US 20150176583A1

(19) United States

(12) Patent Application Publication

(10) Pub. No.: US 2015/0176583 A1

(43) Pub. Date: Jun. 25, 2015

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(54) ROTARY COMPRESSOR

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(21) Appl. No.: 14/409,289

(22) PCT Filed: Jun. 26, 2013

(86) PCT No.: PCT/JP2013/067528

§ 371 (c)(1),
(2) Date: Dec. 18, 2014

(30) Foreign Application Priority Data

Jun. 26, 2012 (JP) 2012-142867

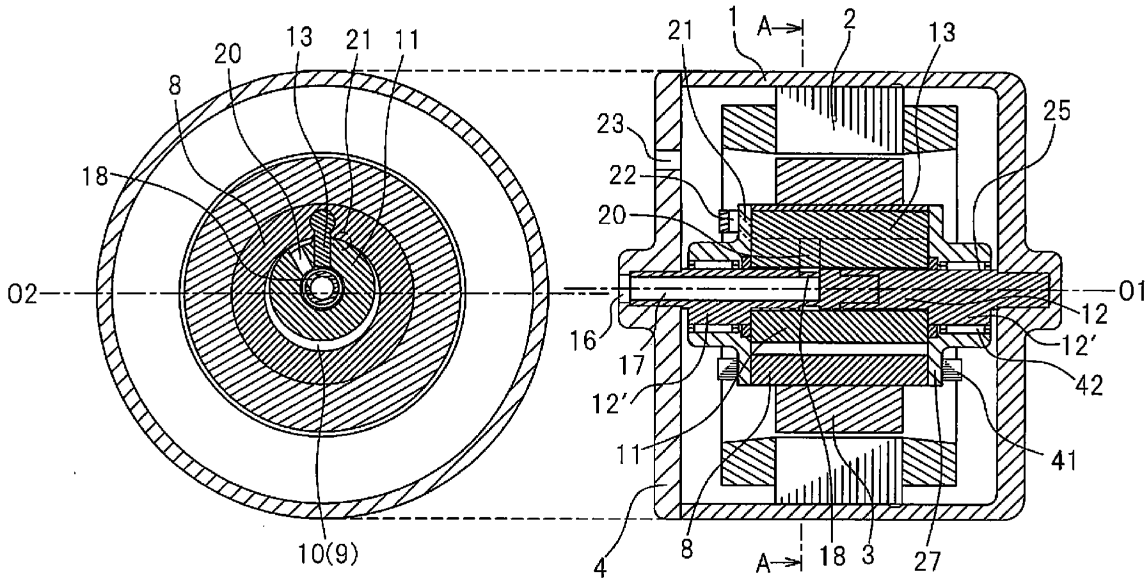
Publication Classification

(51) Int. Cl.
F04C 18/22 (2006.01)
F04C 29/12 (2006.01)

(52) U.S. Cl.
CPC *F04C 18/22* (2013.01); *F04C 29/12* (2013.01)

