked from the center is decompressed and discharged from the circumference.

[0003] Such a known scroll fluid machine is used for middle or high pressure to make relatively high-pressure compressed gas or achieve effective decompressing.

[0004] However, in the scroll fluid machine, to transport powders such as flour, it is impossible to obtain a high volume of compressed gases under low pressure such as about 0.2 to 0.3MPa. To obtain a high volume of compressed gases under such low pressure, it is necessary to expand spaces between wraps and to reduce the number of windings.

[0005] Expanded spaces between the wraps make a radius of a revolving orbiting scroll larger to increase an external diameter of the orbiting scroll. So it is necessary for the heavy orbiting scroll to revolve with a larger diameter. Load adapted to a support for an orbiting shaft of the orbiting scroll increases to make it necessary to provide a high load-resistant bearing thereby resulting in increase in weight and size requiring high manufacturing cost.

[0006] To avoid such problems, the wraps must be made as close as possible to the center of the orbiting scroll not to increase a diameter of the orbiting scroll. But it involves high discharge pressure to make it impossible to obtain a desired low-pressure compressed gas.

[0007] Thus, conventionally, in a scroll compressor for low pressure, an orbiting wrap is partially removed near the center of an orbiting scroll and large-spaced wraps are provided only in parts remote from the center. However, the center of the orbiting scroll does not play a role of output, which is inefficient and uneconomical.

SUMMARY OF THE INVENTION

[0008] In view of the disadvantages in the prior art, it is an object of the present invention to provide a scroll fluid machine in which a space between wraps is the same as a known middle or high pressure machine, wraps- being provided to produce a low-pressure compressed gas almost equal to a compressed gas in the circumference to make it possible to obtain a high volume of low-pressure gases without change in the whole size or the number of revolutions of the scroll.

BREIF DESCRIPTION OF THE DRAWINGS

[0009] The features and advantages of the invention will become more apparent from the following description with respect to embodiments as shown in accompanying drawings wherein:

Fig. 1 is a vertical sectional view of one 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;
Fig. 3 is a vertical sectional view similar to Fig. 2 and showing that engagement of wraps varies; and
Fig. 4 is a vertical sectional view similar to Fig. 2 and showing another embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0010] Fig. 1 is a vertical sectional side view of a scroll compressor as one embodiment of the present invention. In this invention, there are outer and inner volume-variable chambers defined by stationary and orbiting wraps.

[0011] The scroll compressor in Fig. 1 is basically similar to a known device and will be simply described. In Fig. 1, left and rights sides are deemed front and rear respectively.

[0012] In the front or left side in Fig. 1, an outer intake port 3a is formed on the circumference of a stationary end plate 2 of a stationary scroll 1, and an inner discharge port 4b is formed at the center. Between them, an outer discharge port 4a and an inner intake port 3b are formed.

[0013] A spiral stationary wrap 5 is provided on the rear surface of the stationary end plate 2. On the front surface, there are a plurality of horizontal equal-height gently-corrugated cooling fins 6 equally spaced. An orbiting scroll 7 behind the stationary scroll 1 has a spiral orbiting wrap 9 on the front surface of a circular orbiting end plate 3 or opposing surface to the stationary scroll 1, and a plurality of horizontal equal-height corrugated cooling fins 10 equally spaced on the rear surface.

[0014] On the rear surface of the orbiting scroll 7, a bearing plate 11 is mounted. At the center of the rear surface of the bearing plate 11, there is a tubular boss 15 pivotally supporting an eccentric axial portion 13 of a driving shaft 12 via a bearing 14.

[0015] At three points of the circumference on the rear surface of the bearing plate 11, there is a known crank-pin-type self-rotation preventing device 16, so that the orbiting scroll 7 is eccentrically revolved around the driving shaft 12 with respect to a housing 17.

[0016] A cover plate 18 is fixed to the front surface of the stationary scroll 1 with a screw 19. The orbiting scroll 7 is fixed to the bearing plate 11 with a screw 20. A rear portion 21 of the stationary scroll 1 is fixed to the housing 17 with a bolt 22 and a nut 23.

