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(54) **SEALED-TYPE ELECTRIC COMPRESSOR**

(57) Provided is a sealed-type electric compressor that can easily reduce vibration and noise simply by changing the shape of a portion of a casing, without impacting in any way a compressor mechanism and an electric motor, or the performance and reliability thereof. In a sealed-type electric compressor (1), an electric motor (5) and a compressor mechanism (6) are accommodated in a cylindrical casing (2), and the compressor mechanism (6) can be driven by the electric motor (5). Both-end portions (E1, E2) of a stator (12) of the electric motor (5) are shrink-fit, press-fit, or welded to the circular inner circumferential surface of the cylindrical casing (2), and as a result, the electric motor is fixedly disposed. An intermediate portion (M) excluding the both-end portions (E1, E2) is not in contact with the casing (2), over a whole or a part excluding a contact portion.

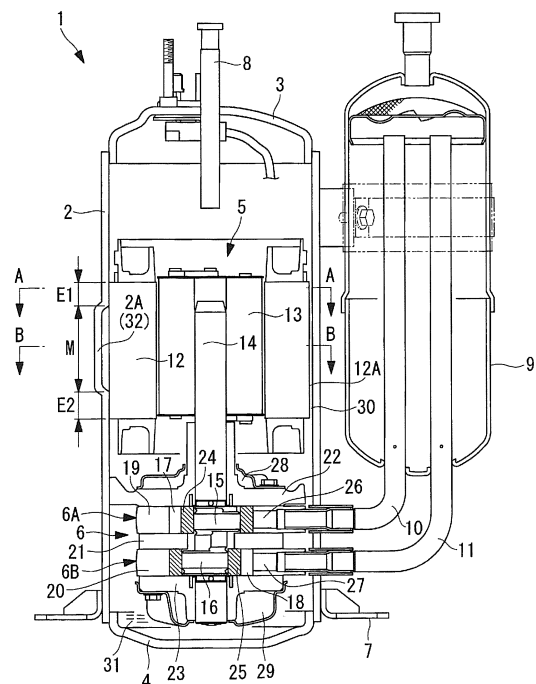


FIG. 1

Description

Technical Field

[0001] The present invention relates to a sealed-type electric compressor in which an electric motor and a compressor mechanism are accommodated in a cylindrical casing, and the compressor mechanism is driven by the electric motor.

Background Art

[0002] As a compressor for refrigerating or air-conditioning machines or various types of heat pumps, a sealed-type electric compressor, such as a rotary-type and a scroll-type electric compressor, has been used. In such a compressor, an electric motor and a compressor mechanism are accommodated in a cylindrical casing. In the sealed-type electric compressor, in order to fix and dispose the electric motor in the casing, a stator of the electric motor is shrink-fit, press-fit, or welded to the inner circumferential surface of the cylindrical casing. Further, as the motor for the compressor, a motor is used which has a coil wire wound through concentrated winding in order to improve the motor efficiency. However, the motor with the concentrated winding generates loud noise arising from an electromagnetic vibrating force. Even though measures, such as optimizing core shape, have been taken to reduce the electromagnetic vibrating force, it has been difficult to reduce the noise of the motor itself, since priority is placed on motor efficiency.

[0003] On the sealed-type compressor side, as a countermeasure against the vibration and noise, a technology is disclosed in Patent Document 1 in which a pair of top and bottom ring-shaped intermediate members are fixed to a top end portion and a bottom end portion of the outer peripheral edge of a stator of an electric motor, and, by fitting the ring-shaped intermediate members to the inner wall of a casing, propagation of the motor vibration to the casing is suppressed, thereby reducing the vibration and noise of the compressor. Further, in Patent Documents 2 to 4, technologies are disclosed in which a waveform area formed by a multitude of recesses and projections extending in the circumferential direction, or a plurality of ribs extending in the axial direction are provided on the circumferential wall of the casing, and as a result, the rigidity of the casing is improved, thereby reducing the noise of the compressor.

Citation List

Patent Documents

[0004]

Patent Document 1: Japanese Unexamined Patent Application Publication No. 2009-299524A
Patent Document 2: Japanese Unexamined Patent

Application Publication No. 2009-103134A

Patent Document 3: Japanese Unexamined Patent

Application Publication No. S62-147079A

Patent Document 4: Japanese Unexamined Patent

Application Publication No. S62-170796A

Summary of the Invention

Technical Problems

[0005] However, with the configuration in which the ring-shaped intermediate members are interposed, as disclosed in Patent Document 1, the diameter of a housing or the diameter of a motor core needs to be changed. If the diameter of the housing is changed, the diameter of the compressor mechanism also needs to be changed, and as a result, design and capital investment are encumbered. Alternatively, if the diameter of the motor core is changed, measures need to be taken to secure a similar level of performance while making the diameter smaller, and as a result, design is encumbered dramatically. Further, as the ring-shaped intermediate members, additional parts, and processing costs and assembly processes thereof become necessary. Moreover, there are many issues concerning, for example, a deterioration in the holding power of the motor itself by the ring-shaped intermediate members, or a deterioration in the holding power due to thermal expansion and thermal contraction.

