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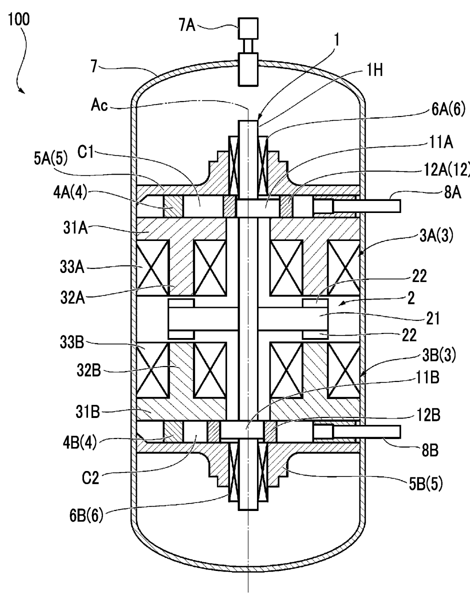
(54) **ROTARY COMPRESSOR**

(57) This rotary compressor is provided with: a shaft extending along the axial line; a disk-shaped rotor that is centered on the axial line and that is fixed to the shaft; a pair of stators that respectively face the rotor from both sides of the axial line and that have disk-shaped back yokes centered on the axial line, teeth protruding from the back yokes, and coils wound around the teeth; a pair of annular cylinders that are centered on the axial line and that respectively axially come into contact with the stators; rotary pistons that eccentrically rotate together with the shaft; a pair of end plates that form compression chambers for housing the rotary pistons together with the back yokes by axially sandwiching the cylinders together with the stators; and a pair of bearings provided to the end plates and/or the back yokes.

FIG. 1



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Description

Technical Field

[0001] The present disclosure relates to a rotary compressor.

[0002] This application claims the priority of Japanese Patent Application No. 2020-065992 filed in Japan on April 1, 2020, the contents of which are incorporated herein by reference.

Background Art

[0003] A rotary compressor is known as a device used for compressing a refrigerant in an air conditioner. The rotary compressor includes a motor, a shaft driven by the motor, a rotary piston attached to the shaft, and a cylinder covering the rotary piston. The refrigerant is compressed by an eccentric rotation of the rotary piston in the compression chamber of the cylinder.

[0004] In recent years, as the above-mentioned motor, a type called an axial gap motor has been widely used (for example, PTL 1 below). An axial gap motor described in PTL 1 has one stator and two rotors facing the stator from both sides in an axial direction. The rotary piston and the cylinder described above are independently disposed below the axial gap motor.

Citation List

Patent Literature

[0005] [PTL 1] Japanese Unexamined Patent Application Publication No. 2008-106694

Summary of Invention

Technical Problem

[0006] However, when the axial gap motor and the cylinder are disposed independently as described above, there are problems that the number of parts increases and a size of the device increases.

[0007] The present disclosure has been made in order to solve the above problems, and an object of the present disclosure is to provide a rotary compressor having a reduced number of parts and a smaller size.

Solution to Problem

[0008] In order to solve the above problems, according to an aspect of the present disclosure, there is provided a rotary compressor including: a shaft that extends along an axis; a disk-shaped rotor that is fixed to the shaft and centered on the axis; a pair of stators that faces the rotor from both sides in a direction of the axis, and includes a disk-shaped back yoke centered on the axis, teeth protruding from the back yoke, and a coil wound around the teeth; a pair of cylinders that abuts on the stator from the direction of the axis and has an annular shape centered on the axis; a rotary piston that rotates eccentrically with the shaft; a pair of end plates that forms a compression chamber for accommodating the rotary piston together with the back yoke by sandwiching the cylinder together with the stator from the direction of the axis; and a pair of bearings that is provided on at least one of the end plate and the back yoke. Advantageous Effects of Invention

[0009] According to the present disclosure, it is possible to provide a rotary compressor having a reduced number of parts and a smaller size.

Brief Description of Drawings

[0010]

Fig. 1 is a vertical sectional view of a rotary compressor according to a first embodiment of the present disclosure.