[0017] Engagement grooves 24,25 are formed on the tip ends of the stationary and orbiting wraps 5,9 respectively. Sealing members "S" are fitted in the engagement grooves 24,25 in sliding contact between the orbiting end plate 8 of the orbiting scroll 7 and the stationary end plate 4 of the stationary scroll 1.

[0018] As shown in Figs. 2 and 3 sectioned along the line II-II in Fig. 1, the stationary wrap 5 is separated to an outer volume-variable chamber stationary wrap 5a communicating with the outer intake port 3a and an inner volume-variable chamber stationary wrap 5b communicating with the inner discharge port 4b, while the orbiting wrap 9 is separated to an outer volume-variable chamber orbiting wrap 9a and an inner volume-variable chamber orbiting wrap 9b.

[0019] A gap between the outer volume-variable chamber stationary wrap 5a and the outer volume-variable chamber orbiting wrap 9a is large, and a gap between the inner volume-variable chamber stationary wrap 5b and the inner volume-variable chamber orbiting wrap 9b is somewhat small.

[0020] A volume ratio of an outer beginning-end volume-variable chamber "B" communicating with the outer discharger port 4a to an outer terminating-end volume-variable chamber "A" communicating with the outer intake port 3a is substantially the same as a volume ratio of an inner terminating-end volume-variable chamber "D" communicating with the inner discharge port 4b to an inner beginning-end volume-variable chamber "C" communicating with the inner intake port 3b.

[0021] Accordingly, compressed gases having almost equal pressure are produced in the outer and inner volume-variable chambers, so that a large quantity of low-pressure compressed gas is obtained compared with a conventional device in which a central wrap is removed in a scroll.

[0022] Fig. 4 is a vertical sectional side view of a scroll decompressor according to the present invention and similar to Fig. 2.

[0023] In Fig. 4, the inner discharge port 4b in Fig. 2 is changed to an inner intake port 3b and the outer discharge port 4a is changed to an outer intake port 3a. Similarly, the inner intake port 3b is changed to an inner discharge port 4b, and the outer intake port 3a is changed to an outer discharge port 4a. The others are the same as those in Figs. 1 to 3. In Fig. 4, a gas sucked from the inner intake port 3b is decompressed and discharged from the outer discharge port 4a.

[0024] The foregoing merely relates to embodiments of the present invention. Various- changes and modifications may be made by a person skilled in the art without departing from the scope of claims wherein:

Claims

1. A scroll fluid machine comprising:

a housing;
a driving shaft having an eccentric axial portion;
a stationary scroll fixed to and in the housing and having an inner stationary wrap and an outer stationary wrap on an stationary end plate;
an orbiting scroll having an inner orbiting wrap and an outer orbiting wrap on an orbiting end plate, the orbiting scroll being revolved with the eccentric axial portion of the driving shaft with respect to the stationary scroll to allow the inner stationary wrap to engage with the inner orbiting wrap to form an inner volume-variable chamber within the inner stationary wrap and to allow the outer stationary wrap to engage with the outer orbiting wrap to form an outer volume-variable chamber between the inner and outer stationary wraps, the stationary end plate having an outer intake port at a circumference and an outer discharge port radially far from the circumference within the outer volume variable chamber and having an inner intake port radially far from a center and an inner discharge port at the center in the inner volume-variable chamber, the inner volume-variable chamber having substantially the same compression ratio as that of the outer volume-variable chamber, a gas introduced from the outer intake port being compressed in the outer volume-variable chamber with revolution of the orbiting scroll and discharged from the outer discharge port, a gas introduced from the inner intake port being compressed in the inner volume-variable chamber with the revolution of the orbiting scroll and discharged from the inner discharge port under substantially the same low-pressure as what is discharged from the outer discharge port.

2. A scroll fluid machine as claimed in claim 1 wherein the outer volume-variable chamber comprises an outer beginning-end volume-variable chamber communicating with the outer intake port and an outer terminating-end volume-variable chamber communicating with the outer discharger port, the inner volume-variable chamber comprising an inner beginning-end volume-variable chamber communicating with the inner intake port and an inner terminating-end volume-variable chamber communicating with the inner discharger port, a volume ratio of the outer terminating-end volume-variable chamber to the outer beginning-end volume-variable chamber being substantially equal to that of the inner terminating-end volume variable chamber to the inner beginning-end volume-variable chamber.

