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(71) Applicant: **MITSUBISHI HEAVY INDUSTRIES, LTD.**
Tokyo 108-8215 (JP)

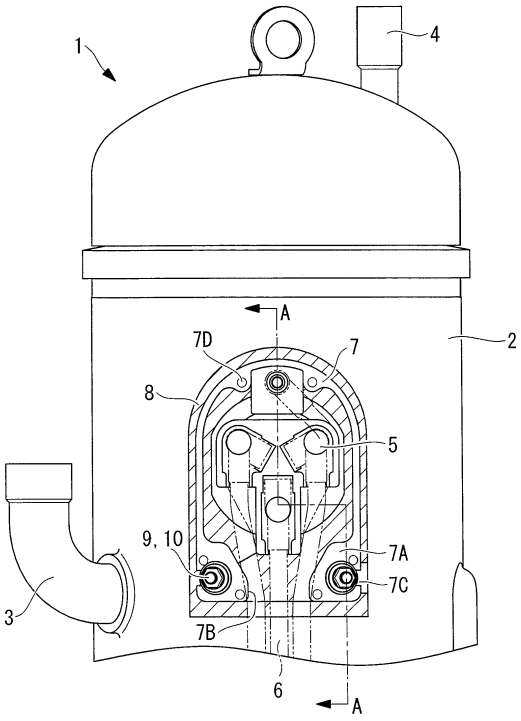
(72) Inventors:
- **Takasu, Yogo**
  Tokyo, 108-8215 (JP)
- **Yamaoka, Hiroki**
  Tokyo, 108-8215 (JP)
- **Kimata, Yoshiyuki**
  Tokyo, 108-8215 (JP)

(74) Representative: **Intès, Didier Gérard André et al**
Cabinet Beau de Loménie
158, rue de l'Université
75340 Paris Cedex 07 (FR)

(54) Hermetic electric compressor

(57) An object is to provide a hermetic electric compressor capable of preventing a sealing material from being crushed so as to reliably secure sealing performance even if a pressing force is large and its tolerance is wide, and also capable of preventing a tightening torque from being insufficient and a terminal cover from loosening. In a hermetic electric compressor (1) in which a terminal cover (7) protecting a terminal (5) passing through a hermetic housing (2) is tightened and fixed at a plurality of positions by a nut (10) to a bolt (9) provided on a side of the hermetic housing (2) with a sealing material (8) interposed therebetween, a pair of protruded portions (7D) regulating a compression allowance of the sealing material (8) are provided corresponding to each bolt (9) at symmetrical positions on a straight line passing through substantially the center of each bolt (9) on an inner peripheral sealing surface (7A) of the terminal cover (7) contacting and pressing the sealing material (8).

FIG. 2



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Description

{Technical Field}

[0001] The present invention relates to a hermetic electric compressor having a terminal cover for protecting a terminal supplying power to a motor inside a hermetic housing.

{Background Art}

[0002] The hermetic electric compressor is configured such that a terminal for supplying power to a coil of a motor housed and installed inside a hermetic housing is provided so as to pass through the hermetic housing; and so as not to allow the terminal to be exposed to water or the like, a terminal cover covering the outside of the terminal is tightened and fixed to an outer surface of the hermetic housing by welding bolts, nuts, and the like with a sealing material such as a gasket interposed therebetween.

[0003] In order to secure waterproof property, the terminal cover is tightened and fixed with a sealing material interposed therebetween in the above manner, but the compression range for an external force is large depending on the sealing material. Thus, the terminal cover has a problem that it is difficult to manage a pressing force by a nut tightening torque such that a sealing material is crushed and the sealing performance is degraded, while for fear of this, nuts may be loosened because of an insufficient tightening torque or a reduced reaction force due to aged deterioration of the sealing material.

[0004] Patent Literature 1 discloses a terminal cover including a bending portion bending downward in an L-shape extending over an edge portion of a gasket in a portion near a tightening bolt of a pressing edge portion of the terminal cover, in which the bending portion is set to have a predetermined length longer than the thickness of the gasket, and the difference between a pressing force near the tightening bolt and a pressing force far from the tightening bolt is reduced by a pressing force received by the bending portion when the terminal cover is tightened and fixed, thereby allowing uniformity of a pressing force applied to the entire pressing edge portion.

{Citation List}

{Patent Literature}

{PTL 1}

[0005] Japanese Unexamined Patent Application, Publication No. Hei 11-141485

{Summary of Invention}

{Technical Problem}

[0006] Unfortunately, according to the terminal cover disclosed in Patent Literature 1, a sealing material always can be pressed to a constant thickness in a portion including a bending portion near a tightening bolt, but in order to uniformize pressing forces applied to an entire pressing edge portion, the length L of the bending portion needs to be longer by a predetermined length δ than the thickness t of a gasket in a pressed state. Specifically, the length needs to be set so as to reduce the difference between a pressing force near the tightening bolt and a pressing force far from the tightening bolt by adding an actual pressing force based on the conditions such as the magnitude of an entire pressing force due to nut tightening, the gasket material, and the compressor temperature.

[0007] Specifically, if the length δ is too large, the pressing force f3 of the bending portion becomes too large and the pressing force f1 near the tightening bolt becomes small. Conversely, if the length δ is too small, the pressing force f3 of the bending portion is not sufficiently large and the pressing force f1 near the tightening bolt does not become sufficiently small. Thus, the terminal cover disclosed in Patent Literature 1 has a problem in that it is difficult to uniformize the pressing forces and adjust the length of the bending portion. In addition, the terminal cover also has a problem in that there are many constraint conditions such as the need to arrange the sealing material so as not to be pinched by the bending portion.