[0006] Further, as disclosed in Patent Documents 2 to 4, with the configuration in which the waveform area formed by the recesses and projections or the plurality of ribs is provided, the vibration of the casing can be suppressed by increasing the rigidity of the casing. However, with such a configuration, since the vibration caused by the electromagnetic vibrating force of the motor is directly propagated to the casing through an entire area of the inner circumferential surface of the casing to which the stator is shrink-fit, press-fit, or welded, the vibration and noise cannot be reduced to a satisfactory level. Particularly, when the recesses and projections or the ribs provided on the casing are extended beyond the area over which the stator is shrink-fit, press-fit, or welded, the propagation area of the vibration expands via the highly rigid recesses and projections or ribs. As a result, there have been cases in which necessary vibration and noise reduction effects cannot be obtained.

[0007] In light of the foregoing, an object of the present invention is to provide a sealed-type electric compressor that can easily reduce vibration and noise simply by changing the shape of a portion of a casing, without impacting in any way a compressor mechanism and an electric motor, or the performance and reliability thereof.

Solution to Problems

[0008] A first aspect of the present invention is a sealed-type electric compressor including an electric motor and a compressor mechanism accommodated in a

cylindrical casing, the compressor mechanism being able to be driven by the electric motor. The electric motor is fixedly disposed by each of both-end portions of a stator of the electric motor being shrink-fit, press-fit, or welded to a circular inner circumferential surface of the cylindrical casing. An intermediate portion excluding the both-end portions is not in contact with the casing, over a whole of the intermediate portion or over a part of the intermediate portion excluding a contact portion.

[0009] According to the first aspect of the present invention, the electric motor is fixedly disposed by each of the both-end portions of the stator of the electric motor being shrink-fit, press-fit, or welded to the circular inner circumferential surface of the cylindrical casing, and the intermediate portion excluding the both-end portions is not in contact with the casing, over a whole of the intermediate portion or over a part of the intermediate portion excluding a contact portion. As a result, the electric motor can be fixedly disposed reliably and firmly by causing the both-end portions of the stator thereof to be shrink-fit, press-fit, or welded to the circular inner circumferential surface of the cylindrical casing. Further, as a result of causing the intermediate portion excluding the both-end portions of the stator to be in a non-contact state with respect to the inner circumferential surface of the casing, over a whole of the intermediate portion or over a part of the intermediate portion excluding the contact portion, a propagation amount of vibration in the radial direction of the motor caused by an electromagnetic vibrating force, which has increased by concentrated winding of a coil wire in order to improve the efficiency of the electric motor, can be significantly reduced, and as a result, radiated noise from the casing can be reduced. Therefore, not only can noise of the compressor be reduced, but also, since the noise reduction can be achieved simply by partially changing the shape of the casing, the present invention can be implemented easily and in a low-cost manner, while minimizing an impact on the performance and reliability of the compressor, on a design load, on capital investment, on investment into molds, and the like. Further, since shrink-fitting stress and the like in the intermediate portion of the stator can be alleviated, an efficiency improvement of the motor due to a reduction in core loss can also be expected.

[0010] In the sealed-type electric compressor according to the first aspect of the present invention, a section of the casing corresponding to the intermediate portion may be formed into a rib-like shape protruding outward so as to be in a non-contact state, apart from a section corresponding to a notched portion formed for a refrigerant passage provided on an outer circumference of the stator.

[0011] According to the first aspect of the present invention, the section of the casing corresponding to the intermediate portion is in the non-contact state, as a result of the section being caused to bulge outward in the rib-like shape, apart from the section corresponding to the notched portion formed for the refrigerant passage pro-

vided on the outer circumference of the stator. As a result of this configuration, the rigidity of the cylindrical casing, which acts as a noise radiating surface, can be increased due to the rib-shaped bulging portion caused to bulge outward provided in the section corresponding to the intermediate portion of the stator. Thus, due to the increased rigidity of the casing, noise reduction effects of the compressor can also be expected.

[0012] In the sealed-type electric compressor according to the first aspect of the present invention, means for increasing rigidity for maintaining the non-contact state with respect to the outer circumference of the stator may be provided on the section caused to bulge in the rib-like shape.