3. A scroll fluid machine as claimed in claim 1 wherein the outer discharge port of the outer volume-variable chamber is connected to the inner intake port of the inner volume-variable chamber:

4. A scroll fluid machine as claimed in claim 1 wherein the scroll fluid machine is a scroll compressor.

5. A scroll fluid machine comprising:

a housing;
a driving shaft having an eccentric axial portion;
a stationary scroll fixed to and in the housing and having an inner stationary wrap and an outer stationary wrap on an stationary end plate;
an orbiting scroll having an inner orbiting wrap and an outer orbiting wrap on an orbiting end plate, the orbiting scroll being revolved with the eccentric axial portion of the driving shaft with respect to the stationary scroll to allow the inner stationary wrap to engage with the inner orbiting wrap to form an inner volume-variable chamber within the inner stationary wrap and to allow the outer stationary wrap to engage with the outer orbiting wrap to form an outer volume-variable chamber between the inner and outer stationary wraps, the stationary end plate having an outer intake port radially inward far from a circumference and an outer discharge port at the circumference within the outer volume variable chamber and having an inner intake port at the center and an inner discharge port radially far from a center in the inner volume-variable chamber, the inner volume-variable chamber having substantially the same compression ratio as that of the outer volume-variable chamber, a gas introduced from the inner intake port being decompressed in the outer volume-variable chamber with revolution of the orbiting scroll and discharged from the outer discharge port, a gas introduced from the outer intake port being decompressed in the inner volume-variable chamber with the revolution of the orbiting scroll and discharged from the outer discharge port under substantially the same low-pressure as what is discharged from the inner discharge port.

6. A scroll fluid machine as claimed in claim 5 wherein the outer volume-variable chamber comprises an outer beginning-end volume-variable chamber communicating with the outer intake port and an outer terminating-end volume-variable chamber communicating with the outer discharge port, the inner volume-variable chamber comprising an inner beginning-end volume-variable chamber communicating with the inner intake port and an inner terminating-end volume-variable chamber communicating with the inner discharger port, a volume ratio of the outer terminating-end volume-variable chamber to the outer beginning-end volume-variable chamber being substantially equal to that of the inner terminating-end volume variable chamber to the inner beginning-end volume-variable chamber.

7. A scroll fluid machine as claimed in claim 5 wherein the inner discharge port of the inner volume-variable chamber is connected to the outer intake port of the outer volume-variable chamber.