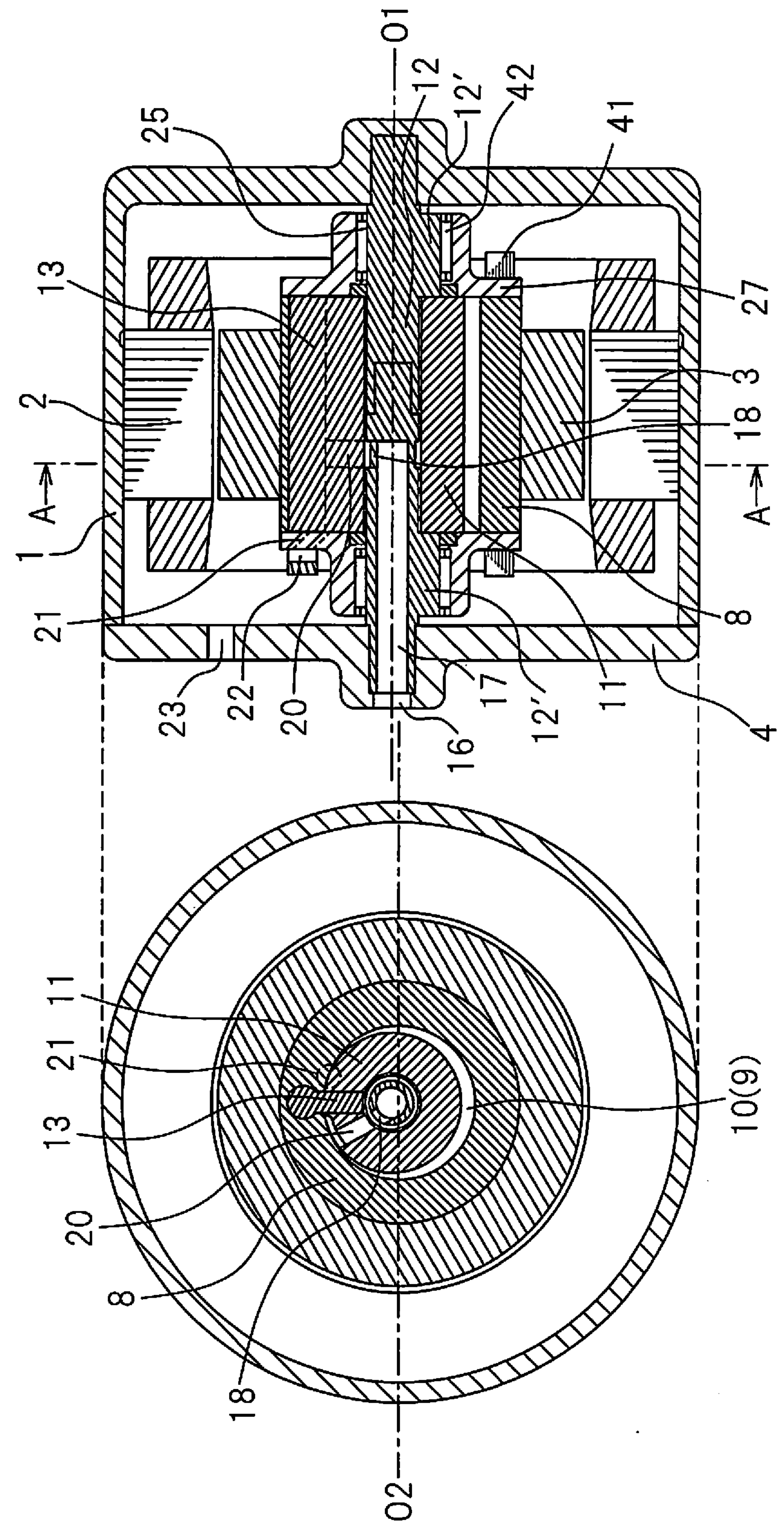
(57) ABSTRACT

A rotary compression mechanism is provided with a rotor which can rotate about the axis of a shaft mounted to a casing, a cylinder which can rotate about a rotation center eccentric from the shaft, and a drive plate which is installed so as to be capable of swinging relative to one of the cylinder and the rotor and to be capable of sliding relative to the other of the cylinder and the rotor and which rotationally connects the cylinder and the rotor. Spaces which are separated from each other by both a partition point and the drive plate and which are located between the inner surface of the cylinder and the outer periphery of the rotor are operating chambers for performing compression or suction.



