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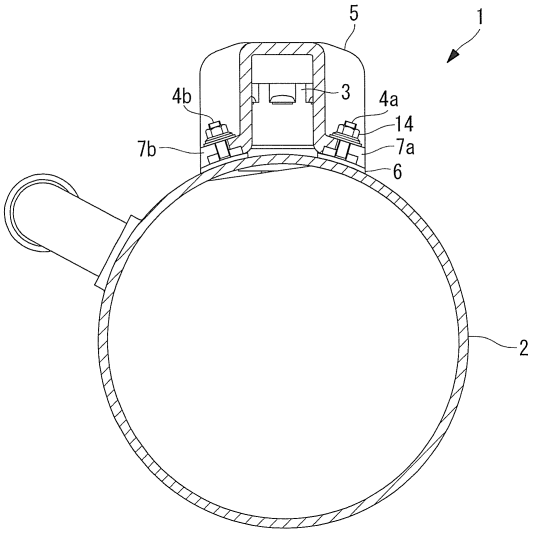
(54) ELECTRIC COMPRESSOR AND METHOD FOR MANUFACTURING ELECTRIC COMPRESSOR

(57) An object is to provide an electric compressor with which the need to process an external surface of a housing can be eliminated, making it possible to reduce time and labor involved in processing, and with which a protection member can easily be mounted to the external surface of the housing, and to provide a manufacturing method of an electric compressor. An electric compressor (1) comprises: a housing (2) having a curved external surface; an electric terminal (3) provided at the external surface of the housing; pin-like bolts (4a and 4b) that protrude from the external surface of the housing in a normal direction of the external surface; and a terminal guard (5) in which apertures (7a and 7b) that correspond to the positions and protruding directions of the bolts are formed, and that surrounds the electric terminal with the bolts being inserted into the apertures.

FIG. 5



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Description

{Technical Field}

[0001] The present invention relates to an electric compressor provided with a compressing section that compresses refrigerant gas and a motor that drives the compressing section, and to a manufacturing method of an electric compressor.

{Background Art}

[0002] In an electric compressor, a compressor and a motor that drives the compressor are accommodated in a metallic housing. By operating the compressor, refrigerant gas in the interior thereof is compressed and discharged. The metallic housing possesses airtightness, and the power for the motor is supplied to the motor from an external power supply part via electric terminals provided at an opening of the housing.

[0003] In order to prevent the electric terminals from being exposed to the exterior, a terminal guard, which is a protection member that surrounds the electric terminals, is provided at the external surface of the housing. Patent Literature 1 discloses an invention related to a terminal protection cover of an electric compressor, which shows a technology useful to omit processing work and to make its manufacturing process easier.

{Citation List}

{Patent Literature}

[0004] {Patent Literature 1} Japanese Examined Utility Model Application, Publication No. S49-23291

{Summary of Invention}

{Technical Problem}

[0005] When installing a terminal guard made of synthetic resin at an external surface of a housing, it is necessary to ensure sealability, such as waterproofing or the like. Therefore, in the related art, a sealing surface where the terminal guard and the external surface of the housing come into contact is formed in a flat shape. Thus, machining, for example, press processing or the like, is performed for forming the flat shape on the housing having a cylindrical shape or a spherical shape.

[0006] In addition, when mounting the terminal guard to the external surface of the housing, the installation direction of the terminal guard is such that the terminal guard is moved and mounted toward the center of the housing (in the normal direction of the external surface of the housing). Accordingly, securing bolts are employed and, in general, the securing bolts are inserted toward the housing from outside the terminal guard. This is why portions of the securing bolts end up penetrating into the interior of the housing.

[0007] In addition, in the case where installation is performed by using the securing bolts, there is no member that can be used to position a sealing member, which is made of rubber or the like and which is to be provided between the terminal guard and the external surface of the housing, with respect to the external surface of the housing. This is why the sealing member is attached to the terminal guard first and is installed on the external surface of the housing together with the terminal guard at the same time. Thus, since the external surface of the housing is wrapped with a noise insulation member made of felt, and since the terminal guard and the sealing member are installed after the noise insulation member is wrapped around the external surface, the noise insulation member may be sandwiched between the sealing member and the external surface of the housing. As a result, it has been difficult to make the sealing member fit inside the external shape of the terminal guard, thus leaving a portion of the sealing member outside the terminal guard.

[0008] The present invention is made in light of the above-described circumstances, and an object thereof is to provide an electric compressor with which the need to process an external surface of a housing can be eliminated, making it possible to reduce the time and labor involved in processing, and with which a protection member can easily be mounted to the external surface of the housing, and to provide a manufacturing method of an electric compressor.

{Solution to Problem}

[0009] An electric compressor according to a first aspect of the present invention comprises: a housing having a curved external surface; an electric terminal provided at the external surface of the housing; a pin-like protrusion that protrudes from the external surface of the housing in a normal direction of the external surface; and a protection member that has an aperture which corresponds to the position and a protruding direction of the protrusion, and that surrounds the electric terminal in a state in which the protrusion is inserted into the aperture.

[0010] With this configuration, the pin-like protrusion is provided so as to protrude in the normal direction of the external surface from the curved external surface of the housing, and the aperture of the protection member is formed in correspondence with the position and the protruding direction of the protrusion. Then, by inserting the protrusion into the aperture of the protection member, the protection member is mounted to the housing and surrounds the electric terminal located at the external surface of the housing. Therefore, because the protection member can be mounted at the portion of the housing to which the protection member is mounted without forming a flat portion at the external surface, leaving the curved surface as it is, time and labor for the processing can be reduced.

[0011] In the first aspect of the present invention, two

of the protrusions may be arranged in the circumferential direction of the external surface, and the aperture corresponding to the two protrusions may be cut out to open in a lateral direction of the protection member.

[0012] With this configuration, because the two protrusions are arranged in the circumferential direction of the external surface of the housing and these protrusions protrude in the normal directions of the curved surface, the two protrusions spread out in an inverted V-shape when viewed in the axial direction of the curved surface. Also, because the aperture of the protection member is cut out in the lateral direction, insertion of the protrusions into the aperture of the protection member is facilitated.

[0013] The first aspect of the present invention may be further provided with a sealing member that is installed between the external surface of the housing and the protection member, wherein the protrusions include two first protrusions arranged in the circumferential direction of the external surface and one second protrusion that is provided at a position apart in an axial direction of the external surface with respect to the first protrusions, and two first apertures are formed in the sealing member so that the first apertures individually correspond to one of the first protrusions and the second protrusion and that the sealing member is supported by the two positions.

[0014] With this configuration, the two first apertures are formed in the sealing member, and the sealing member is supported at two positions by the first protrusion and the second protrusion that are inserted into the first apertures. Accordingly, when mounting the sealing member to the housing, the sealing member is reliably positioned with respect to the external surface of the housing.

[0015] In the first aspect of the present invention, in a case in which a protruding direction of the electric terminal is inclined with respect to a straight portion of a base portion to which the housing is installed, the protection member has an external surface in which a surface is configured to be parallel to the straight portion of the base portion when the protection member is mounted on the housing.

[0016] With this configuration, when the protection member is mounted to the housing, the protection member has the external surface that is parallel to the straight portion of the base portion on which the housing is installed. Accordingly, the straight portion of the base portion and the external surface of the protection member become parallel to each other. Therefore, even in the case in which the protruding direction of the electric terminals is inclined with respect to the straight portion of the base portion, the protection member can appropriately be positioned inside the base portion.