[0013] According to the first aspect of the present invention, since the means for increasing rigidity for maintaining the non-contact state with respect to the outer circumference of the stator is provided on the section caused to bulge in the rib-like shape, the rigidity of the casing can be further improved by the means for increasing rigidity, such as recesses and projections provided in the section caused to bulge in the rib-like shape. As a result, the noise of the compressor can be further reduced.

Advantageous Effects of Invention

[0014] According to the present invention, the electric motor can be fixedly disposed reliably and firmly by the both-end portions of the stator thereof being shrink-fit, press-fit, or welded to the circular inner circumferential surface of the cylindrical casing. Further, as a result of causing the intermediate portion excluding the both-end portions of the stator to be in the non-contact state with respect to the inner circumferential surface of the casing, over a whole of the intermediate portion or a part of the intermediate portion excluding the contact portion, the propagation amount of the vibration in the radial direction of the motor caused by the electromagnetic vibrating force, which has increased by the concentrated winding of the coil wire in order to improve the efficiency of the electric motor, can be significantly reduced. As a result, the radiated noise from the casing can be reduced, and thus, the noise of the compressor can be reduced. Further, since the noise reduction can be achieved simply by partially changing the shape of the casing, the present invention can be implemented easily and in a low-cost manner, while minimizing the impact on the performance and reliability of the compressor, on the design load, on the capital investment, on the investment into molds, and the like. Further, since shrink-fitting stress and the like in the intermediate portion of the stator can be alleviated, an efficiency improvement of the motor due to a reduction in core loss can also be expected.

Brief Description of the Drawings

[0015]

FIG. 1 is a vertical cross-sectional view of a sealed-type electric compressor according to an embodiment of the present invention.

FIG. 2 is a cross-sectional view taken along A-A in FIG. 1.

FIG. 3 is a cross-sectional view taken along B-B in FIG. 1.

Description of Embodiment

[0016] An embodiment of the present invention will be described below with reference to FIGS. 1 to 3.

[0017] FIG. 1 is a vertical cross-sectional view of a sealed-type electric compressor according to an embodiment of the present invention. FIG. 2 is a cross-sectional view taken along A-A in FIG. 1, and FIG. 3 is a cross-sectional view taken along B-B in FIG. 1.

[0018] As a sealed-type electric compressor 1 according to the present embodiment, a multi-cylinder rotary compressor is exemplified, but the sealed-type electric compressor 1 is of course not limited thereto. This sealed-type electric compressor 1 is provided with a cylindrical casing 2, a top portion and a bottom portion of which are sealed by covers 3 and 4. The sealed-type electric compressor 1 has a configuration in which an electric motor 5 is provided inside an upper part of the casing 2 and a compressor mechanism (a rotary compressor mechanism) 6 that is driven by the electric motor 5 is provided inside a lower part of the casing 2.

[0019] A mounting leg 7 is provided on the outer circumference of the bottom portion of the casing 2. Further, a discharge pipe 8 penetrating through the cover 3 is provided in the top portion of the casing 2 such that a high-pressure refrigerant gas compressed by the compressor mechanism 6 can be discharged to a refrigerating cycle side. Furthermore, an accumulator 9 is integrally assembled to an outer circumferential portion of the casing 2, such that a liquid portion, such as oil and liquid refrigerant, contained in a low-pressure refrigerant gas returned from the refrigerating cycle side can be separated, and only a gas portion can be taken in by the compressor mechanism 6 via intake pipes 10 and 11.

[0020] The electric motor 5 is provided with a stator 12 and a rotor 13 and is fixedly disposed as a result of the stator 12 being shrink-fit, press-fit, or welded (tack-welded, for example), to the inner circumferential surface of the casing 2. A crank shaft 14 is integrally joined to the rotor 13, and as a result, a rotational driving force of the rotor 13 can be transmitted to the compressor mechanism 6 via the crank shaft 14. Further, in a lower part of the crank shaft 14, a first eccentric portion 15 and a second eccentric portion 16 are provided which respectively correspond to a first rotor 24 and a second rotor 25 of the compressor mechanism 6, which will be described later.

[0021] The compressor mechanism (the rotary compressor mechanism) 6 is a two cylinder-type compressor mechanism. First and second rotary compressor mechanisms 6A and 6B form a first cylinder chamber 17 and

a second cylinder chamber 18 (hereinafter, sometimes simply referred to as cylinders 17 and 18). The compressor mechanism 6 is provided with a first cylinder main body 19 and a second cylinder main body 20 that are fixedly disposed in the casing 2 corresponding to the first eccentric portion 15 and the second eccentric portion 16 of the crank shaft 14, a partition plate 21 that is interposed between the first cylinder main body 19 and the second cylinder main body 20 and partitions the first cylinder chamber 17 and the second cylinder chamber 18, an upper bearing 22 that is provided on the top surface of the first cylinder main body 19, partitions the first cylinder chamber 17, and supports the crank shaft 14, and a lower bearing 23 that is provided on the bottom surface of the second cylinder main body 20, partitions the second cylinder chamber 18, and supports the crank shaft 14.