Fig. 2 is an enlarged cross-sectional view of a main part of the rotary compressor according to the first embodiment of the present disclosure.

Fig. 3 is an enlarged cross-sectional view of a main part of a rotary compressor according to a second embodiment of the present disclosure.

Fig. 4 is an enlarged cross-sectional view of a main part showing a modification example of the rotary compressor according to the second embodiment of the present disclosure. Description of Embodiments

[First Embodiment]

(Configuration of Rotary Compressor)

[0011] Hereinafter, a rotary compressor 100 according to a first embodiment of the present disclosure will be described with reference to Figs. 1 and 2. As shown in Fig. 1, the rotary compressor 100 according to the present embodiment includes a shaft 1, a rotor 2, a stator 3, a cylinder 4, an end plate 5, a bearing 6, a rotary piston 12, and a housing 7 for accommodating these.

[0012] The shaft 1 has a shaft main body 1H, an upper eccentric shaft 11A, and a lower eccentric shaft 11B. The shaft main body 1H has a columnar shape extending along an axis Ac. The upper eccentric shaft 11A and the lower eccentric shaft 11B are provided at an interval in a direction of the axis Ac. Each of the upper eccentric shaft 11A and the lower eccentric shaft 11B has a disk shape eccentric in a radial direction with respect to the axis Ac. Eccentric directions of the upper eccentric shaft 11A and the lower eccentric shaft 11B are different from each other. For example, the eccentric direction of the upper eccentric shaft 11A differs from the eccentric direction of the lower eccentric shaft 11B by 180°.

[0013] The rotor 2 is integrally provided at a position (central portion) in a middle of extension of the shaft main body 1H. That is, the rotor 2 is provided at an intermediate position between the upper eccentric shaft 11A and the lower eccentric shaft 11B. The rotor 2 has a rotor core 21 and a permanent magnet 22. The rotor core 21 has a disk shape centered on the axis Ac. The permanent magnet 22 has a ring shape extending along a peripheral edge of the rotor core 21. Instead of the permanent magnet 22, it is possible to adopt a configuration in which a plurality of magnets are arranged on the peripheral edge of the rotor core 21 at intervals in a circumferential direction.

[0014] The stator 3 disposed so as to face the rotor 2 from both sides in the direction of the axis Ac includes an upper stator 3A and a lower stator 3B. The upper stator 3A faces the rotor 2 from one side (upper side) in the direction of the axis Ac. The upper stator 3A has a back yoke 31A, teeth 32A, and a coil 33A. The back yoke 31A has an annular shape centered on the axis Ac. An opening through which the shaft 1 is inserted is formed in a portion including the center of the back yoke 31A. The teeth 32A are positioned on a surface of the back yoke 31A facing the other side (lower side) in the direction of the axis Ac, and have a rod shape protruding in the direction of the axis Ac from the center position in the radial direction. A plurality of teeth 32A are arranged at equal intervals in the circumferential direction with respect to the axis Ac. The coil 33A is formed by winding a copper wire around each tooth 32A. Power is supplied to the coil 33A from a power source (not shown).

[0015] The lower stator 3B has a back yoke 31B, teeth 32B, and a coil 33B. The back yoke 31B has an annular shape centered on the axis Ac. An opening through which the shaft 1 is inserted is formed in a portion including the center of the back yoke 31B. The teeth 32B are positioned on a surface of the back yoke 31B facing one side (upper side) in the direction of the axis Ac, and have a rod shape protruding in the direction of the axis Ac from the center position in the radial direction. A plurality of teeth 32B are arranged at equal intervals in the circumferential direction with respect to the axis Ac. The coil 33B is formed by winding a copper wire around each tooth 32B. Power is supplied to the coil 33B from a power source (not shown). As a result, the upper stator 3A and the lower stator 3B are excited, and the shaft 1 is rotated by the electromagnetic force generated between the rotor 2 and the stator 3. That is, the rotor 2 and the stator 3 constitute a one rotor-two stator type axial gap motor.