[0017] A manufacturing method of an electric compressor according to a second aspect of the present invention is a manufacturing method of an electric compressor, the electric compressor comprising: a housing; an electric terminal provided at an external surface of the housing; a pin-like protrusion that protrudes from the external surface of the housing; a protection member that has an aperture which corresponds to the position and a protruding direction of the protrusion, and that surrounds the electric terminal in a state in which the protrusion is inserted into the aperture; and a sealing member that is installed between the external surface of the housing and the protection member, the manufacturing method comprising: a step of inserting the protrusion through the sealing member; a step of wrapping a noise insulation member on the external surface of the housing after inserting the protrusion through the sealing member; a step of connecting a cable to the electric terminal of the housing that has been wrapped with the noise insulation member; and a step of mounting the protection member to the external surface of the housing in which the cable is connected to the electric terminal.

[0018] With this configuration, after the sealing member is placed so that the protrusion passes therethrough and is mounted to the external surface of the housing, the external surface of the housing is wrapped with the noise insulation member, and, furthermore, the cable is connected to the electric terminal. The protection member is subsequently mounted to the external surface of the housing. Therefore, because the noise insulation member is installed after the sealing member is positioned, processing work is facilitated at the potion where the sealing member and the noise insulation member come together. Accordingly, because the sealing member can reliably be mounted, mounting of the protection member is also facilitated. With a common compressor, because the sealing member is mounted to the external surface of the housing together with the protection member after the noise insulation member is wrapped on the housing, a portion of the sealing member is left outside the external shape of the protection member, which hinders assembly. However, such a problem is less likely to occur with the aforementioned configuration.

{Advantageous Effects of Invention}

[0019] With the present invention, the need to process an external surface of a housing can be eliminated, making it possible to reduce time and labor involved in processing, and a protection member can easily be mounted to the external surface of the housing.

{Brief Description of Drawings}

[0020]

{Fig. 1} Fig. 1 is a front view showing an electric compressor according to an embodiment of the present invention.

{Fig. 2} Fig. 2 is a perspective view showing an external surface and a terminal guard of the electric compressor according to the embodiment of the present invention.

{Fig. 3} Fig. 3 is a front view showing the electric compressor before mounting the terminal guard ac-

cording to the embodiment of the present invention.
{Fig. 4} Fig. 4 is a perspective view showing an external surface, electric terminals, and a gasket of the electric compressor before mounting the terminal guard according to the embodiment of the present invention.
{Fig. 5} Fig. 5 is a cross-sectional view of the electric compressor taken along the A-A line in Fig. 1.
{Fig. 6} Fig. 6 is a cross-sectional view showing the electric compressor according to the embodiment of the present invention, showing a state before mounting the terminal guard and the gasket.
{Fig. 7} Fig. 7 is a front view showing the terminal guard according to the embodiment of the present invention.
{Fig. 8} Fig. 8 is a back view showing the terminal guard according to the embodiment of the present invention.
{Fig. 9} Fig. 9 is a longitudinal sectional view of the terminal guard taken along the C-C line in Fig. 7.
{Fig. 10} Fig. 10 is a longitudinal sectional view of the terminal guard taken along the B-B line in Fig. 9.
{Fig. 11} Fig. 11 is a longitudinal sectional view of the terminal guard taken along the D-D line in Fig. 9.
{Fig. 12} Fig. 12 is a front view showing the gasket according to the embodiment of the present invention.
{Fig. 13} Fig. 13 is a plan view showing the electric compressor and its base portion according to the embodiment of the present invention.

{Description of Embodiment}

[0021] An embodiment according to the present invention will be described below with reference to the drawings.

[0022] First, the configuration of an electric compressor 1 will be described.

[0023] In an electric compressor 1, a compressor, a motor that drives the compressor, and so forth are accommodated in a metallic housing 2. By operating the compressor, refrigerant gas in the interior thereof is compressed and discharged. The metallic housing 2 possesses airtightness, and the power for the motor is supplied to the motor from a power source located at the exterior of the housing 2 via electric terminals 3 located in an aperture of the housing 2.

[0024] As shown in Figs. 5 and 6, the housing 2 has, for example, a cylindrical shape in the cross section. The axial direction of the cylindrical shape corresponds to the top-to-bottom direction of the electric compressor 1 when the electric compressor 1 is installed.

[0025] As shown in Figs. 4 and 6, the electric terminals 3 protrude outward from the external surface of the housing 2. The protruding direction of the electric terminals 3 is, for example, the radial direction of the cylindrical shape of the housing 2, that is, the normal direction of the external surface of the cylindrical shape. The electric terminals 3 are connected to cables (not shown). The cables supply power from the external power source to the motor of the electric compressor 1.

[0026] As shown in Figs. 1 and 2, the external surface of the housing 2 of the electric compressor 1 is provided with a terminal guard 5, with a gasket 6 interposed therebetween. In addition, in order to install the terminal guard 5, bolts 4a, 4b, and 4c are provided on the external surface of the housing 2.

[0027] The bolts 4a, 4b, and 4c are examples of pin-like protrusions, and protrude outward from the external surface of the housing 2, as shown in Figs. 4 and 5. The bolts 4a, 4b, and 4c are mounted on curved portions without processing the external surface of the housing 2 into a flat shape. The protruding directions of the bolts 4a, 4b, and 4c are, for example, the radial directions of the cylindrical shape of the housing 2, that is, the normal directions of the external surface of the cylindrical shape.

[0028] The terminal guard 5 is an example of a protection member and accommodates the electric terminals 3 in the interior thereof by surrounding the electric terminals 3, as shown in Fig. 5. As shown in Fig. 7, apertures 7a, 7b, and 8, which correspond to the positions and protruding directions of the bolts 4a, 4b, and 4c, are formed in the terminal guard 5. As shown in Figs. 10 and 11, a surface 5A of the terminal guard 5, which faces the housing 2 when the terminal guard 5 is installed on the external surface of the housing 2, matches the shape of the external surface of the housing 2. In this embodiment, the cross-section of the surface 5A of the terminal guard 5 has a circular arc shape that has a common axial center 0 with the housing 2.

[0029] The gasket 6 is an example of a sealing member and is installed between the terminal guard 5 and the external surface of the housing 2, as shown in Figs. 1, 2, and 5. The gasket 6 is made of, for example, rubber, and ensures waterproofing between the terminal guard 5 and the external surface of the housing 2.

[0030] With this embodiment, the pin-like bolts 4a, 4b, and 4c are provided at the external surface of the housing 2 having the cylindrical shape, so as to protrude in the normal directions of the external surface, and the apertures 7a, 7b, and 8 of the terminal guard 5 are formed in correspondence with the positions and protruding directions of the bolts 4a, 4b, and 4c. Thus, the terminal guard 5 is mounted to the housing 2 by inserting the bolts 4a, 4b, and 4c into the apertures 7a, 7b, and 8 of the terminal guard 5, and the electric terminals 3 provided at the external surface of the housing 2 are surrounded by the terminal guard 5 and are accommodated in the terminal guard 3. Since the bolts 4a, 4b, and 4c are mounted to the external surface of the cylindrical shape without any modification of the shape of the external surface, and since a flat portion is not formed at the portion of the external surface of the housing 2 where the terminal guard 5 is mounted and the curved surface thereof is left as it is, and because it is possible to mount the terminal guard 5 in this state, it is possible to reduce the time and

labor for processing.

[0031] Next, the bolts 4a, 4b, and 4c and the terminal guard 5 will be described below.