[0022] Further, the first and second rotary compressor mechanisms 6A and 6B are provided with a first rotor 24 and a second rotor 25 that are rotatably fitted with the first eccentric portion 15 and the second eccentric portion 16 and that are rotated in the first cylinder chamber 17 and the second cylinder chamber 18, and blades (not illustrated) that are slidably fitted into blade grooves (not illustrated) provided in the first cylinder main body 19 and the second cylinder main body 20 and that partition the interiors of the first cylinder chamber 17 and the second cylinder chamber 18 into an intake side and a discharge side.

[0023] A low-pressure refrigerant gas is taken into the first cylinder chamber 17 and the second cylinder chamber 18 of the first and second rotary compressor mechanisms 6A and 6B, from the intake pipes 10 and 11 via intake ports 26 and 27. This refrigerant is compressed by the rotation of the first rotor 24 and the second rotor 25 and discharged into discharge chambers 28 and 29, as a high-pressure refrigerant gas, via discharge ports and discharge valves (not illustrated). Further, after being discharged into the casing 2 from the discharge chambers 28 and 29, the high-pressure refrigerant gas passes through a plurality of notched portions 12A (see FIGS. 2 and 3), which are provided on the outer circumference of the stator 12 in the axial direction, and refrigerant passages 30 formed between the stator 12 and the inner circumferential surface of the casing 2, and is guided to an upper portion of the interior of the casing 2 and discharged to the refrigerating cycle side via the discharge pipe 8.

[0024] The first cylinder main body 19, the second cylinder main body 20, the partition plate 21, the upper bearing 22, and the lower bearing 23, which configure the rotary compressor mechanism 6, are integrally fastened and fixed by bolts. Further, a bottom portion of the interior of the casing 2 is filled with refrigeration oil 31, such as PAG oil or POE oil. The refrigeration oil 31 can be supplied to lubrication parts inside the compressor mechanism 6 in a known manner, via oil supply holes and the like provided in the crank shaft 14.

[0025] Further, in the sealed-type electric compressor 1 having the above-described configuration, the following configuration is adopted in order to reduce radiated noise arising from motor vibrations caused by an electromagnetic vibrating force of the electric motor 5.

[0026] As described above, the stator 12 of the electric motor 5 is fixedly disposed by being shrink-fit, press-fit, or welded (tack-welded, for example), to the circular inner circumferential surface of the casing 2. However, as illustrated in FIG. 1, an area over which the stator 12 is shrink-fit, press-fit, or welded is limited to both-end portions E1 and E2 of the stator 12, and there is no contact with the outer circumference of the stator 12 over an entire area of an intermediate portion M formed between the both-end portions E1 and E2.

[0027] Specifically, as illustrated in FIG. 2, the both-end portions E1 and E2 of the stator 12 are fixedly disposed as a result of the outer circumference of the stator 12, excluding the plurality of notched portions (portions cut out in a D shape) 12A provided so as to form the refrigerant passages 30 provided on the outer circumference of the stator 12, being shrink-fit, press-fit, or welded, for example, to the circular inner circumferential surface of the casing 2.

[0028] Meanwhile, over the intermediate portion M of the stator 12, the plurality of notched portions 12A, which are originally provided to form the refrigerant passages 30, are not in contact with the inner circumferential surface of the casing 2, thus forming a non-contact area. While sections other than the intermediate portion M are fitted to the circular inner circumferential surface of the casing 2, the stator 12 and the casing 2 are also not in contact with each other over the intermediate portion M, as illustrated in FIG. 3, as a result of causing corresponding sections 2A on the casing 2 side, which correspond to fitting sections of the intermediate portion M, to bulge outward in a rib-like shape.

[0029] As illustrated in FIG. 3, the outwardly-bulging corresponding sections 2A on the casing 2 side, which correspond to the intermediate portion M of the stator 12, are provided at six locations around the circumference of the casing 2, and each of the corresponding sections 2A forms a rib-shaped bulging portion 32 having a uniform width and a length in the axial direction corresponding to the intermediate portion M. As a result of forming the bulging portions 32 as part of the casing 2, without changing the electric motor 5 and the compressor mechanism 6 in any way, a configuration can be obtained in which the electric motor 5 is fixedly disposed by causing only the both-end portions E1 and E2 of the stator 12 to be shrink-fit, press-fit, or welded to the casing 2, and the entire area of the intermediate portion M between the both-end portions E1 and E2 is not in contact with the casing 2.