[0016] The cylinder 4 (upper cylinder 4A and lower cylinder 4B) abuts on one side (upper side) of the upper stator 3A in the direction of the axis Ac and the other side (lower side) of the lower stator 3B in the direction of the axis Ac. Each of the upper cylinder 4A and the lower cylinder 4B has a cylindrical shape centered on the axis Ac. The above-mentioned upper eccentric shaft 11A and the ring-shaped rotary piston 12 (upper rotary piston 12A) fitted in the upper eccentric shaft 11A are accommodated inside the upper cylinder 4A. The above-mentioned lower eccentric shaft 11B and the ring-shaped rotary piston 12 (lower rotary piston 12B) fitted in the lower eccentric shaft 11B are accommodated inside the lower cylinder 4B. Further, intake ports 8A and 8B for guiding the refrigerant from the outside are provided in a portion of the upper cylinder 4A and the lower cylinder 4B in the circumferential direction, respectively.

[0017] The end plates 5 (upper end plate 5A, lower end plate 5B) abut on one side (upper side) of the upper cylinder 4A in the direction of the axis Ac and the other side (lower side) of the lower cylinder 4B in the direction of the axis Ac, respectively. That is, the upper end plate 5A sandwiches the upper cylinder 4A together with the back yoke 31A from the direction of the axis Ac. Similarly, the lower end plate 5B sandwiches the lower cylinder 4B together with the back yoke 31B from the direction of the axis Ac. Each of the upper end plate 5A and the lower end plate 5B has a disk shape centered on the axis Ac. The bearings 6 (upper bearing 6A, lower bearing 6B) are attached to a portion including the centers of the upper end plate 5A and the lower end plate 5B, respectively. A shaft end of the shaft main body 1H is supported by these bearings 6. Further, the upper end plate 5A and the lower end plate 5B are fixed to an inner peripheral surface of the housing 7 in a tightly fitted state.

[0018] As shown in an enlarged manner in Fig. 2, a surface of the upper end plate 5A facing the other side (lower side) in the direction of the axis Ac is an end plate main surface 5S. Further, a surface of the back yoke 31A facing one side (upper side) of the direction of the axis Ac is a back yoke facing surface 31S. An upper compression chamber C1 is formed by the end plate main surface 5S, the back yoke facing surface 31S, and the inner peripheral surface of the upper cylinder 4A. That is, in the present embodiment, a portion (back yoke 31A) of the stator 3 also serves as a member forming a portion of the upper compression chamber C1. Further, a lower compression chamber C2 is also formed by the back yoke 31B of the lower stator 3B, the lower end plate 5B, and the lower cylinder 4B, similarly to the upper compression chamber C1.

[0019] In the upper compression chamber C1 and the lower compression chamber C2, the above-mentioned upper rotary piston 12A and lower rotary piston 12B rotate eccentrically, respectively. As a result, volumes of the upper compression chamber C1 and the lower compression chamber C2 change with time, and the refrigerant taken in from the intake ports 8A and 8B is compressed. The compressed refrigerant passes through the inside of the housing 7 and is taken out from a discharge port 7A.

[0020] It is also possible to adopt a configuration in which the pressure of the refrigerant is increased in two stages by sequentially passing the upper compression chamber C1 and the lower compression chamber C2, and it is also possible to adopt a configuration in which the upper compression chamber C1 and the lower compression chamber C2 function independently.

(Action Effect)

[0021] According to the above configuration, the back yokes 31A and 31B of the stator 3 form the compression chambers C1 and C2 together with the end plate 5 and the cylinder 4. In other words, the back yokes 31A and 31B have both a function as a portion of the motor and a function as a portion of the members forming the compression chambers C1 and C2. As a result, the number of parts can be reduced. Further, the size of the device in the direction of the axis Ac can be suppressed by the reduced members.

[0022] Further, according to the above configuration, since the bearing 6 is provided in each of the pair of end plates 5, the shaft 1 can be supported by both end portions thereof. As a result, noise and vibration are reduced, and the shaft 1 can be rotated more stably.