8. A scroll fluid machine as claimed in claim 5 wherein the scroll fluid machine is a scroll decompressor.

FIG.1

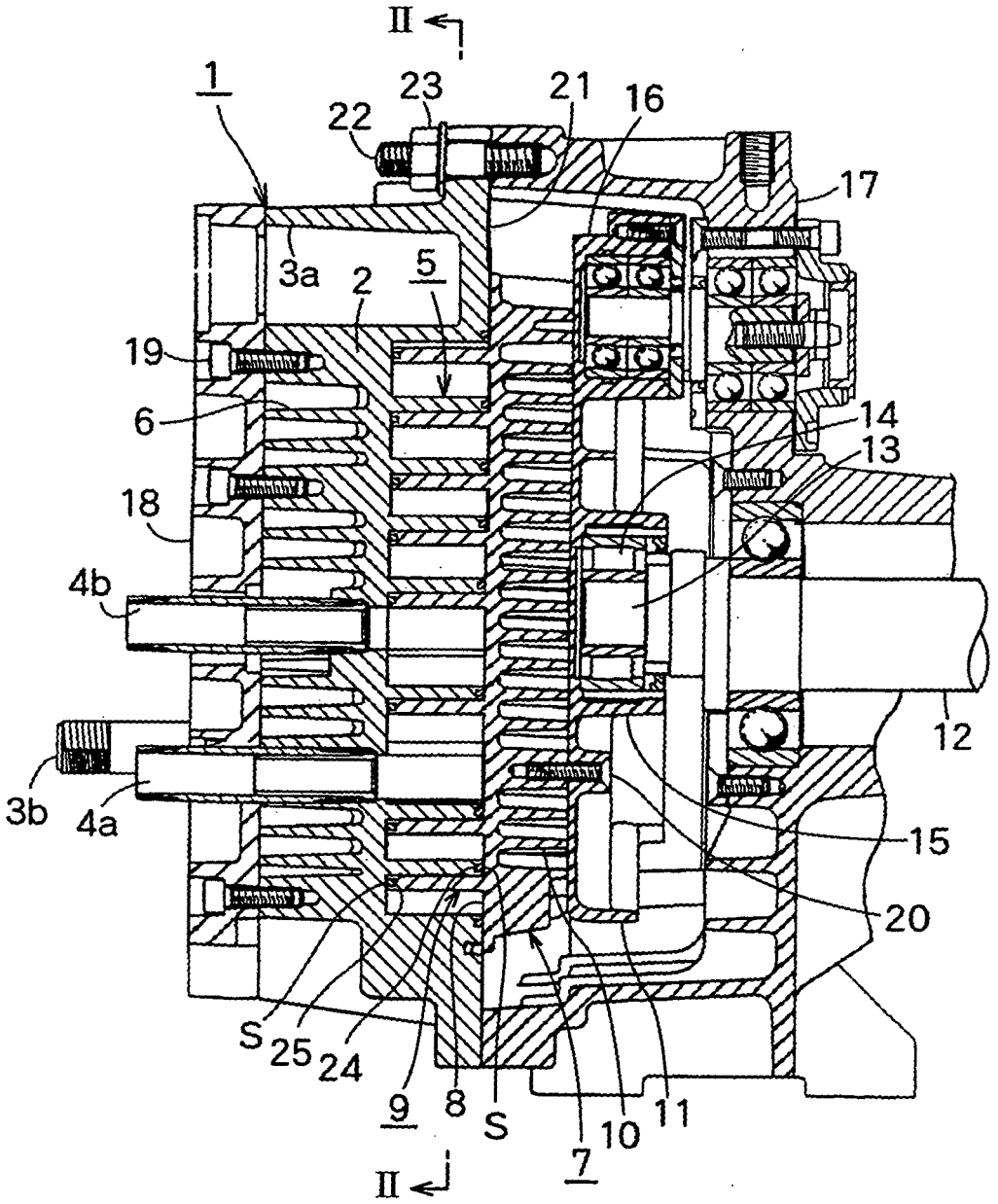
II
1
23
21
16
22
17
3a
2
5
19
6
14
13
18
4b
12
3b
4a
15
20
S
25
24
9
8
S
10
11
7
II