[0030] Further, with respect to the above-described rib-shaped bulging portions 32, in order to increase the rigidity of the casing 2, means for increasing rigidity, such as recesses and projections (not illustrated), may be pro-

vided, as long as such means are not in contact with the outer circumference of the stator 12.

[0031] Furthermore, in the above-described embodiment, although the configuration is adopted in which the entire area of the intermediate portion M of the stator 12 is not in contact with the casing 2, even if a part of the intermediate portion M comes into contact with the casing 2 due to the shape of a motor core and the like, such a case is deemed to be included in the present invention as long as remaining parts of the intermediate portion M are not in contact with the casing 2.

[0032] According to the configuration described above, the present embodiment has the following actions and effects.

[0033] In the above-described sealed-type electric compressor 1, when the compressor mechanism 6 is driven by the rotation of the electric motor 5, the low-pressure refrigerant gas is taken into each of the first cylinder chamber 17 and the second cylinder chamber 18 of the first and second rotary compressor mechanisms 6A and 6B via the accumulator 9, and after being compressed by the rotation of the first rotor 24 and the second rotor 25, the low-pressure refrigerant gas is discharged into the discharge chambers 28 and 29 via the discharge ports and discharge valves (not illustrated).

[0034] After being discharged into the casing 2 from the discharge chambers 28 and 29, this compressed gas passes through the refrigerant passages 30 formed by the plurality of notched portions 12A (see FIGS. 2 and 3) provided on the outer circumference of the stator 12 in the axial direction and is guided to the upper portion of the interior of the casing 2 and discharged therefrom to the refrigerating cycle side via the discharge pipe 8. During this compression operation, the motor vibration is generated in the electric motor 5 due to the electromagnetic vibrating force thereof. As a result of the vibration in the radial direction of the motor being propagated to the casing 2, radiated noise of the compressor is generated since the casing 2 acts as a noise-radiating surface.

[0035] In the present embodiment, in order to reduce the propagation amount of the vibration in the radial direction of the motor, which causes the above-described radiated noise, when fixing and disposing the electric motor 5 in the casing 2, the configuration is adopted in which only the both-end portions E1 and E2 of the stator 12 of the electric motor 5 are fixedly disposed firmly by being shrink-fit, press-fit, or welded to the circular inner circumferential surface of the cylindrical casing 2, and the intermediate portion M excluding the both-end portions E1 and E2 is provided so as not to be in contact with the casing 2, over the whole area of the intermediate portion M or portions excluding contact portions thereof.

[0036] As a result of adopting such a configuration, the electric motor 5 can be fixedly disposed reliably and firmly by causing the both-end portions E1 and E2 of the stator 12 to be shrink-fit, press-fit, or welded to the circular inner circumferential surface of the cylindrical casing 2. Further, as a result of causing the intermediate portion M of

the stator 12 excluding the both-end portions E1 and E2, not to be in contact with the inner circumferential surface of the casing 2, over the whole area of the intermediate portion M or portions excluding contact portions thereof, the propagation amount of the vibration in the radial direction of the motor caused by the electromagnetic vibrating force, which has increased by the concentrated winding of the coil wire in order to improve the efficiency of the electric motor 5, can be significantly reduced, and as a result, the radiated noise from the casing 2 can be reduced.

[0037] Therefore, not only the noise of the sealed-type electric compressor 1 can be reduced, but also, since the noise reduction can be achieved simply by partially changing the shape of the casing 2, the present invention can be implemented easily and in a low-cost manner, while minimizing an impact on performance and reliability, on a design load, on capital investment, on investment into molds, and the like. Furthermore, since shrink-fitting stress and the like in the intermediate portion of the stator 12 can be alleviated, an efficiency improvement of the motor due to a reduction in core loss can also be expected.

[0038] Further, in the present embodiment, since a non-contact state is obtained by causing sections corresponding to the intermediate portion M of the cylindrical casing 2 to bulge outward in the rib-like shape, excluding sections corresponding to the notched portions 12A formed for the refrigerant passages provided on the outer circumference of the stator, as a result of the bulging portions 32 being provided on the sections 2A corresponding to the intermediate portion M of the stator 12 and being caused to bulge outward in the rib-like shape, the rigidity of the cylindrical casing 2, which acts as a noise-radiating surface, can be increased. Thus, due to the increased rigidity of the casing 2, noise reduction effects of the sealed-type electric compressor 1 can also be expected.

[0039] Particularly, in the present embodiment, since the configuration is adopted in which the means for increasing rigidity, such as the recesses and projections, is applied to the rib-shaped bulging sections (the bulging portions 32) 2A to maintain the non-contact state with respect to the outer circumference of the stator 12, the rigidity of the casing 2 can be further improved by the means for increasing rigidity, such as the recesses and projections, and as a result, the noise of the sealed-type electric compressor 1 can be even further reduced.