[0032] The bolt 4a and the bolt 4b are installed on the same circumference line on the external surface of the housing 2. The bolt 4a and the bolt 4b are examples of first protrusions. The bolt 4c is provided away from the bolt 4a and the bolt 4b in the axial direction of the housing 2. The bolt 4c is an example of a second protrusion. In this embodiment, the bolt 4c is installed between the bolt 4a and the bolt 4b in the circumferential direction, and above the bolt 4a and the bolt 4b in the housing 2.

[0033] In the terminal guard 5, the apertures 7a, 7b, and 8 are formed. As shown in Figs. 7 and 8, the apertures 7a and 7b have shapes formed by cutting out the terminal guard 5 to open in the lateral direction. The aperture 8 is provided on the center axis of the terminal guard 5 and has a circular shape. As shown in Figs. 7 to 9, the terminal guard 5 has an open portion at the bottom portion that is opposite from the aperture 8 at the top portion, and the cables connected to the electric terminals 3 are installed so as to pass through this open portion of the terminal guard 5.

[0034] The bolt 4a and the bolt 4b are installed on the same circumference line on the external surface of the housing 2 and protrude in the normal directions of the cylindrical shape. Accordingly, as shown in Figs. 5 and 6, the bolt 4a and the bolt 4b are spread out in an inverted V-shape when viewed in the axial direction of the housing 2. Specifically, the space between the tip of the bolt 4a and the tip of the bolt 4b is greater than the space between the proximal portion of the bolt 4a and the proximal portion of the bolt 4b.

[0035] When mounting the terminal guard 5 to the external surface of the housing 2, the installation direction of the terminal guard 5 is such that the terminal guard 5 is moved and mounted toward the center of the housing 2 (in the normal direction of the external surface of the housing 2). Accordingly, it is not possible to mount the terminal guard 5 if the apertures 7a and 7b of the terminal guard 5 have, for example, a perfectly circular shape. In this embodiment, because the apertures 7a and 7b of the terminal guard 5 are cut out to open in the lateral direction, insertion of the bolts 4a and 4b into the apertures 7a and 7b of the terminal guard 5 is facilitated. Note that the apertures 7a and 7b may have elongated circular shapes that are elongated in the lateral direction.

[0036] Next, the gasket 6 will be described.

[0037] As shown in Fig. 12, apertures 11a, 11b, 12, and 13 are formed in the gasket 6. The aperture 11a corresponds to the bolt 4a, and which is cut out to open in the lateral direction. Accordingly, as with the terminal guard 5, the gasket 6 can be mounted to the bolt 4a and the bolt 4b installed to extend in the normal directions of the external surface of the housing 2. Specifically, because the aperture 11a is cut out to open in the lateral direction, insertion of the gasket 6 at the external surface of the housing 2 is facilitated.

[0038] The aperture 11b corresponds to the bolt 4b and has a circular shape. The aperture 12 corresponds to the bolt 4c, and which is cut out to open to the aperture 13. The aperture 13 has a circular shape that surrounds the electric terminals 3. The aperture 11b and the aperture 12 are examples of first apertures.

[0039] With the gasket 6, when mounting the gasket 6 to the external surface of the housing 2, first, the bolt 4b is inserted into the aperture 11b and the aperture 12 is hooked on the bolt 4c. By doing so, because the gasket 6 is supported at two points by the bolt 4b and the bolt 4c, the gasket 6 is reliably positioned with respect to the external surface of the housing 2. Accordingly, in the subsequent steps, for example, in a step of wrapping the external surface of the housing 2 with a noise insulation member (not shown), the work is facilitated at a portion where the noise insulation member and the gasket 6 come together.

[0040] Next, the external shape of the terminal guard 5 will be described with reference to Fig. 13 and so forth.

[0041] Here, as shown in Fig. 13, a leg portion 2A of the housing 2 of the electric compressor 1 is installed on the base portion 10. Also, in the case in which a protruding direction E of the electric terminals 3 is not orthogonal to a straight portion L of the base portion 10 but is inclined with respect to the straight portion L, an external surface 5B of the terminal guard 5 is a surface that is parallel to the straight portion L of the base portion 10 when the terminal guard 5 is mounted to the housing 2.

[0042] With this embodiment, when the terminal guard 5 is mounted to the housing 2, the straight portion L of the base portion 10 and the external surface 5B of the terminal guard 5 become parallel to each other. Therefore, even in the case in which the protruding direction E of the electric terminals 3 is not perpendicular to the straight portion L of the base portion 10 but is inclined with the straight portion L, the terminal guard 5 can appropriately be contained with respect to the base portion 10.

[0043] Next, a method of mounting the terminal guard 5 on the electric compressor 1 will be described.

[0044] First, as shown in Figs. 3 and 4, the gasket 6 is placed so that the bolts 4a, 4b, and 4c pass therethrough. Subsequently, the external surface of the housing 2 is wrapped with the noise insulation member (not shown). The noise insulation member is made of, for example, felt. Then, cables (not shown) are connected to the electric terminals 3 of the housing 2 that has been wrapped with the noise insulation member. Next, as shown in Figs. 1 and 5, the terminal guard 5 is mounted to the external surface of the housing 2 in which the cables have been connected to the electric terminals 3. The terminal guard 5 is secured by using nuts fitted to the bolts 4a, 4b, and 4c.

[0045] With this embodiment, after the gasket 6 is placed so that the bolts 4a, 4b, and 4c pass therethrough and is mounted on the external surface of the housing 2, the external surface of the housing 2 is wrapped with the noise insulation member, and, furthermore, the cables

are connected to the electric terminals 3. The terminal guard 5 is subsequently mounted to the external surface of the housing 2. Therefore, because the noise insulation member is installed after the gasket 6 is positioned, processing work can be facilitated at the portion where the gasket 6 and the noise insulation member come together. Accordingly, because the gasket 6 can reliably be mounted, mounting of the terminal guard 5 is also facilitated. With a common technique, because the gasket is mounted to the external surface of the housing together with the terminal guard after the noise insulation member is wrapped on the housing, a portion of the gasket may be left outside the external shape of the terminal guard, which hinders assembly. However, such a problem is less likely to occur with the aforementioned embodiment.

[0046] Note that this mounting method is not limited to the terminal guard 5 and the external surface of the housing 2 of this embodiment described above. For example, mounting in the same manner is possible even in the case in which, at a portion to which the terminal guard is mounted, the external surface of the housing is formed in a flat shape with bolts protruding from the external surface of the housing, as in a common compressor. Thus, in this case also, the same operational advantages as this mounting method are afforded.

{Reference Signs List}

[0047]

1 electric compressor
2 housing
3 electric terminal
4a, 4b, 4c bolt (protrusion)
5 terminal guard (protection member)
6 gasket (sealing member)
7a, 7b, 8, 11a, 11b, 12, 13 aperture
10 base portion
14 nut

Claims

1. An electric compressor comprising:

a housing having a curved external surface;
an electric terminal provided at the external surface of the housing;
a pin-like protrusion that protrudes from the external surface of the housing in a normal direction of the external surface; and
a protection member that has an aperture which corresponds to the position and a protruding direction of the protrusion, and that surrounds the electric terminal in a state in which the protrusion is inserted into the aperture.

2. The electric compressor according to Claim 1, wherein two of the protrusions are arranged in a circumferential direction of the external surface, and the aperture corresponding to the two protrusions is cut out to open in a lateral direction of the protection member.