FIG.2

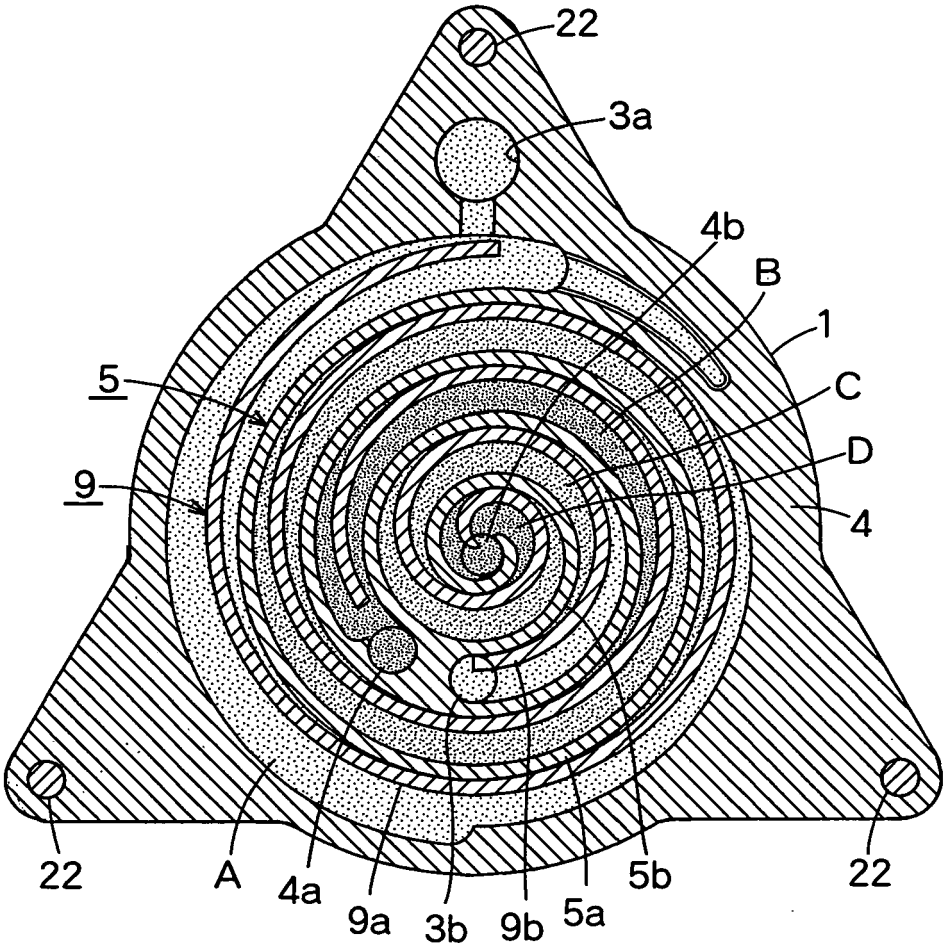

FIG.3

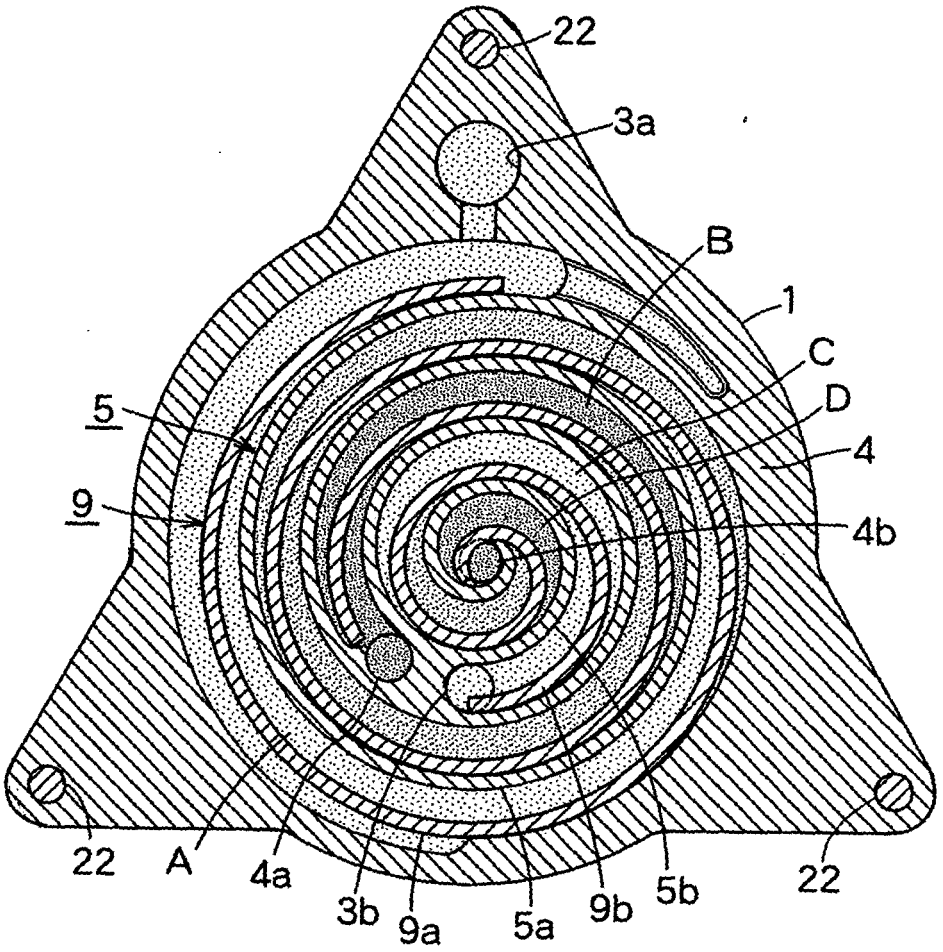

FIG.4