[Second Embodiment]

[0023] Next, a second embodiment of the present disclosure will be described with reference to Fig. 3. The same components as those in the first embodiment are designated by the same reference numerals, and detailed description thereof will be omitted. As shown in Fig. 3, in the present embodiment, a bearing 6' (upper bearing 6A') is integrally provided in a back yoke 31A instead of an end plate 5' (upper end plate 5A'). As a result, the end plate 5' has a disk shape centered on an axis Ac, and no opening or the like is formed in the portion including the center. Further, although not shown in detail, another bearing 6' located at the lower portion is also integrally provided on a back yoke 31B like the upper bearing 6A'.

[0024] According to the above configuration, since the bearing 6' is provided in each of the pair of back yokes 31A and 31B, an end portion of a shaft 1 does not protrude from the end plate 5' side. That is, the dimension of the shaft 1 in the direction of the axis Ac can be kept small. As a result, the possibility that the shaft 1 is bent or misaligned can be further reduced. As a result, a rotary compressor 100 can be operated more stably.

(Other Embodiments)

[0025] The embodiments of the present disclosure have been described above. It is possible to make various changes and modifications to the above configuration as long as it does not deviate from the gist of the present disclosure. For example, as a modification example of the second embodiment, as shown in Fig. 4, the back yoke 31A can be configured to include an annular back yoke main body 34 integrally formed with the teeth 32A and a support plate 35 separately provided from the back yoke main body 34. The support plate 35 has a disk shape centered on the axis Ac, and a bearing 6' is provided at the center of the support plate 35. According to such a configuration, when the coil 33A is configured, the back yoke main body 34 is detachable from the support plate 35, and thus, ease of manufacturing can be further improved.

[0026] Further, the configuration described in the first embodiment (the configuration in which the bearing 6 is provided in the end plate 5) and the configuration described in the second embodiment (the configuration in which the bearing 6' is provided in the back yokes 31A and 31B) can be combined. That is, it is possible to adopt a configuration in which the upper bearing 6A is attached to the end plate 5 and the lower bearing 6B is attached to the back yoke 31B, or a configuration in which the upper bearing 6A is attached to the back yoke 31A and the lower bearing 6B is attached to the end plate 5.

[Additional Notes]

[0027] The rotary compressor 100 described in each embodiment is grasped as follows, for example.

(1) A rotary compressor 100 according to a first aspect includes a shaft 1 that extends along an axis Ac, a disk-shaped rotor 2 that is fixed to the shaft 1 and centered on the axis Ac, a pair of stators 3 that faces the rotor 2 from both sides in a direction of the axis Ac, and includes disk-shaped back yokes 31A and 31B centered on the axis Ac, teeth 32A and 32B protruding from the back yokes 31A and 31B, and coils 33A and 33B wound around the teeth 32A and 32B, a pair of cylinders 4 that abuts on the stator 3 from the direction of the axis Ac and has an annular shape centered on the axis Ac, a pair of rotary pistons 12 that rotates eccentrically with the shaft 1, a pair of end plates 5 that forms compression chambers C1 and C2 for accommodating the rotary piston 12 together with the back yokes 31A and 31B by sandwiching the cylinder 4 together with the stator 3 from the direction of the axis Ac, and a pair of bearings 6 that is provided on at least one of the end plate 5 and the back yokes 31A and 31B.

According to the above configuration, the back yokes 31A and 31B of the stator 3 form the compression chambers C1 and C2 together with the end plate 5 and the cylinder 4. In other words, the back yokes 31A and 31B have both a function as a portion of the motor and a function as a portion of the members forming the compression chambers C1 and C2. As a result, the number of parts can be reduced. Further, the size of the device in the direction of the axis Ac can be suppressed by the reduced members.

(2) In the rotary compressor 100 according to a second aspect, the bearing 6 may be integrally provided in each of the pair of end plates 5.

According to the above configuration, since the bearing 6 is provided in each of the pair of end plates 5, the shaft 1 can be supported by both end portions thereof. As a result, noise and vibration are reduced, and the shaft 1 can be rotated more stably.