3. The electric compressor according to Claim 1 or 2, further comprising:

a sealing member that is installed between the external surface of the housing and the protection member,
wherein the protrusions include two first protrusions arranged in the circumferential direction of the external surface and one second protrusion that is provided at a position apart in an axial direction of the external surface with respect to the first protrusions, and
two first apertures are formed in the sealing member so that the first apertures individually correspond to one of the first protrusions and the second protrusion and that the sealing member is supported by the two positions.

4. The electric compressor according to any one of Claims 1 to 3, wherein, in a case in which a protruding direction of the electric terminal is inclined with respect to a straight portion of a base portion to which the housing is installed, the protection member has an external surface in which a surface is configured to be parallel to the straight portion of the base portion when the protection member is mounted on the housing.

5. A manufacturing method of an electric compressor, the electric compressor comprising: a housing; an electric terminal provided at an external surface of the housing; a pin-like protrusion that protrudes from the external surface of the housing; a protection member that has an aperture which corresponds to the position and a protruding direction of the protrusion, and that surrounds the electric terminal in a state in which the protrusion is inserted into the aperture; and a sealing member that is installed between the external surface of the housing and the protection member, the manufacturing method comprising:

a step of inserting the protrusion through the sealing member;
a step of wrapping a noise insulation member on the external surface of the housing after inserting the protrusion through the sealing member;
a step of connecting a cable to the electric terminal of the housing that has been wrapped with the noise insulation member; and

a step of mounting the protection member to the external surface of the housing in which the cable is connected to the electric terminal.

Amended claims under Art. 19.1 PCT

1. An electric compressor comprising:

a housing having a curved external surface;
an electric terminal provided at the external surface of the housing;
a pin-like protrusion that protrudes from the external surface of the housing in a normal direction of the external surface; and
a protection member that has an aperture which corresponds to the position and a protruding direction of the protrusion, and that surrounds the electric terminal in a state in which the protrusion is inserted into the aperture,
wherein two of the protrusions are arranged in a circumferential direction of the external surface, and
the aperture corresponding to the two protrusions are cut out to open in a lateral direction of the protection member.

3. The electric compressor according to Claim 1, further comprising:

a sealing member that is installed between the external surface of the housing and the protection member,
wherein the protrusions include two first protrusions arranged in the circumferential direction of the external surface and one second protrusion that is provided at a position apart in an axial direction of the external surface with respect to the first protrusions, and
two first apertures are formed in the sealing member so that the first apertures individually correspond to one of the first protrusions and the second protrusion and that the sealing member is supported by the two positions.

4. The electric compressor according to Claim 1 or 3, wherein, in a case in which a protruding direction of the electric terminal is inclined with respect to a straight portion of a base portion to which the housing is installed, the protection member has an external surface in which a surface is configured to be parallel to the straight portion of the base portion when the protection member is mounted on the housing.

5. A manufacturing method of an electric compressor, the electric compressor comprising: a housing; an electric terminal provided at an external surface of the housing; a pin-like protrusion that protrudes from the external surface of the housing; a protection member that has an aperture which corresponds to the position and a protruding direction of the protrusion, and that surrounds the electric terminal in a state in which the protrusion is inserted into the aperture; and a sealing member that is installed between the external surface of the housing and the protection member, the manufacturing method comprising:

a step of inserting the protrusion through the sealing member;
a step of wrapping a noise insulation member on the external surface of the housing after inserting the protrusion through the sealing member;
a step of connecting a cable to the electric terminal of the housing that has been wrapped with the noise insulation member; and
a step of mounting the protection member to the external surface of the housing in which the cable is connected to the electric terminal.