A-A

FIG. 1



O1
12
12'
42
25
41
13
27
2
3
18
A
1
8
21
22
20
23
17
16
12'
11
4
11
21
13
20
8
18
10(9)
A-A
O2

FIG. 2

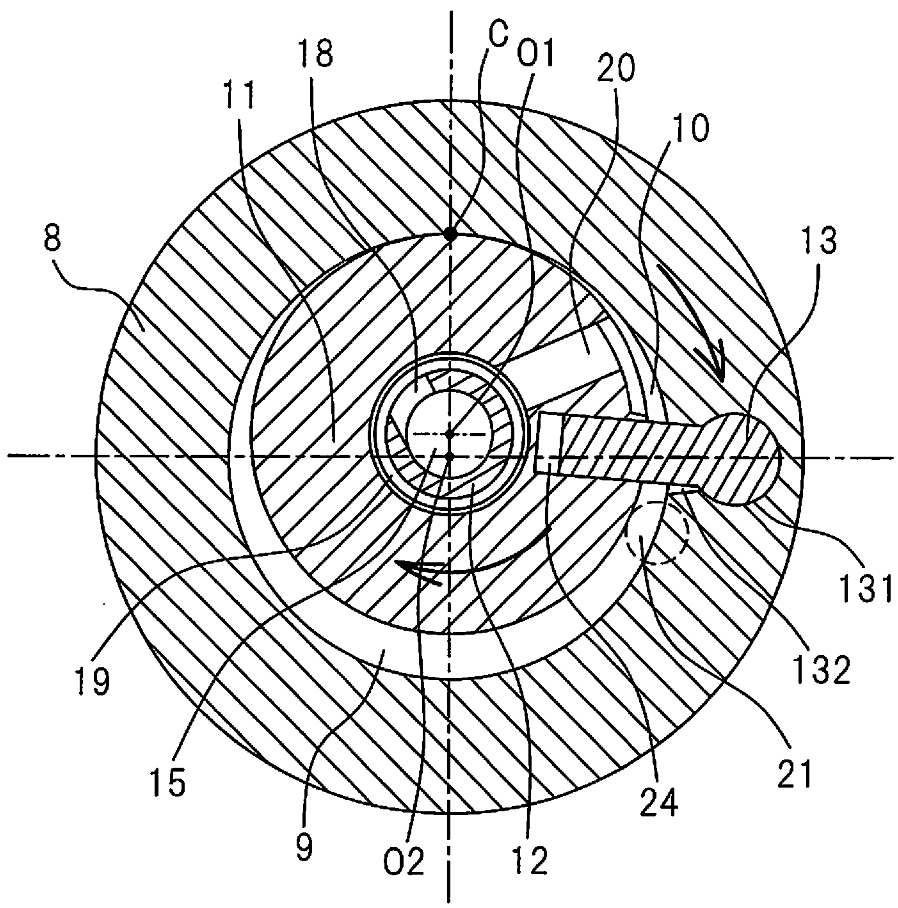


FIG. 3

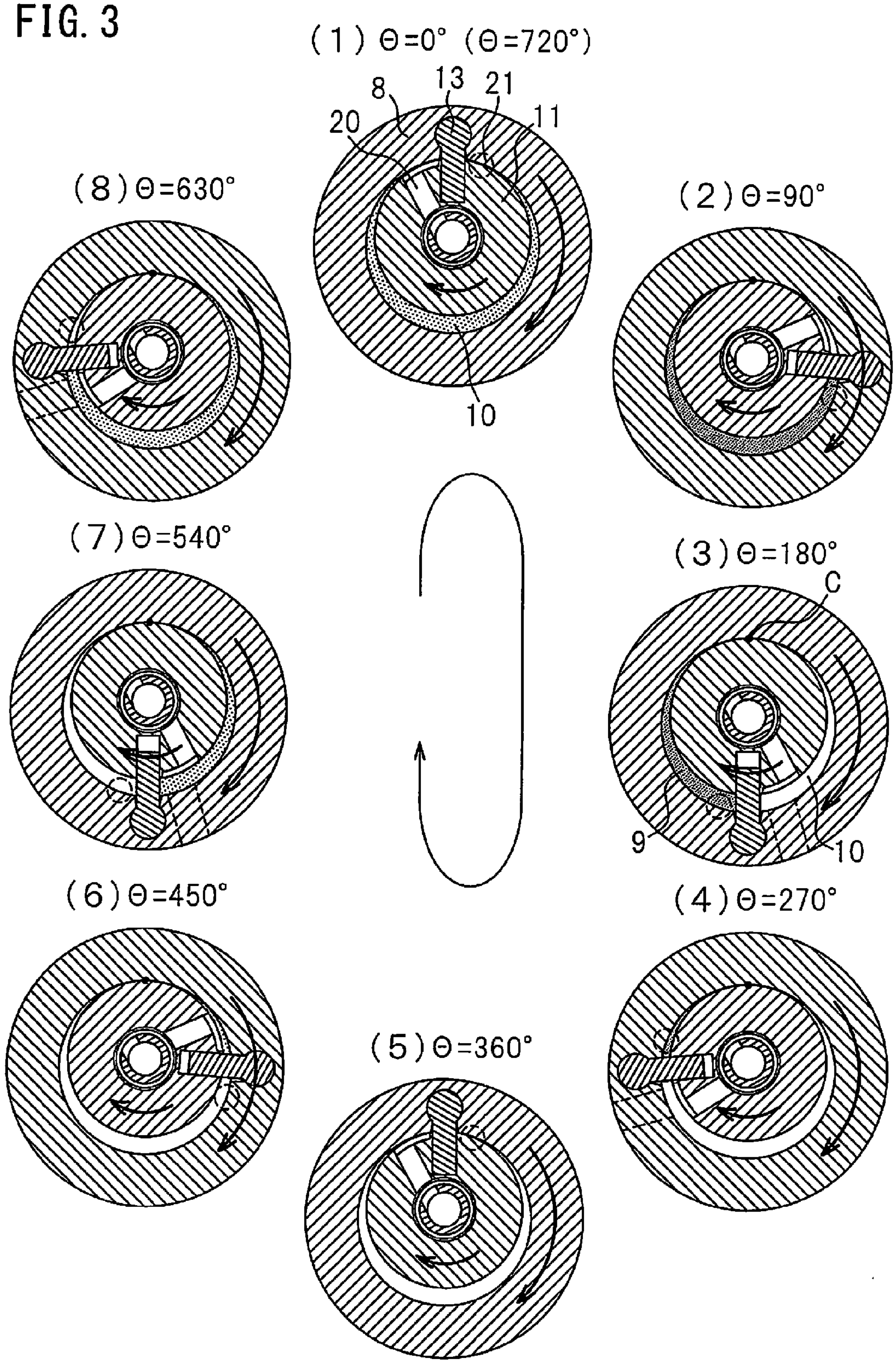

(1) Θ=0° (Θ=720°)
8
13
21
20
11
10
(2) Θ=90°
(3) Θ=180°
C
9
10
(4) Θ=270°
(5) Θ=360°
(6) Θ=450°
(7) Θ=540°
(8) Θ=630°

FIG. 4

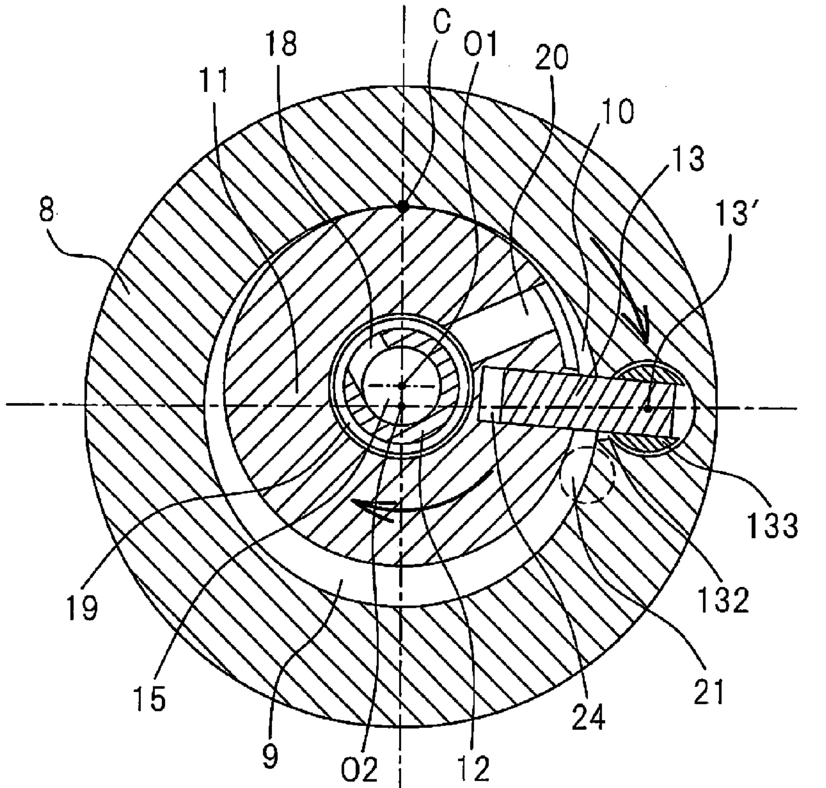

C
O1
18
11
20
10
13
13′
8
133
132
19
21
24
15
9
O2
12

FIG. 5

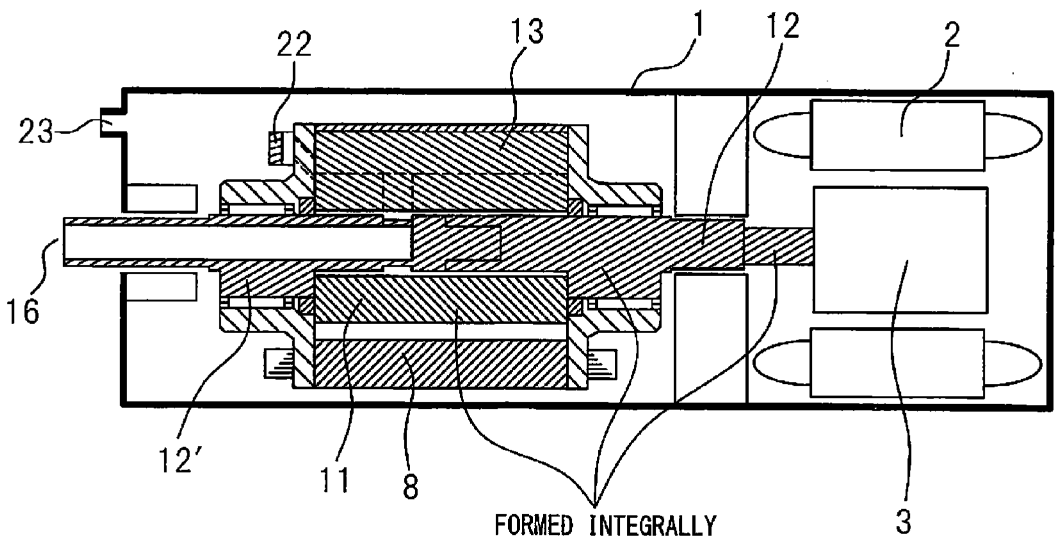

22
13
1
12
2
23
16
12′
11
8
FORMED INTEGRALLY
3

FIG. 6

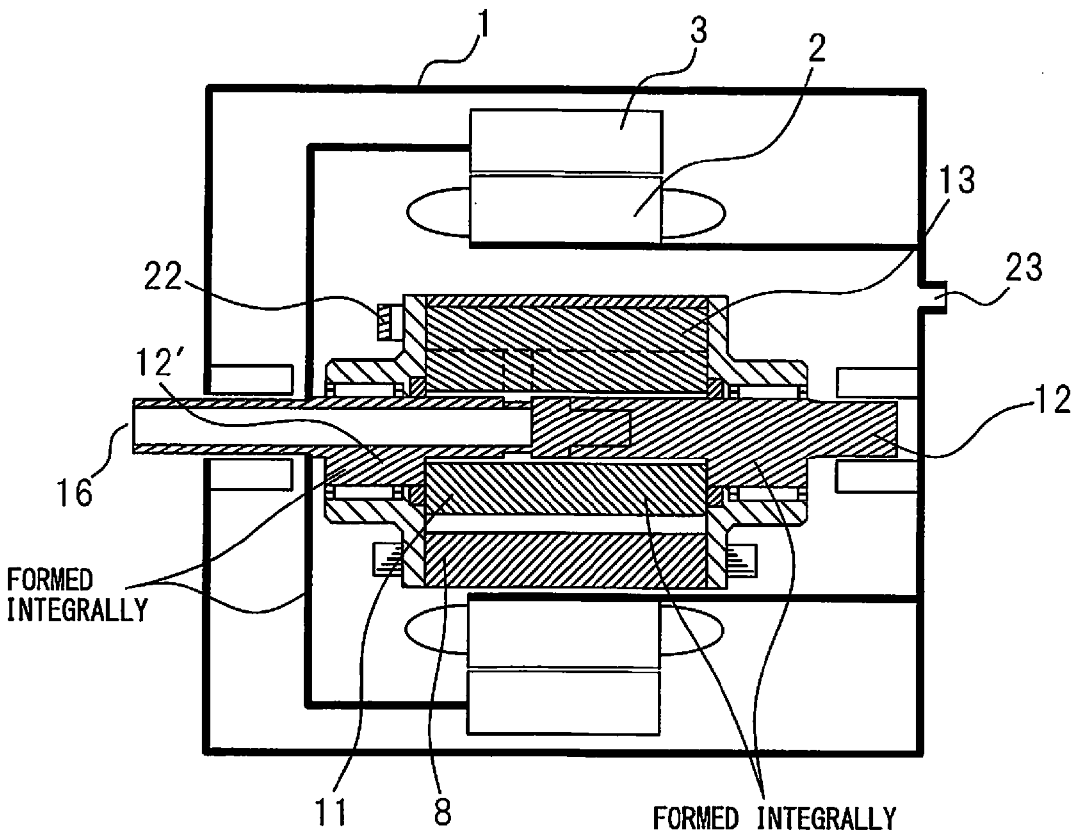
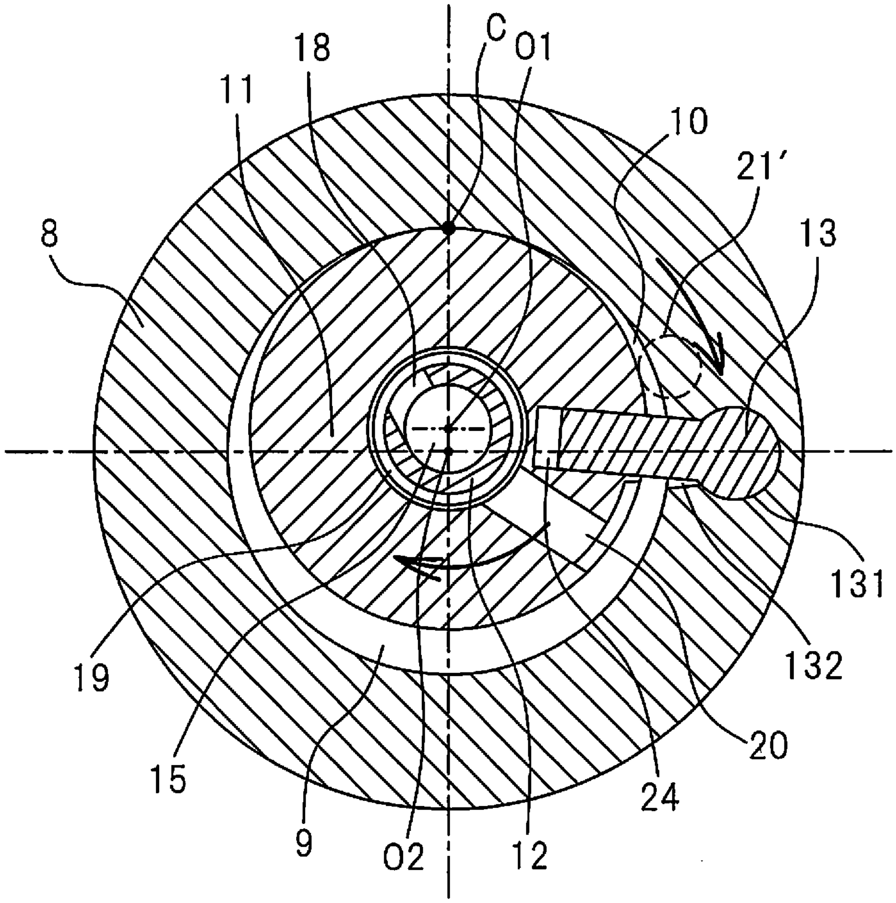

1
3
2
13
23
22
12'
12
16
FORMED INTEGRALLY
11
8
FORMED INTEGRALLY

FIG. 7



ROTARY COMPRESSOR

TECHNICAL FIELD

[0001] The present invention relates to a rotary compressor, more particularly to one which is high in efficiency and reliability in compression of a refrigerant in an air-conditioner etc. and which can be reduced in size while achieving both high efficiency and reliability.