(3) In the rotary compressor 100 according to a third

aspect, the bearing 6 may be integrally provided in each of the pair of back yokes 31A and 31B.
According to the above configuration, since the bearing 6 is provided in each of the pair of back yokes 31A and 31B, the end portion of the shaft 1 does not protrude from the end plate 5 side. That is, the dimension of the shaft 1 can be kept small. This makes it possible to reduce the possibility that the shaft 1 is bent or misaligned.
(4) In the rotary compressor 100 according to a fourth aspect, the bearing 6 may protrude from the back yokes 31A and 31B in a direction toward the rotor 2.
According to the above configuration, since the bearing 6 protrudes from the back yokes 31A and 31B in the direction toward the rotor 2, it is possible to secure a large dimension of the bearing 6 in the direction of the axis Ac. This makes it possible to stably support the shaft 1 even when the load is high.

Industrial Applicability

[0028] The present disclosure relates to a rotary compressor.
[0029] According to the present disclosure, it is possible to provide a rotary compressor having a reduced number of parts and a smaller size.

Reference Signs List

[0030]

100 Rotary compressor
1 Shaft
1H Shaft main body
11A Upper eccentric shaft
11B Lower eccentric shaft
12 Rotary piston
12A Upper rotary piston
12B Lower rotary piston
2 Rotor
21 Rotor core
22 Permanent magnet
3 Stator
3A Upper stator
3B Lower stator
31A, 31B Back yoke
31S Back yoke facing surface
32A, 32B Teeth
33A, 33B Coil
4 Cylinder
4A Upper cylinder
4B Lower cylinder
5 End plate
5A Upper end plate
5B Lower end plate
5S End plate main surface
6 Bearing
6A Upper bearing
6B Lower bearing
7 Housing
7A Discharge port
8A, 8B Intake port
Ac Axis
C1 Upper compression chamber
C2 Lower compression chamber

Claims

1. A rotary compressor comprising:
a shaft that extends along an axis;

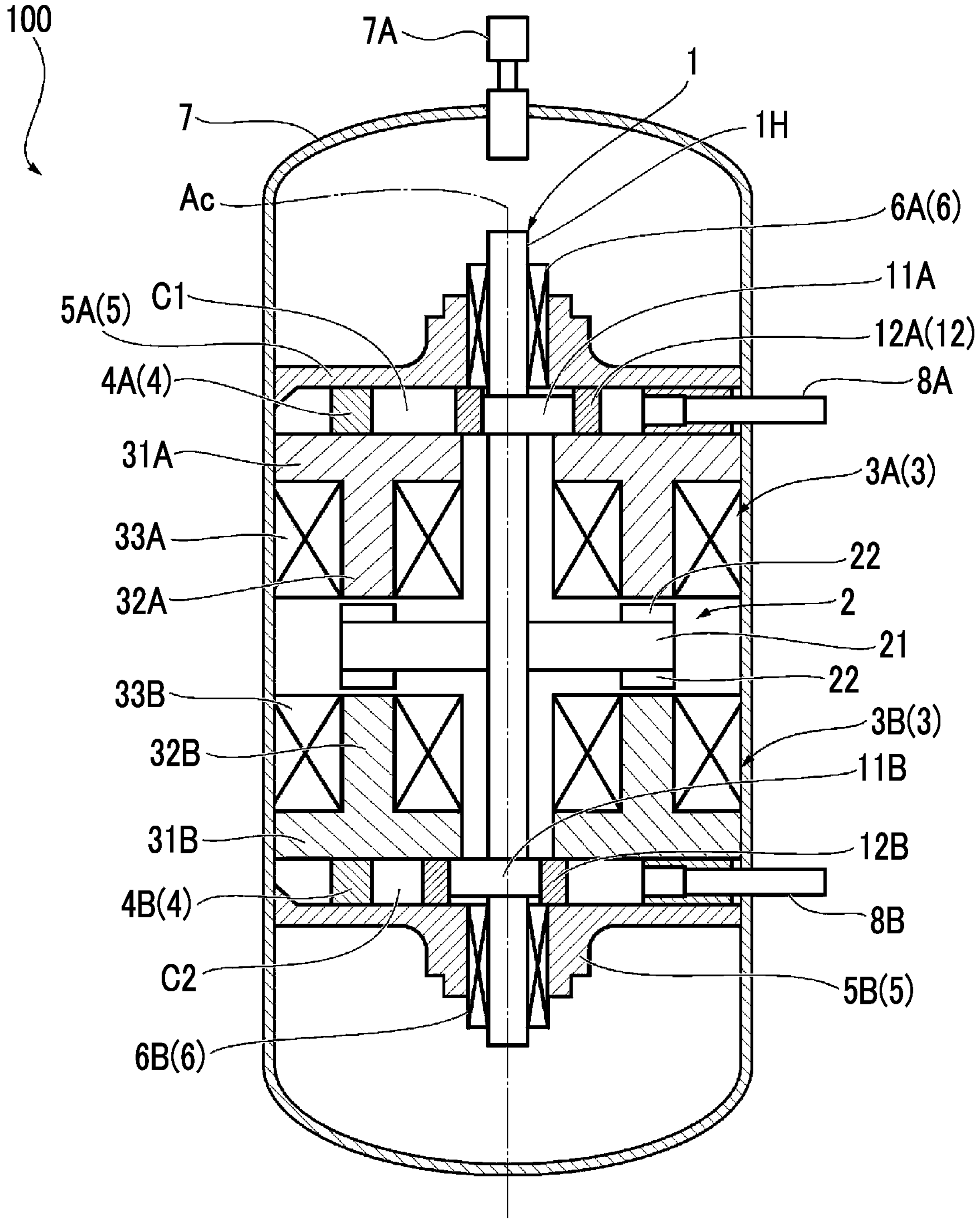
a disk-shaped rotor that is fixed to the shaft and centered on the axis;
a pair of stators that faces the rotor from both sides in a direction of the axis, and includes a disk-shaped back yoke centered on the axis, teeth protruding from the back yoke, and a coil wound around the teeth;
a pair of cylinders that abuts on the stator from the direction of the axis and has an annular shape centered on the axis;
a rotary piston that rotates eccentrically with the shaft;
a pair of end plates that forms a compression chamber for accommodating the rotary piston together with the back yoke by sandwiching the cylinder together with the stator from the direction of the axis; and
a pair of bearings that is provided on at least one of the end plate and the back yoke.