[0040] Note that the present invention is not limited to the invention according to the above-described embodiment and can be modified as required without departing from the spirit of the present invention. For example, in the above-described embodiment, although an example has been described in which a multi-cylinder rotary compressor is used as an example of the sealed-type electric compressor 1, the present invention is not limited to this example. It goes without saying that the present invention can also be widely applied to various types of sealed-

type compressors, in which the electric motor 5 is fixedly disposed in the sealed casing 2, including a scroll-type compressor and the like, for example.

[0041] Further, the notched portions 12A formed for the refrigerant passages 30 provided on the outer circumference of the stator 12 are not limited to the portions cut in the D-shape, but may be notches formed in various shapes. Also, the number of the notched portions 12A is also not necessarily limited to six. Further, the shape of the rib-shaped bulging portion 32 may be any shape, as long as the non-contact state is achieved with respect to the motor core shape and the shape is effective in terms of increasing the rigidity of the casing 2.

15 Reference Signs List

[0042]

1	Sealed-type electric compressor
2	Casing
2A	Section corresponding to intermediate portion
5	Electric motor
6	Compressor mechanism
12	Stator
12A	Notched portion formed for refrigerant pas-
30	sage
32	Refrigerant passage
E1, E2	Bulging portion (rib-shaped bulging section)
M	Both-end portions of stator
	Intermediate portion of stator

Claims

1. A sealed-type electric compressor, comprising:
 - an electric motor and a compressor mechanism accommodated in a cylindrical casing, the compressor mechanism being able to be driven by the electric motor, wherein
 - the electric motor is fixedly disposed by each of both-end portions of a stator of the electric motor being shrink-fit, press-fit, or welded to a circular inner circumferential surface of the cylindrical casing, and
 - an intermediate portion excluding the both-end portions is not in contact with the casing over a whole of the intermediate portion or a part of the intermediate portion excluding a contact portion.
2. The sealed-type electric compressor according to claim 1, wherein a section of the casing corresponding to the intermediate portion is formed into a rib-like shape protruding outward so as to be in a non-contact state, apart from a section corresponding to a notched portion formed for a refrigerant passage provided on an outer circumference of the stator.

3. The sealed-type electric compressor according to claim 2, wherein means for increasing rigidity for maintaining the non-contact state with respect to the outer circumference of the stator is provided on the section caused to bulge in the rib-like shape. 5

Amended claims under Art. 19.1 PCT

1. [Currently amended] A sealed-type electric compressor, comprising: 10

an electric motor and a compressor mechanism accommodated in a cylindrical casing, the compressor mechanism being able to be driven by the electric motor, wherein 15

the electric motor is fixedly disposed by each of both-end portions of a stator of the electric motor being shrink-fit, press-fit, or welded to a circular inner circumferential surface of the cylindrical casing, 20

an intermediate portion excluding the both-end portions is not in contact with the casing over a whole of the intermediate portion or a part of the intermediate portion excluding a contact portion, 25

and

a section of the casing corresponding to the intermediate portion is in a non-contact state, as a result of the section being caused to bulge outward in a rib-like shape, apart from a section 30

corresponding to a notched portion formed for a refrigerant passage provided on an outer circumference of the stator.

2. (Canceled) 35

3. [Currently amended] The sealed-type electric compressor according to claim 1, wherein means for increasing rigidity for maintaining the non-contact state with respect to the outer circumference of the stator is provided on the section caused to bulge in the rib-like shape. 40