BACKGROUND ART

[0002] From the viewpoint of lower cost and easier mountability in a vehicle etc., it has become necessary for compressors to be reduced in size. As a means for reducing size, arrangement of the compression part inside of a drive motor is effective for achieving greater compactness. Such a configuration in which a compression part is arranged inside of a motor is disclosed in PLT 1. In this prior art, an elliptical shaped cylinder **8**, which is formed integrally with a rotor of a motor, is configured to rotate with respect to a stationary state piston **17** which is contrary to a usual rolling piston. This basically can still be said to be a usual rolling piston type rotory compressor, so there is a vane nose. Further, the springs and vanes are arranged at the rotating cylinder part, so centrifugal force acts on them at the time of high speed rotation. If overcoming the spring force, clearance is formed between the vane nose and rotor (the vane is separate from the rotor.) and no compression operation occurs, so the drop in performance becomes a problem. Therefore this was unsuited for high speed rotation. Further, if increasing the spring force so as to overcome the centrifugal force, the sliding action occurs in the state where the pressing force between the vane nose and the rotor becomes excessive, and the vane nose part would seize up by adhesive wear or other problems would arise in reliability.

[0003] On the other hand, PLT 2 discloses forming a compression chamber by a vane part **13** (partition plate) between a cylinder **8** which is formed integrally with a rotor of an electric motor, and a stationary type piston **11** which is set at an eccentric position with respect to the cylinder **8**. This prior art can also still basically be called a usual rolling piston, so the above-mentioned problems arose.