2. The rotary compressor according to claim 1, wherein the bearing is integrally provided in each of the pair of end plates.

3. The rotary compressor according to claim 1 or 2, wherein the bearing is integrally provided in each of the pair of back yokes.

4. The rotary compressor according to claim 3, wherein the bearing protrudes from the back yoke in a direction toward the rotor.

FIG. 1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1
7
1H
Ac
6A(6)
11A
C1
5A(5)
12A(12)
4A(4)
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3A(3)
33A
22
32A
2
21
22
33B
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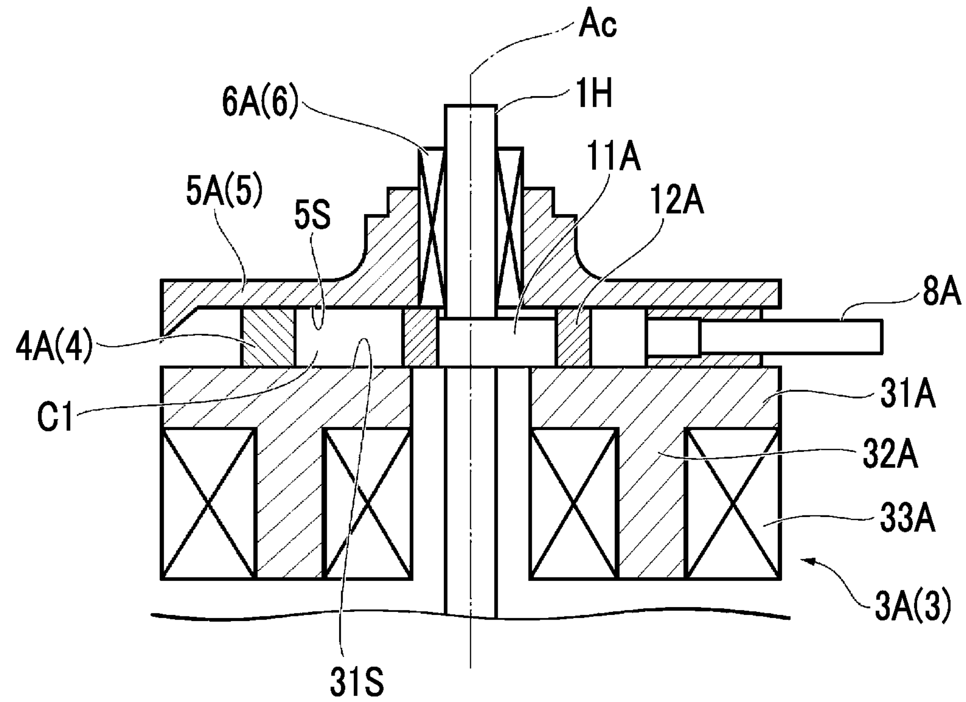
4B(4)
8B
C2
5B(5)
6B(6)