FIG. 1

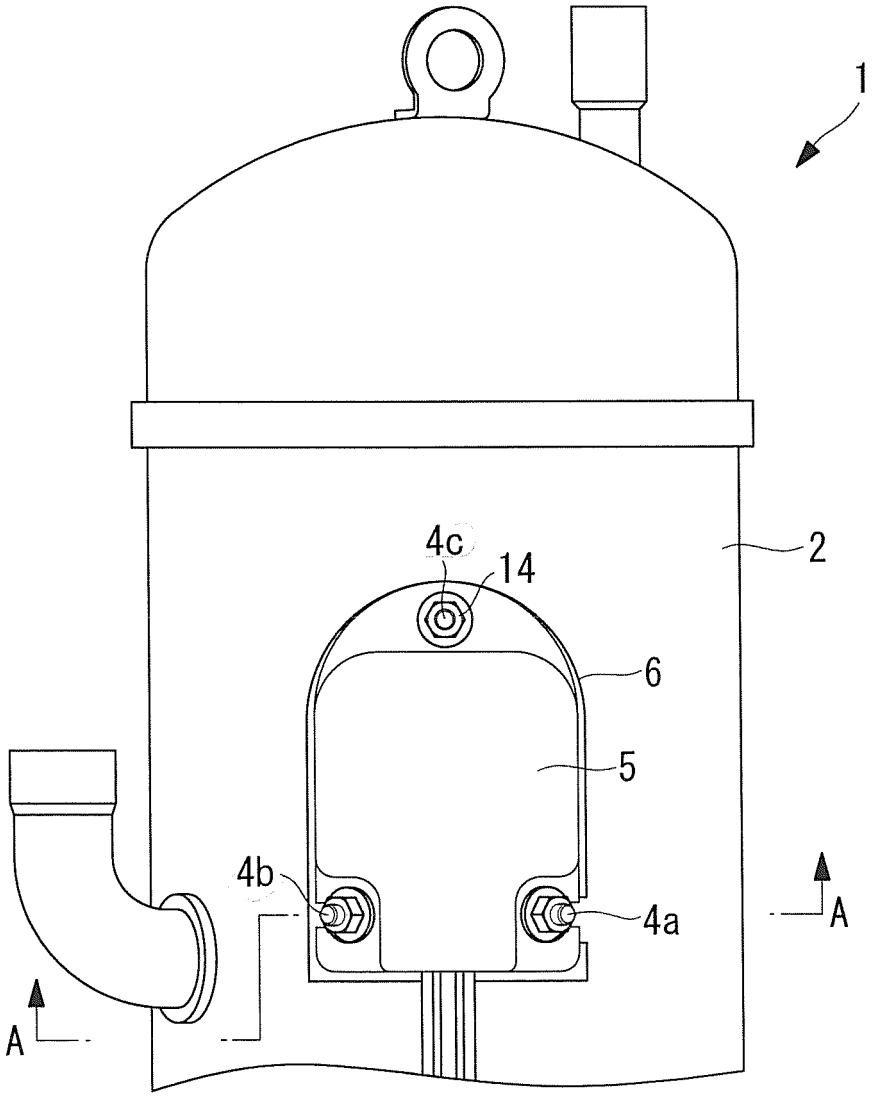


FIG. 2

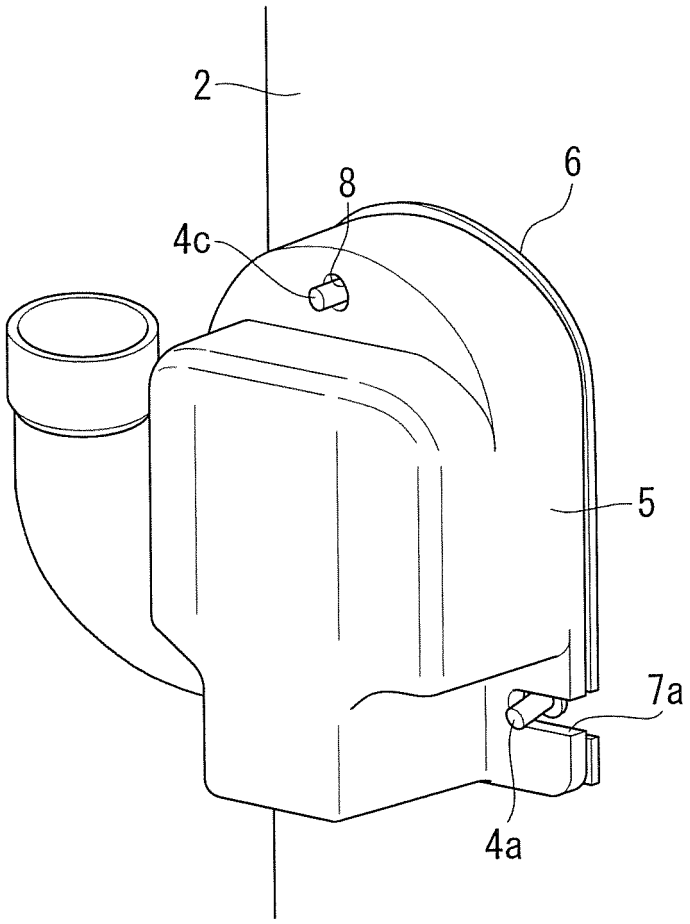


FIG. 3

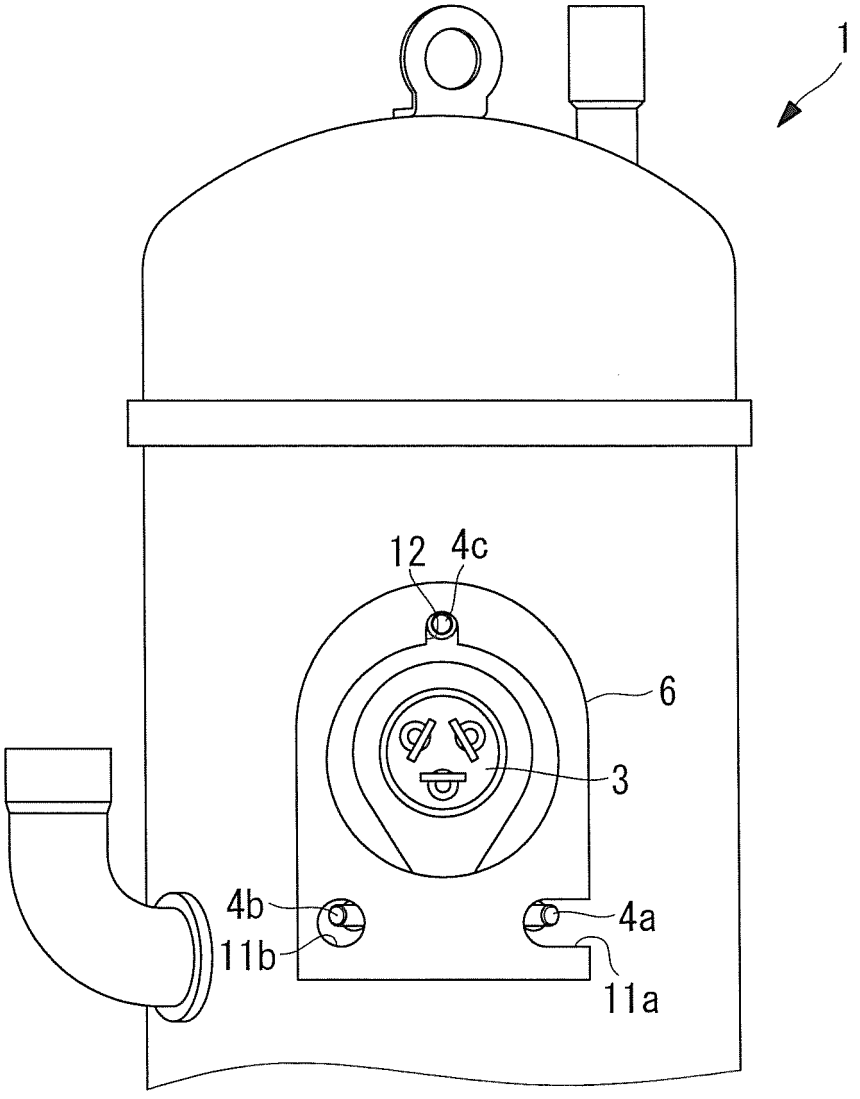


FIG. 4

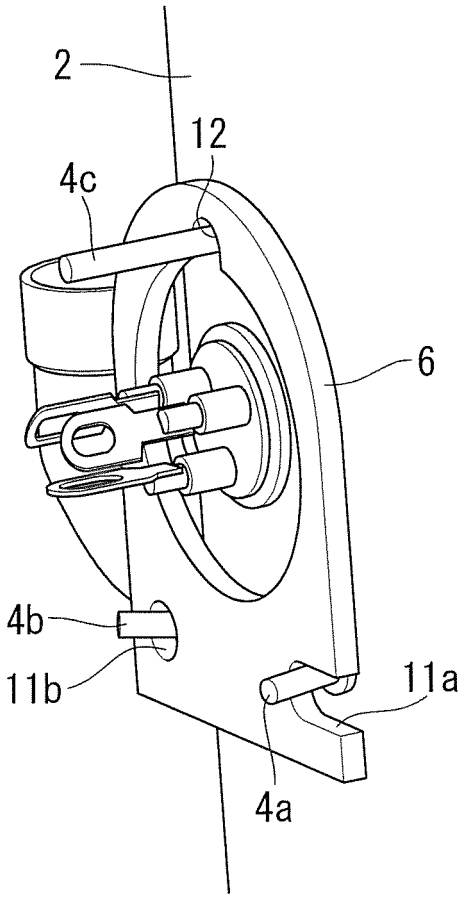


FIG. 5

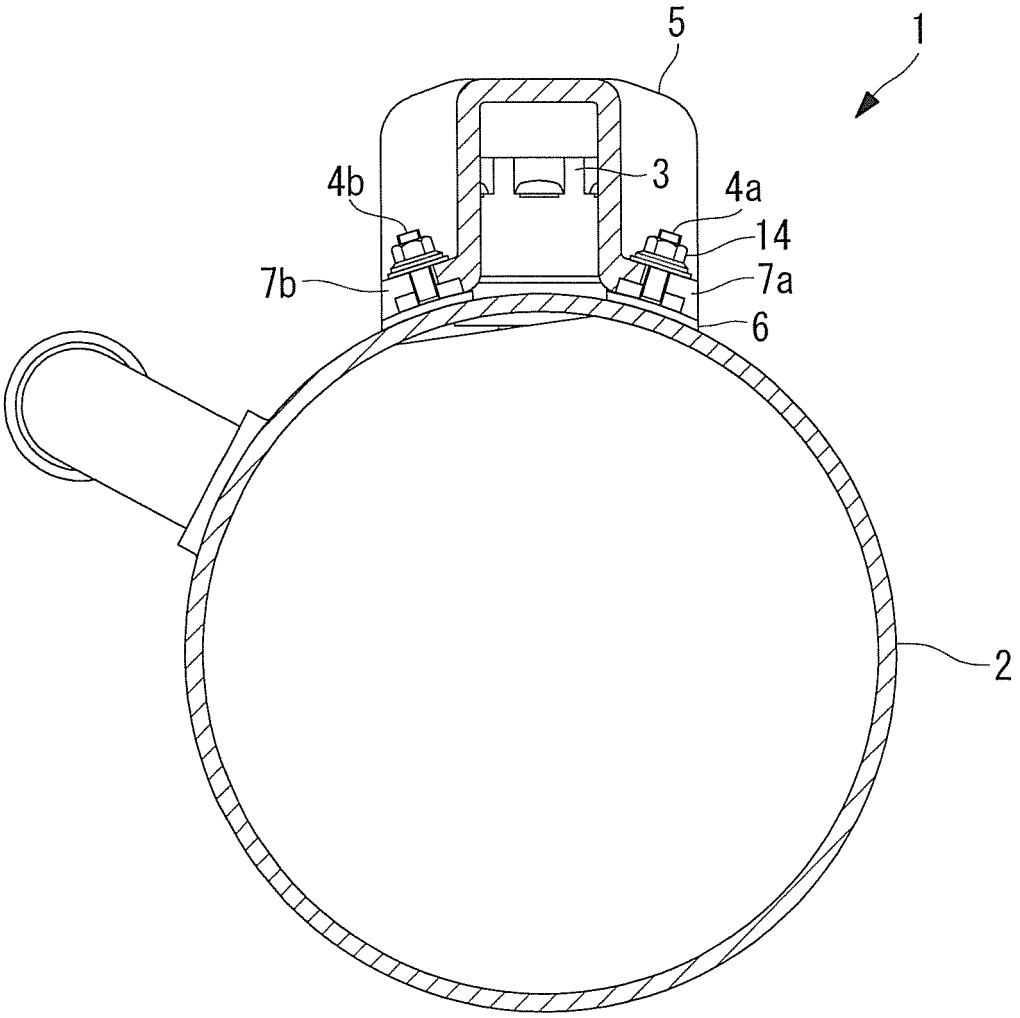


FIG. 6

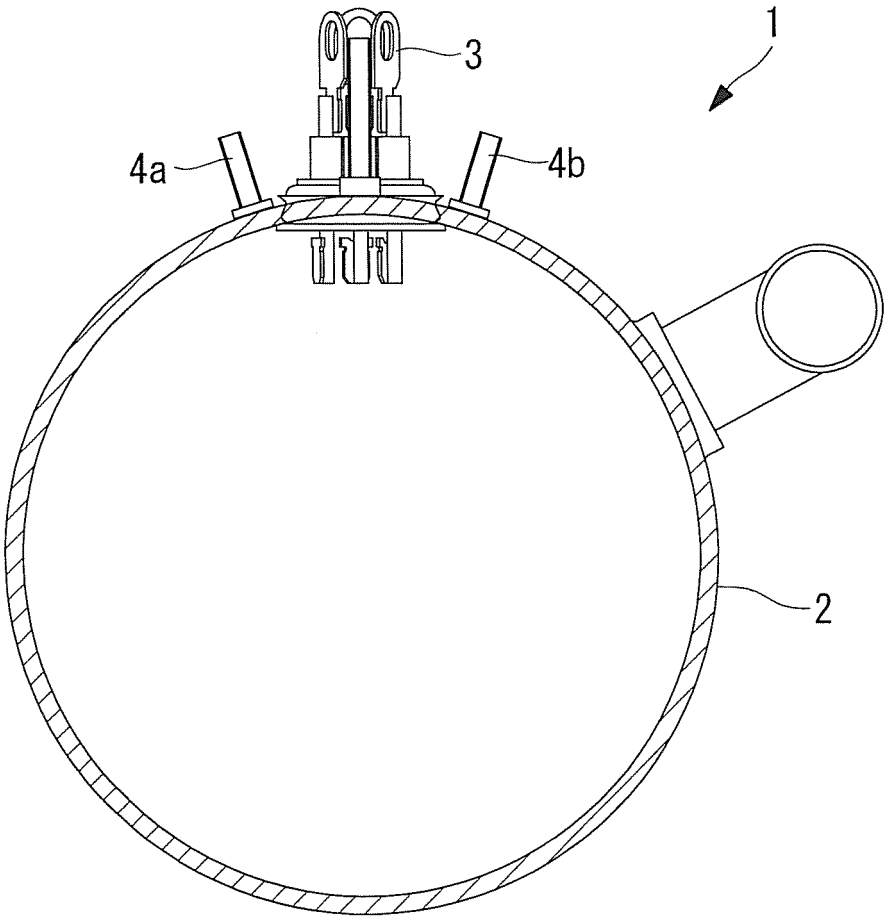


FIG. 7

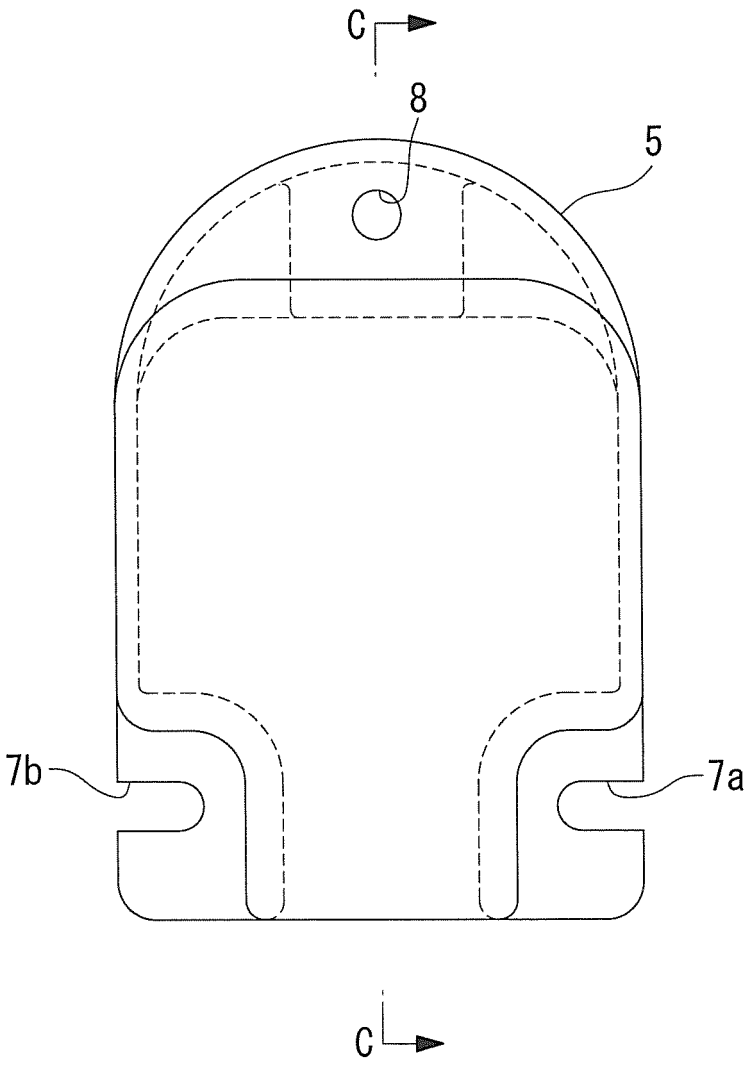


FIG. 8

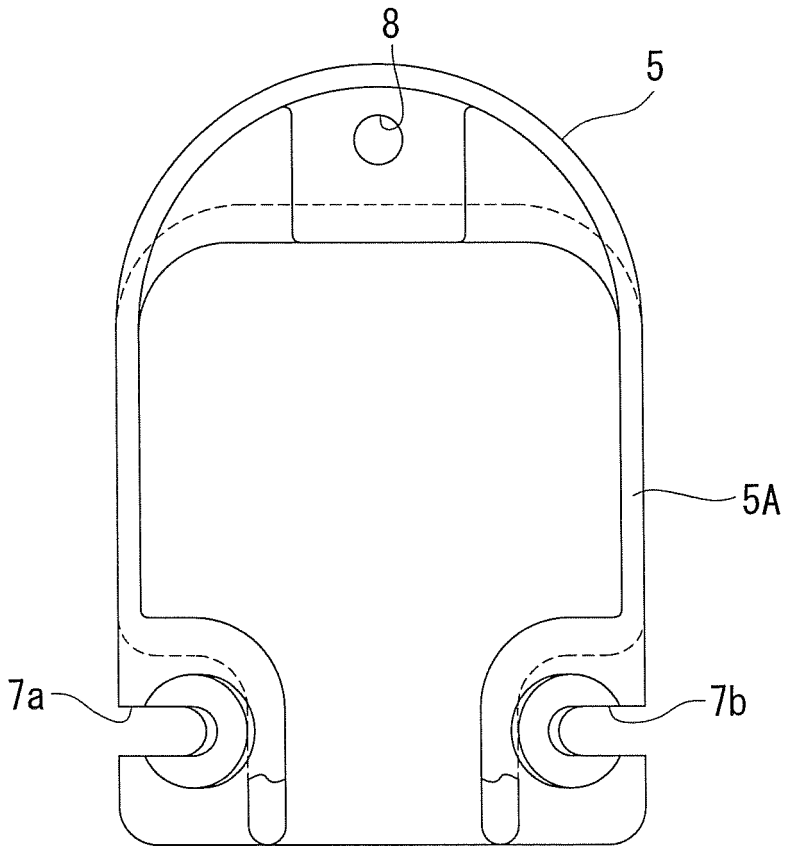


FIG. 9

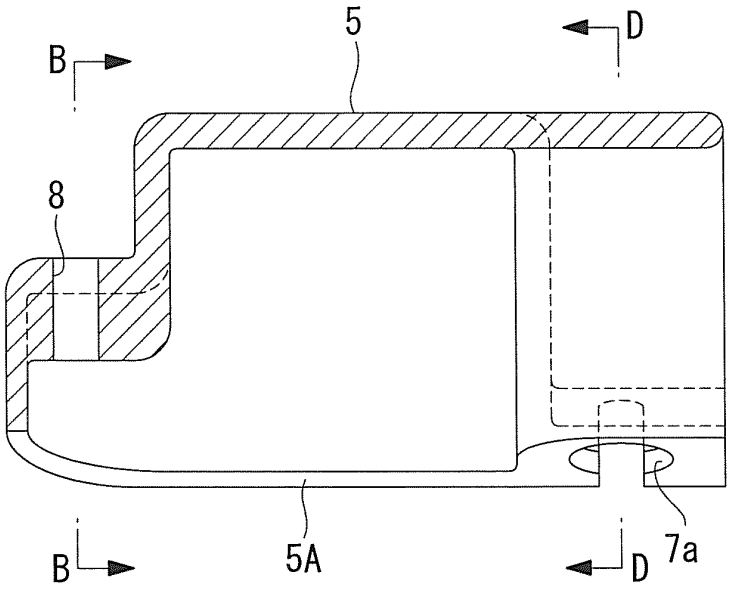


FIG. 10

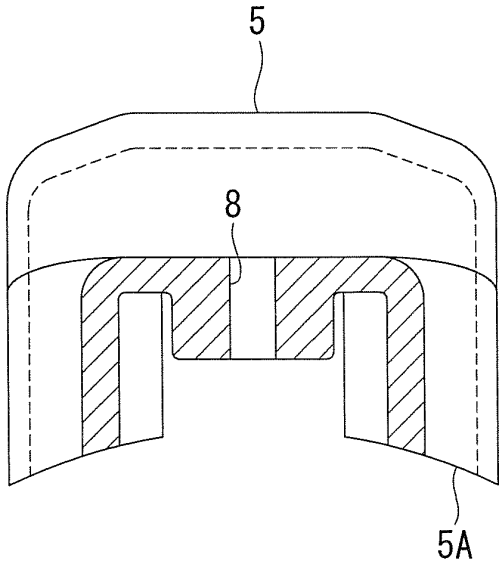


FIG. 11

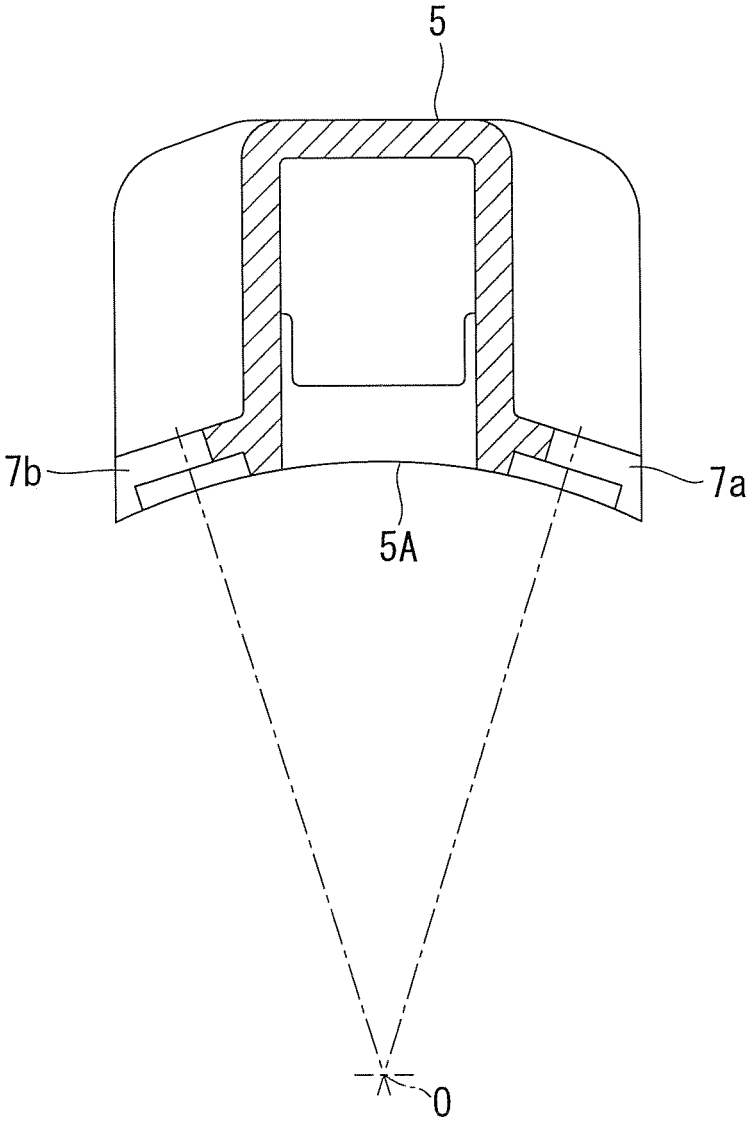


FIG. 12

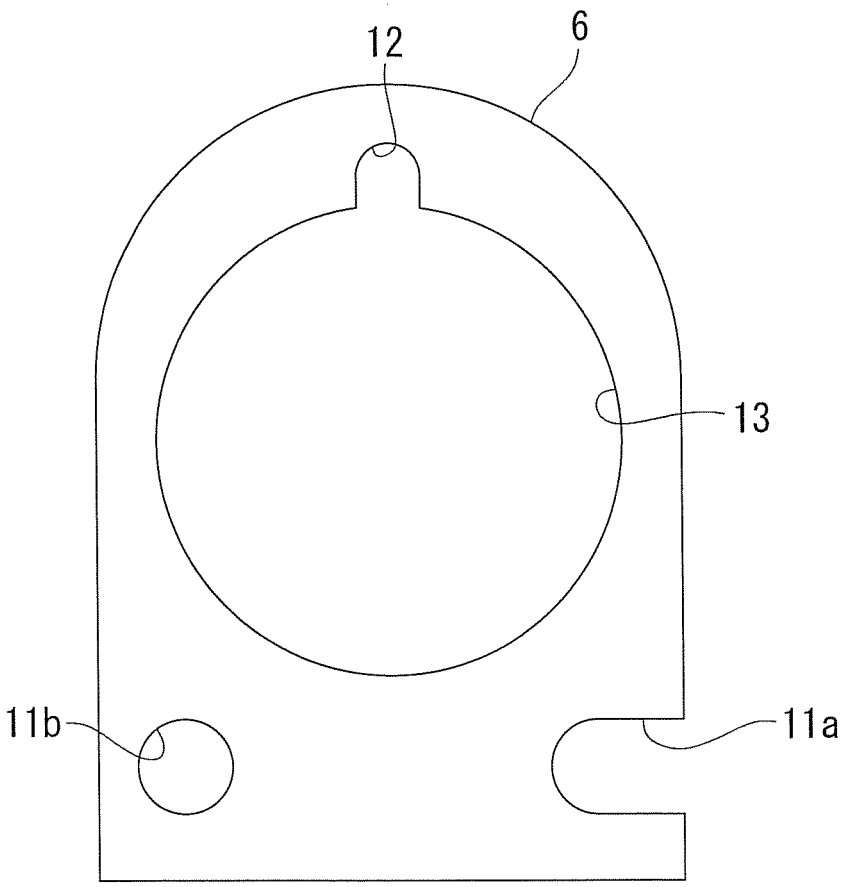
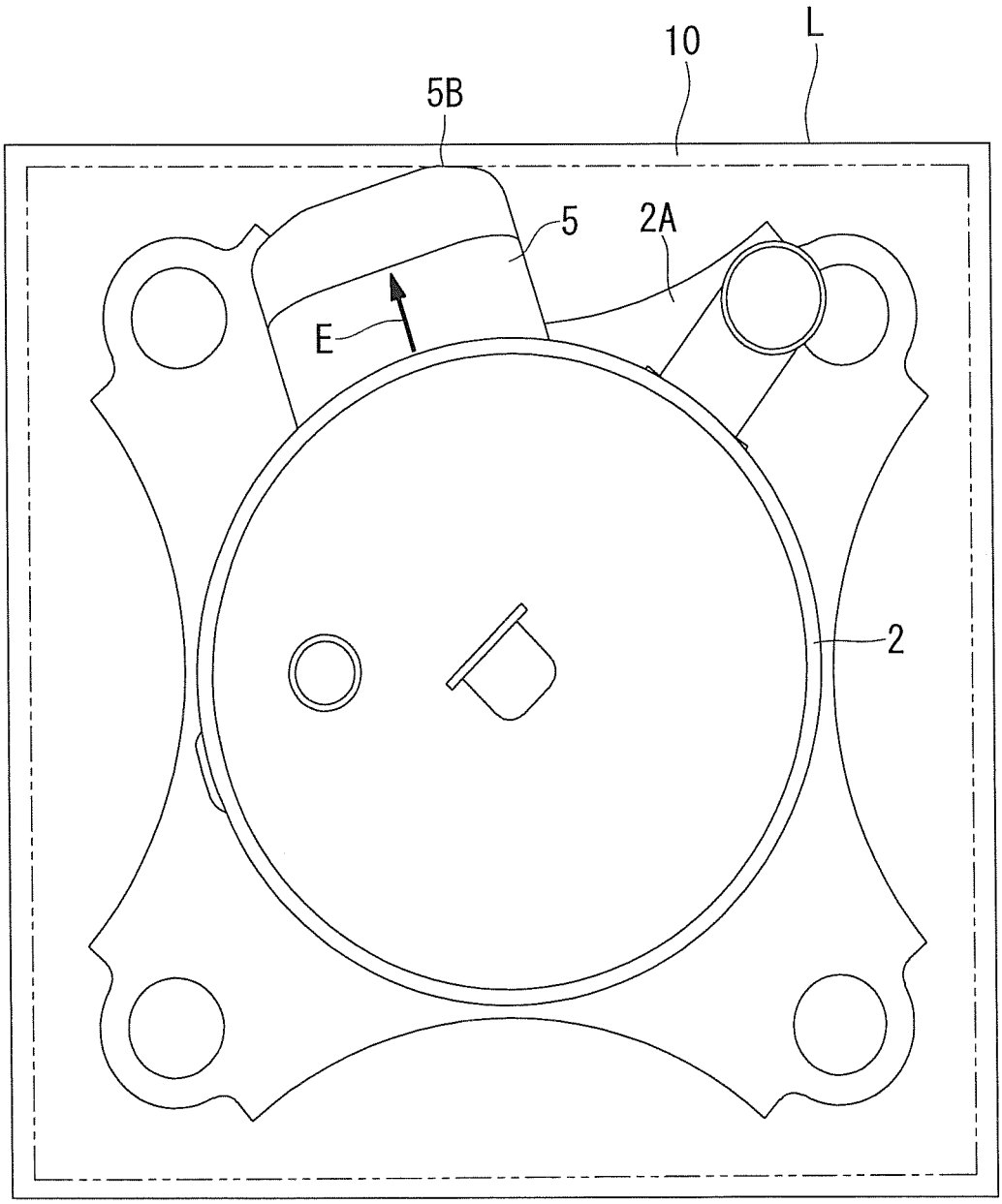


FIG. 13