CITATIONS LIST

Patent Literature

[0004] PLT 1: Japanese Examined Patent Publication No. 53-043682B2

[0005] PLT 2: Japanese Examined Patent Publication No. 01-054560B2

SUMMARY OF INVENTION

Technical Problem

[0006] The present invention, in view of the above problems, provides a rotary compressor which is high in efficiency and reliability and can be reduced in size while achieving both high efficiency and reliability.

Solution to Problem

[0007] To solve the above problem, the aspect of the invention of claim **1** provides a rotary compressor which is provided with a rotor (**11**) which can rotate about an axial center (O1) of a shaft (**12**) which is attached to a casing (**1**), a cylinder (**8**) which can rotate about a center of rotation (O2) which is eccentric from the shaft (**12**), and a drive plate (**13**) which can swing with respect to either the cylinder (**8**) or the rotor (**11**) and can slide with respect to the other and which connects the cylinder (**8**) and the rotor (**11**) to be able to rotate, in which rotary compressor, an inner surface of the cylinder (**8**) and an outer circumference of the rotor (**11**) are made to contact at a partition point (C) by making the center of rotation (O2) of the cylinder (**8**) eccentric from the axial center (O1) of the shaft (**12**), and the space between an inner surface of the cylinder (**8**) and an outer circumference of the rotor (**11**) which is partitioned off by the partition point (C) and the drive plate (**13**) forms working chambers (**9**, **10**) for compression or suction.

[0008] Note that the reference signs which are attached to the above are examples which show the correspondence with specific examples which are described in the later mentioned embodiments.

BRIEF DESCRIPTION OF DRAWINGS

[0009] FIG. **1** is a cross-sectional view which shows a first embodiment of the present invention.

[0010] FIG. **2** is a detailed partial cross-sectional view which shows the first embodiment of the present invention.

[0011] FIG. **3** is an explanatory view which shows the operation of the first embodiment of the present invention.

[0012] FIG. **4** is a cross-sectional view which shows the first embodiment of the present invention.

[0013] FIG. **5** is a cross-sectional view which shows a second embodiment of the present invention.

[0014] FIG. **6** is a cross-sectional view which shows a third embodiment of the present invention.

[0015] FIG. **7** is a cross-sectional view which shows a fourth embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0016] Below, referring to the figures, embodiments of the present invention will be explained. In the embodiments, parts of the same configuration will be assigned the same reference signs and explanations will be omitted. In the following explanation of the embodiments, compression of a refrigerant for a vehicular air-conditioning system will be used as an example, but the invention is not necessarily limited to this. The present invention can be applied to a broad range of home or industrial use compressors.

First Embodiment

[0017] As shown in FIGS. **1** and **2**, a stator **2** of an electric motor is fit and fastened at an inner surface of a casing **1**. The casing **1** has a lid **4** attached to it by fastening bolts etc. A rotor **3** (motor rotor) of the electric motor is fastened to an outer circumference of a drive cylinder **8** (cylinder **8**), so the drive cylinder **8** is made to rotate about a shaft **12** by the motor rotor **3**. The drive cylinder **8** comprises a tubular shaped cylinder and side plates **27** and **27** which are attached to the two sides of the tubular shaped cylinder by fastening bolts **41** etc. The tubular shaped cylinder and the side plates together configure the drive cylinder **8**. The shaft **12** is press fit into the casing **1** at the right end in FIG. **1**. The left end part of the shaft **12** is inserted or press fit into the lid **4**, so the shaft **12** is designed not to rotate.

[0018] The motor rotor **3** and the drive cylinder **8** are formed integrally each other around this stationary shaft **12** and are able to rotate with respect to an eccentric part **12'** of the shaft **12** through bearings **42**. As shown in FIG. **2**, a rotor **11** which acts as a compressor is turned along with the drive cylinder **8** by a drive plate **13**. Here, the axial center O1 of the shaft **12** is eccentric from the center of rotation O2 of the motor rotor **3** of the electric motor. These center of rotation O2 and axial center O1 are non-moving points. The rotor **11** of the compressor is arranged so that the rotor **11** can rotate around the shaft **12**. The rotor **11** can rotate about the non-moving axial center O1 and is turned along with the drive cylinder **8** by the drive plate **13**. Note that, as the drive motor of the present embodiment, an electric motor is used, but the invention can also be applied to the case of a belt transmission.

[0019] One end of the drive plate **13** is set at the drive cylinder **8** so as to be able to swing, while the other end of the drive plate **13** is inserted into a sliding groove **24** of the rotor **11** of the compressor. Rotation of the drive cylinder **8** is transmitted by the drive plate **13** to the rotor **11** whereby the rotor **11** rotates. The drive cylinder **8** and the rotor **11** contact each other at the partition part (contact point) C at all times during rotation. Note that, one end of the drive plate **13** may be set at the rotor **11** so as to be able to swing, while the other end of the drive plate **13** may be inserted into a sliding groove **24** of the drive cylinder **8**.

[0020] The refrigerant gas to be compressed or other compression medium, as shown in FIGS. **1** and **2**, is introduced from a suction port **16**, passes through a suction passage **17**, and is introduced from a shaft opening **18** and rotor passage **20** to a suction side working chamber (suction chamber) **10**. The shaft opening **18** and the rotor passage **20** are communicated at all times at all angles. At the outlet of the shaft opening **18**, a groove **19** is formed across the entire circumference in the circumferential direction of part of the shaft **12**.