FIG. 2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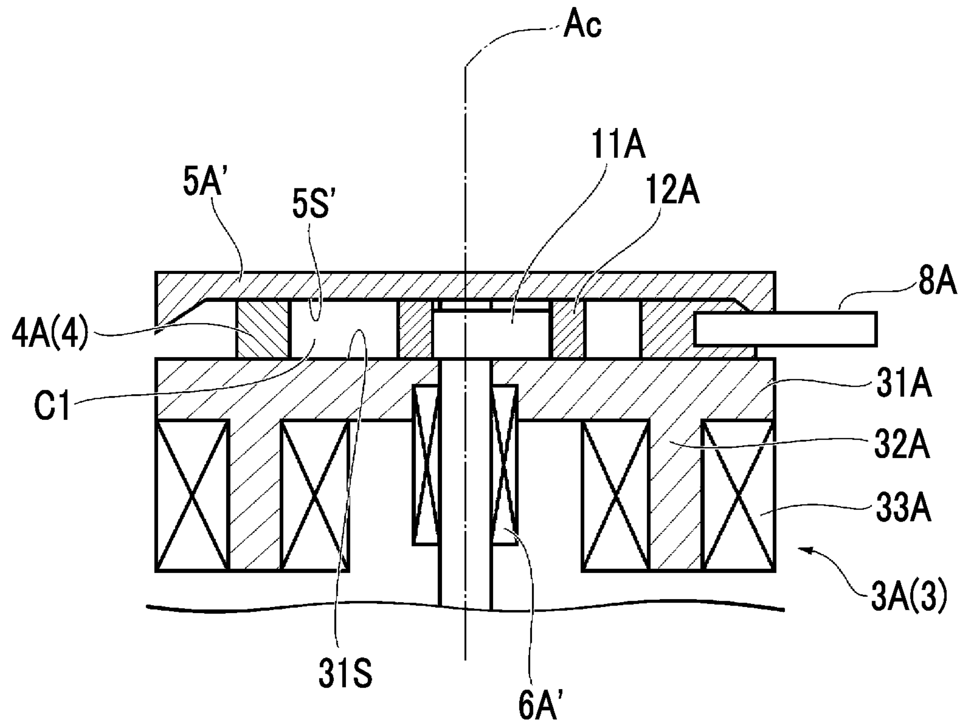
5A(5)
5S
12A
8A
4A(4)
C1
31A
32A
33A
3A(3)
31S