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/050253

A. CLASSIFICATION OF SUBJECT MATTER
F04B39/00(2006.01)i, *F04B39/14*(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)
F04B39/00, F04B39/14

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 1996-2013
Kokai Jitsuyo Shinan Koho 1971-2013 Toroku Jitsuyo Shinan Koho 1994-2013

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 3727459 B2 (Toshiba Carrier Corp.), 14 December 2005 (14.12.2005), paragraphs [0011] to [0013]; fig. 7 (Family: none)	1 2-5
A	JP 9-158835 A (Toshiba Corp.), 17 June 1997 (17.06.1997), entire text; all drawings (Family: none)	2-5
A	JP 1-159476 A (Mitsubishi Electric Corp.), 22 June 1989 (22.06.1989), entire text; all drawings (Family: none)	5

☐ 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
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"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
08 April, 2013 (08.04.13)	16 April, 2013 (16.04.13)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/050253

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

The invention of claim 1 is relevant to the invention which has already been known before filing of the present application in the light of JP 3727459 B2 (paragraphs [0011] to [0013], fig. 7), and therefore, the invention of claim 1 cannot be considered to be novel and does not have a special technical feature.

Consequently, the following two inventions (invention groups) are involved in claims.

Meanwhile, the invention of claim 1 having no special technical feature is classified into invention 1.

(Continued to extra sheet)

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/050253

Continuation of Box No.III of continuation of first sheet(2)

(Invention 1) Claims 1 to 4: An electric compressor having an invention-defining matter defined in claim 2.

(Invention 2) Claim 5: A method of manufacturing an electric compressor having an invention-defining matter defined in claim 5.

Form PCT/ISA/210 (extra sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP S4923291 B **[0004]**