[0021] At the side plate **27** which is fastened to one side of the drive cylinder **8**, a compression chamber discharge port **21** is provided. At the outside, a reed valve **22** (discharge valve part) is set. Instead of a reed valve, another valve (poppet valve etc.) may also be used. Of course, it is also possible to provide the port **21** at the outer circumference of the tubular shaped cylinder of the drive cylinder **8**, but it is necessary to consider the effects of centrifugal force. The compression chamber discharge port **21** and reed valve **22** rotate while discharging compressed gas to the space inside of the casing along with rotation of the drive cylinder **8**. After that, the gas is discharged outside from a casing discharge port **23**.

[0022] Next, the drive plate **13** will be explained. The drive plate **13** is a member which corresponds to a "vane" in a rolling piston of the prior art. That is, in the present embodiment, the drive plate **13** is a member which partitions a space into a compression chamber (compression side working chamber) **9** and a suction chamber **10**. The drive plate **13** also has the function as a connecting member for making the rotor **11** of the compressor be turned along with the drive cylinder **8**. To perform the function as a connecting member, a head part **131** of the drive plate **13** forms a cylindrical surface. The drive plate **13** is designed to be able to swing with respect to a center axis of the head part **131** due to the provision of a clearance **132** at the drive cylinder **8**. At the rotor **11** of the compressor, as the drive cylinder **8** rotates, the drive plate **13** slides inside the sliding groove **24**. Due to this, when turned along, rotation is possible without restriction in spite of the eccentricity of the center of rotation O2 of the drive cylinder **8** and the axial center O1 of the rotor **11**.

[0023] The compressor part comprises the rotor **11** which can rotate about the axial center O1 of the shaft **12** which is fastened to the casing **1**, the drive cylinder **8** which can freely rotate about the center of rotation O2 which is eccentric from the shaft **12**, and the drive plate **13** which connects the drive cylinder **8** and the rotor **11**. The space between the rotor **11** and the drive cylinder **8** forms working chambers. The working chambers are formed by the drive plate **13** splitting the space, whereby the compression chamber **9** and the suction chamber **10** are formed. The electric motor **2**, **3** which drives rotation of the drive cylinder **8** is used to make the drive cylinder **8** rotate so that, among the working chambers which are formed between the drive cylinder **8** and the rotor **11**, the compression chamber **9** at the front of the drive plate **13** in the direction of rotation compresses the suction gas. The working chambers which are formed between the drive cylinder **8** and the rotor **11** are partitioned by the drive plate **13** and the partition point C of the contact point of the drive cylinder **8** and the rotor **11**. At the front of the drive plate **13** in the direction of rotation, the compression chamber **9** is formed, while at the rear, the suction chamber **10** is formed.

[0024] Next, the above-mentioned compression process and suction process will be explained referring to FIG. **3** for each 90° of rotational angle θ of the drive cylinder (position of drive plate **13**). Here, to facilitate understanding, the angles will be made 720° for the explanation. The explanation will be given in the order from (1) θ=0° of FIG. **3** to again (1) θ=720°. At (1) θ=0°, the suction has been completed. The drive plate **13** and the partition point C match, so the suction chamber **10** and the compression chamber **9** are combined. As the rotational angle θ of the drive cylinder **8** increases from θ=0°, as shown in (2) to (4), the span between the front side of the drive plate **13** in the direction of rotation and the partition point C is closed and a compression operation proceeds in the compression chamber **9**.

[0025] At (5) θ=360°, the compression chamber **9** disappears. At this time, the suction chamber **10** is formed between the rear of the drive plate **13** in the direction of rotate and the partition point C. Suction proceeds from (5)→(1) whereupon the compression process and suction process are repeated. Above, 720° was used for the explanation, but the actual compression stroke and suction stroke are simultaneously performed in one rotation of 360°. In (1) to (5) of FIG. **3**, it will be understood that compression proceeds at the compression chamber **9** between the front side of the drive plate **13** in the direction of rotation and the partition point C and, simultaneously, suction proceeds in the suction chamber **10** between the rear of the drive plate **13** in the direction of rotation and the partition point C. At (1) and (5), the drive plate **13** and partition point C match, so the suction chamber **10** and the compression chamber **9** are combined.

[0026] As explained above, to perform the compression operation by rotation of the drive cylinder **8**, the drive cylinder **8** is arranged inside of the motor rotor **3** of the electric motor. Therefore, it is possible to make the compressor smaller in size. The shaft **12** does not rotate, so the shaft **12** may have a suction port **16** set at it to suck in the gas. Further, at a side plate **27** where there is a little effect of centrifugal force at the time of rotation, a compression chamber discharge port **21** and reed valve **22** are provided. In the present embodiment, there is no vane nose sliding part, so there is no detachment or seizing (by adhesive wear) of the vane nose sliding part like in the prior art and both performance and reliability can be secured from a low rotation to high rotation operation and it is possible to provide a small sized compressor which is built into an electric motor rotor. Furthermore, in the prior art like a rolling piston rotory compressor, it was necessary to make the rotor (of the compressor) engage in eccentric motion so as to form a compression chamber and this invited deterioration of the compressor due to vibration by eccentric motion at the time of high speed operation, but in the present embodiment, the rotor **11** of the compressor only engages in revolving motion at the non-moving axial center O**1**, so deterioration of the compressor due to vibration by eccentric motion can be prevented.