FIG. 3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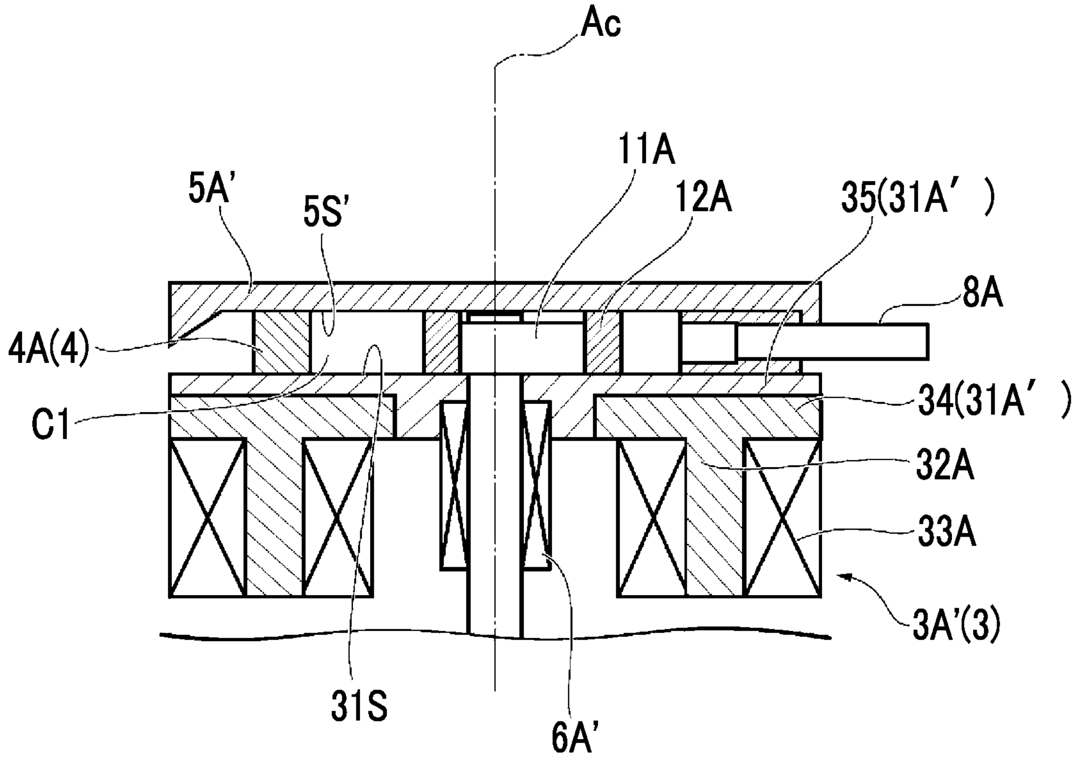
5S'
12A
8A
4A(4)
C1
31A
32A
33A
3A(3)
31S
6A'

FIG. 4



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2021/014156

A. CLASSIFICATION OF SUBJECT MATTER
F04C 23/02(2006.01)i; F04C 29/00(2006.01)i
FI: F04C23/02 D; F04C23/02 F; F04C29/00 T

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)
F04C23/02; F04C29/00

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

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2021
Registered utility model specifications of Japan	1996-2021
Published registered utility model applications of Japan	1994-2021

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.
A	WO 2006/077812 A1 (DAIKIN INDUSTRIES, LTD.) 27 July 2006 (2006-07-27) paragraphs [0262]-[0269], fig. 32-33	1-4
A	WO 2013/094165 A1 (VALEO JAPAN CO., LTD.) 27 June 2013 (2013-06-27) paragraphs [0019]-[0042], fig. 1-4	1-4
A	JP 64-69793 A (HITACHI, LTD.) 15 March 1989 (1989-03-15) page 3, upper left column, line 1 to page 4, upper right column, line 13, fig. 1, 3	1-4
A	CN 104638866 A (ZHUHAI GREE REFRIGERATION TECHNOLOGY CENTER OF ENERGY SAVING AND ENVIRONMENTAL PROTECTION CO., LTD.) 20 May 2015 (2015-05-20) paragraphs [0029]-[0044], fig. 1-2	1-4

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 May 2021 (25.05.2021)	01 June 2021 (01.06.2021)

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2021/014156

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
WO 2006/077812 A1	27 Jul. 2006	US 2011/0133596 A1 paragraphs [0332]-[0339], fig. 32-33 EP 1850451 A1 CN 101107762 A KR 10-2007-0099021 A	
WO 2013/094165 A1	27 Jun. 2013	EP 2803865 A1 paragraphs [0025]-[0050], fig. 1-4 JP 2013-130088 A	
JP 64-69793 A	15 Mar. 1989	(Family: none)	
CN 104638866 A	20 May 2015	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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- JP 2008106694 A **[0005]**