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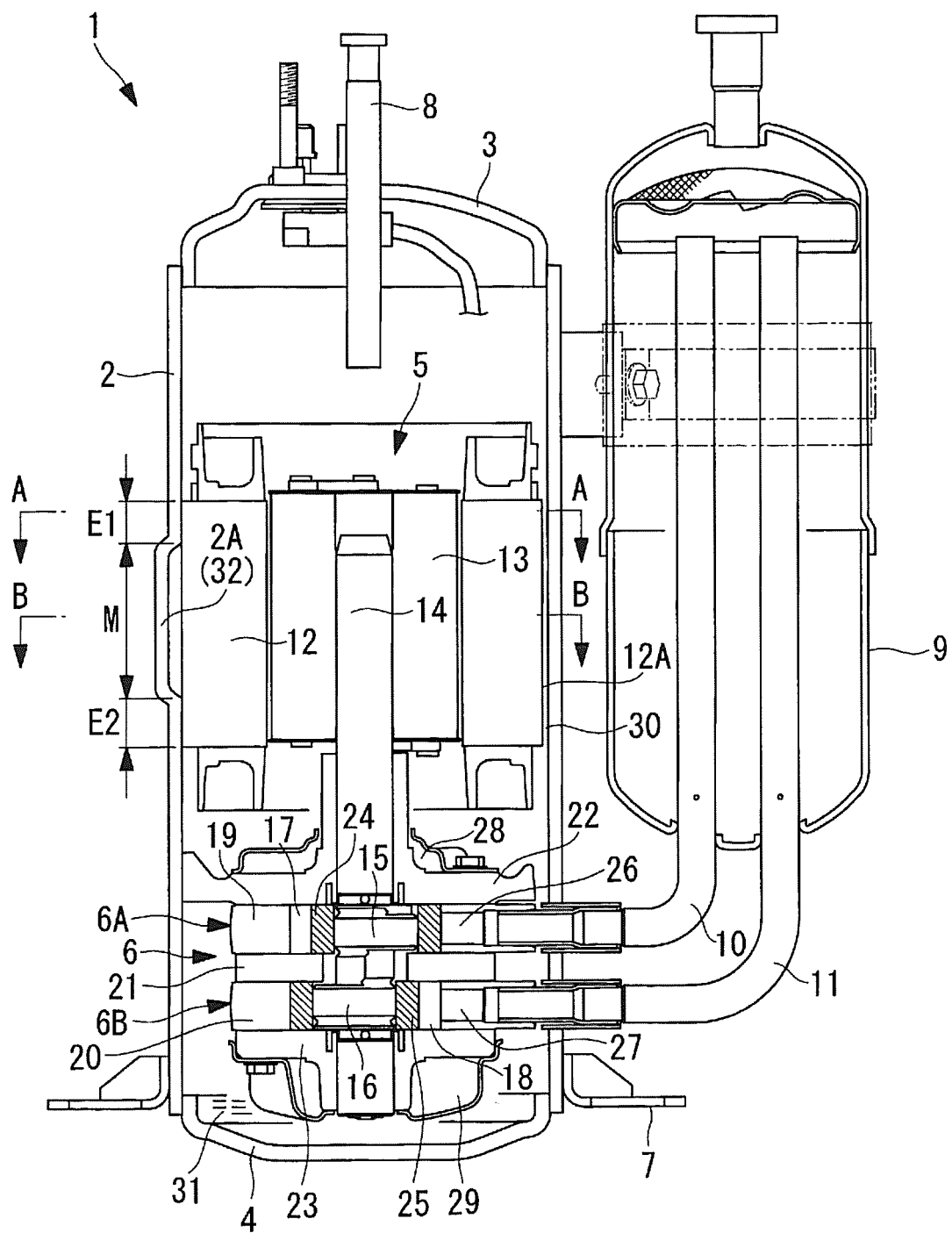