[0027] In the present embodiment, the head part **131** of the drive plate **13** forms a cylindrical surface. The drive plate **13** is configured to be able to swing with respect to the center axis of the head part **131**. As opposed to this, as shown in FIG. **4**, it is also possible to make the drive plate **13** a flat plate with no head part. In this case, two shoes **133** with single sides which are configured by cylindrical surfaces are set so as to sandwich the end part of the drive plate **13**. The rest is configured the same as in FIGS. **1** and **2**. The edge part of the front end face of the drive plate **13**, which is inserted into the sliding groove **24** which is formed at the rotor **11**, is formed with a rounded shape. Further, the edge part of the opening part of the sliding groove **24**, which is formed at the circumferential surface of the rotor **11**, is formed with a rounded shape. The head part **131** of the drive plate **13**, as shown in FIGS. **1** and **2**, can be provided at the drive cylinder **8** or can be provided at the rotor **11**.

Second and Third Embodiments

[0028] The second embodiment of the present invention, as shown in FIG. **5**, is the case where the shaft **12** (axial center O**1**) is attached so as to rotate with respect to the casing **1** and the cylinder **8** is driven to rotate from the rotor **11** of the compressor through the drive plate **13**. The motor rotor **3** is connected with the shaft **12**. Further, in the present embodiment, the rotor **11** of the compressor and the shaft **12** are formed integrally. The shaft **12** is provided with an off-centered eccentric part **12'**, so the cylinder **8** can rotate by the drive plate **13** around the center of rotation O**2** of this eccentric part **12**. The rest is the same as in the first embodiment.

[0029] Regarding the third embodiment as well, as shown in FIG. **6**, the shaft **12** (axial center O**1**) is attached so as to rotate with respect to the casing **1** and the cylinder **8** is driven to rotate from the rotor **11** side through the drive plate **13**. In this case, an electric motor of a type where, unlike a normal motor, the stator **2** is at the inside is used. The motor rotor **3** is formed integrally with the shaft **12** (axial center O**1**) together with the rotor **11** of the compressor. Since the shaft **12** has the off-centered eccentric part **12'** set at the shaft **12**, the cylinder **8** can rotate by the drive plate **13** around the center of rotation O**2** of this eccentric part **12'**. The rest is the same as in the first embodiment.

Fourth Embodiment

[0030] The fourth embodiment is an embodiment in which the suction and discharge of the first embodiment are reversed. In this case, the suction port **16** is set at the position of reference sign **23** in FIG. **1**. The part **21** of the side plate **27** becomes the compression chamber suction port **21'** (reed valve unnecessary). As shown in FIG. **7**, at the front of the drive plate **13** in the direction of rotation, a compression chamber **9** is formed, while at the rear, a suction chamber **10** is formed, so at the front of the drive plate **13** in the direction of rotation, part of the discharge passage constituted by the rotor passage **20** is formed, while at the rear of the drive plate **13** in the direction of rotation, a compression chamber suction port **21'** is provided. Reference signs **17** and **16** of FIG. **1** show the discharge passage in this embodiment. At any position of the discharge passage, a discharge valve part (reed valve etc.) is set. In this embodiment, the inside of the casing **1** becomes a suction chamber, so the temperature becomes low and the electric motor is improved in motor efficiency by cooling. The other effects are the same as in the first embodiment.

REFERENCE SIGNS LIST

[0031] **1** casing
[0032] **8** drive cylinder, cylinder
[0033] **11** rotor
[0034] **12** shaft
[0035] **13** drive plate

What is claimed is:

1. A rotary compressor which is provided with a rotor which can rotate about an axial center of a shaft which is attached to a casing, a cylinder which can rotate about a center of rotation which is eccentric from said shaft, and a drive plate which can swing with respect to either said cylinder or said rotor and can slide with respect to the other and which connects said cylinder and said rotor to be able to rotate, and a side plate which forms a side part of said drive cylinder, wherein,

an inner surface of said cylinder and an outer circumference of said rotor are made to contact at a partition point by making the center of rotation of said cylinder eccentric from the axial center of said shaft, and

the space between an inner surface of said cylinder and an outer circumference of said rotor, which is partitioned off by said partition point and said drive plate, forms working chambers for compression or suction.

a suction passage is provided at said shaft and said rotor for suction into the working chamber which performs suction and a discharge valve part is provided for discharge at a side plate which forms a side part of said cylinder.

2. The rotary compressor according to claim **1**, which drives said cylinder to rotate.

3. The rotary compressor according to claim **2**, which connects a motor rotor of an electric motor to an outer circumference of said cylinder.

4. The rotary compressor according to claim **1**, which drives said rotor to rotate.

5. (canceled)

6. (canceled)

7. The rotary compressor according to claim **1**, wherein a swinging side of said drive plate is configured by a cylindrical surface.

8. The rotary compressor according to claim **1**, wherein said drive plate is configured by a flat plate and wherein a swinging side of said drive plate is sandwiched between two shoes with single sides which are configured by cylindrical surfaces.

* * * * *