FIG. 1

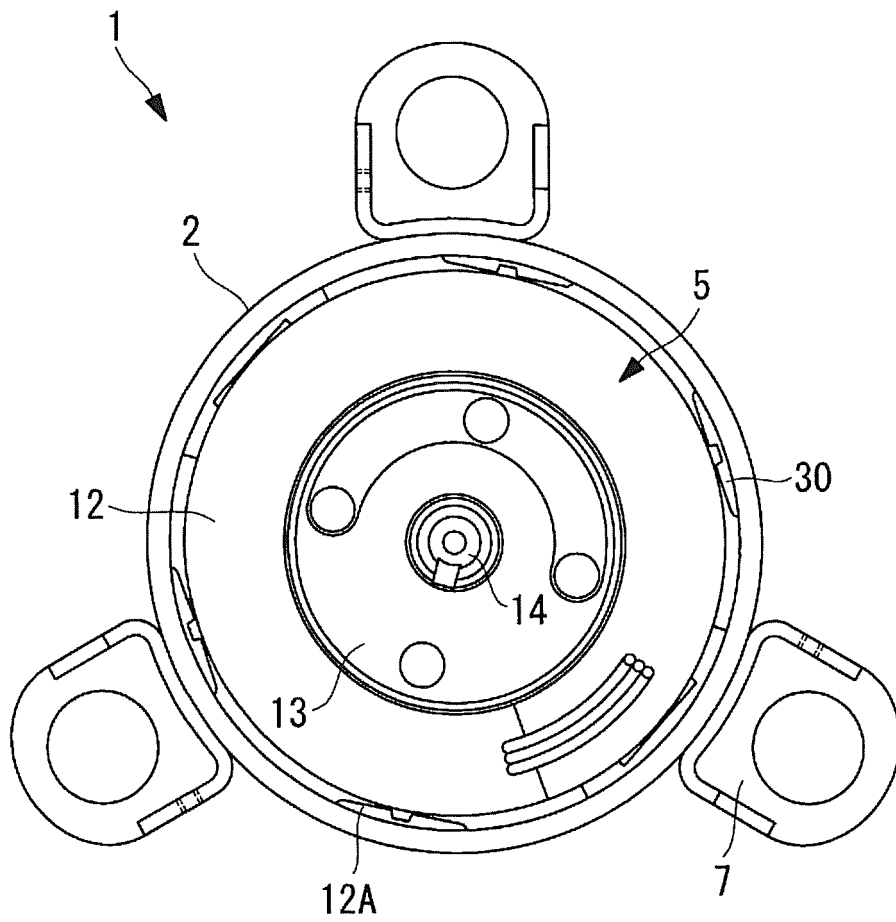


FIG. 2

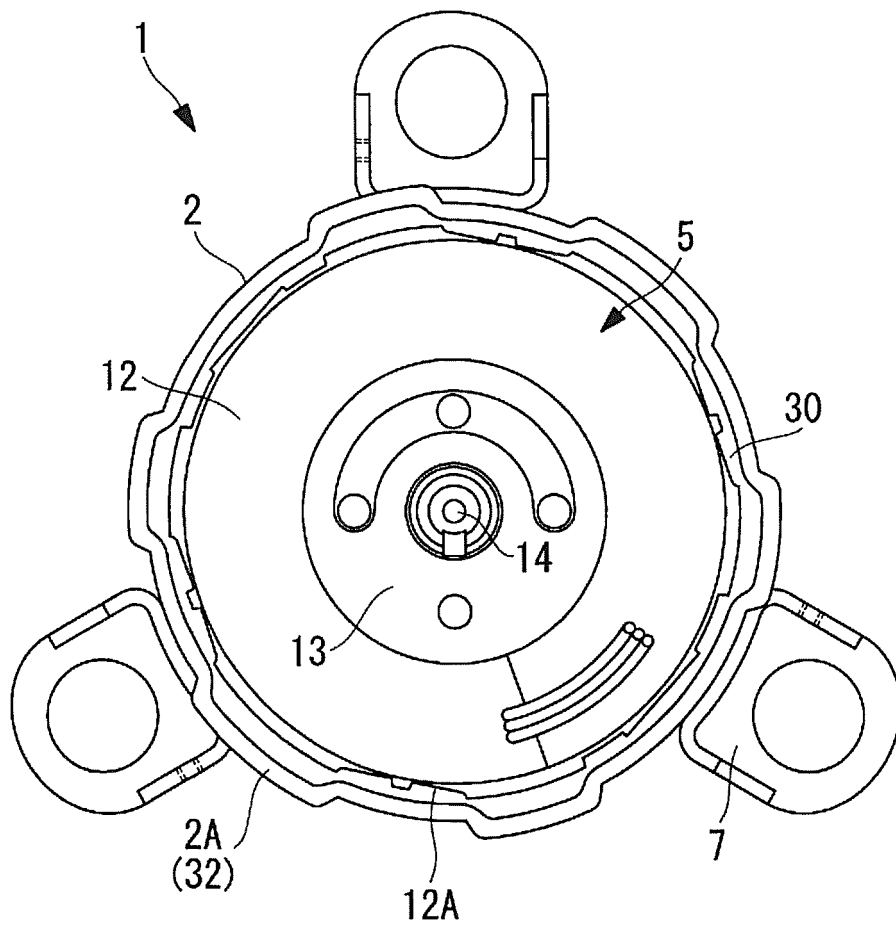


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/072826

A. CLASSIFICATION OF SUBJECT MATTER

F04C23/02(2006.01)i, F04B39/00(2006.01)i, F04B39/12(2006.01)i, F04C29/00(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)

F04C23/02, F04B39/00, F04B39/12, F04C29/00

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 1996-2015
Kokai Jitsuyo Shinan Koho 1971-2015 Toroku Jitsuyo Shinan Koho 1994-2015

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 A	JP 2011-43072 A (Panasonic Corp.), 03 March 2011 (03.03.2011), paragraphs [0016] to [0018]; fig. 1 to 3 (Family: none)	1 2, 3
X A	JP 2011-214464 A (Daikin Industries, Ltd.), 27 October 2011 (27.10.2011), paragraph [0042]; fig. 3 (Family: none)	1 2, 3
A	JP 9-287585 A (Denso Corp.), 04 November 1997 (04.11.1997), fig. 6 (Family: none)	1-3

☒ 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
27 October 2015 (27.10.15)

Date of mailing of the international search report
10 November 2015 (10.11.15)

Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/072826

C (Continuation).	DOCUMENTS CONSIDERED TO BE RELEVANT	
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2-64288 A (Matsushita Refrigeration Co.), 05 March 1990 (05.03.1990), fig. 1 (Family: none)	1-3

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REFERENCES CITED IN THE DESCRIPTION

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