[0008] In view of this, the present invention has been made, and an object of the present invention is to provide a hermetic electric compressor capable of preventing a sealing material from being crushed so as to reliably secure sealing performance even if a pressing force is large and its tolerance is wide, and also capable of preventing a tightening torque from being insufficient and a terminal cover from loosening.

{Solution to Problem}

[0009] In order to solve the above problems, the hermetic electric compressor according to the present invention adopts the following solutions.

Specifically, the hermetic electric compressor according to the present invention is such that in the hermetic electric compressor in which a terminal cover protecting a terminal passing through a hermetic housing is tightened and fixed by a nut to a bolt provided at a plurality of positions on a side of the hermetic housing with a sealing material interposed therebetween, a pair of protruded portions regulating a compression allowance of the sealing material are provided corresponding to the each bolt at symmetrical positions on a straight line passing through substantially the center of the each bolt on an inner peripheral sealing surface of the terminal cover con-

tacting and pressing the sealing material.

[0010] According to the present invention, in the hermetic electric compressor in which a terminal cover is tightened and fixed by a nut to a bolt provided at a plurality of positions on a side of the hermetic housing with a sealing material interposed therebetween, a pair of protruded portions regulating a compression allowance of the sealing material are provided corresponding to each bolt at symmetrical positions on a straight line passing through substantially the center of each bolt on an inner peripheral sealing surface of the terminal cover contacting and pressing the sealing material. Thus, when the terminal cover is tightened and fixed by a bolt and a nut, even if the nut is tightened and fixed with a specified tightening torque into a state in which the front end of the protruded portion provided on an inner peripheral sealing surface thereof is press-contacted to an outer surface of the hermetic housing by crushing the sealing material into a state in which it cannot be crushed any further, the sealing material can be interposed between an inner peripheral sealing surface of the terminal cover and an outer peripheral surface of the hermetic housing by compressing the sealing material by a constant compression allowance. Thus, even if a pressing force for tightening and fixing the terminal cover is large and its tolerance is wide, the sealing material can be interposed in a state capable of preventing the sealing material from being excessively crushed and sufficiently securing the sealing performance. In addition, the terminal cover can be easily mounted by reliably preventing a tightening torque from being insufficient and also preventing a terminal cover from loosening.

[0011] Further, the hermetic electric compressor of the present invention is such that in the hermetic electric compressor, the bolts at the plurality of positions are provided at three positions: a top portion position of the terminal cover formed in an arc shape and both left and right side positions on a bottom side along a peripheral direction of the hermetic housing, and the protruded portions are provided in pairs corresponding to the bolts at three positions at symmetrical positions on a straight line passing through substantially the center of each bolt.

[0012] According to the present invention, the bolts at the plurality of positions are provided at three positions: a top portion position of the terminal cover formed in an arc shape and both left and right side positions on a bottom side along a peripheral direction of the hermetic housing, and the protruded portions are provided in pairs corresponding to the bolts at three positions at symmetrical positions on a straight line passing through substantially the center of each bolt. This configuration makes it possible to tighten and fix the terminal cover at each vertex position of a triangle on an outer peripheral surface of the hermetic housing by bolts and nuts with a specified torque, to crush the sealing material at a pair of protruded portions each provided at symmetrical positions on a straight line passing through substantially the center of each bolt at each fixing position, to compress the sealing material by a constant compression allowance, and thereby to interpose the sealing material between an inner peripheral sealing surface of the terminal cover and an outer peripheral surface of the hermetic housing. Thus, the terminal can be protected by tightening and fixing the terminal cover at three positions with a specified torque while reliably securing sealing performance by the sealing material and mounting the terminal cover so as not to be loosened.

[0013] Further, the hermetic electric compressor of the present invention is such that in the hermetic electric compressor, a pair of the protruded portions provided at both left and right side positions on a bottom side of the terminal cover are provided at symmetrical positions on an inclined straight line passing through substantially the center of the bolt.

[0014] According to the present invention, a pair of protruded portions provided at both left and right side positions on a bottom side of the terminal cover are provided at symmetrical positions on an inclined straight line passing through substantially the center of the bolt. Thus, when each pair of protruded portions is provided at both left and right side positions on a bottom side of the terminal cover, the protruded portions are provided on an inclined straight line passing through substantially the center of the bolt. Thereby, the protruded portions can be provided without expanding the inner peripheral sealing surface. This eliminates the need to change the shape of the terminal cover, and thus the terminal cover can be mounted simply by providing protruded portions on an inner peripheral sealing surface thereof.

[0015] Further, the hermetic electric compressor of the present invention is such that in any one of the hermetic electric compressors, the protruded portion has a protrusion height equivalent to 10% to 30% of the thickness of the sealing material before compression.

[0016] According to the present invention, the protruded portion has a protrusion height equivalent to 10% to 30% of the thickness of the sealing material before compression. Thus, in the case of a relatively soft sponge-like or rubber-like sealing material, the terminal cover is tightened and fixed by crushing the sealing material at each protruded portion into a state in which it cannot be crushed any further and compressing the sealing material to a thickness about 10% to 30% of the thickness on the inner peripheral sealing surface. This configuration makes it possible to reliably hold the sealing material within an elastic deformation region and to secure the sealing performance without excessively crushing the sealing material while tightening and fixing the terminal cover with a specified torque, thus facilitating the management of the tightening torque and the compression allowance when the terminal cover is tightened and fixed.

{Advantageous Effects of Invention}

[0017] According to the present invention, when the terminal cover is tightened and fixed by a bolt and a nut,

even if the nut is tightened and fixed with a specified tightening torque into a state in which the front end of the protruded portion provided on an inner peripheral sealing surface thereof is press-contacted to an outer surface of the hermetic housing by crushing the sealing material into a state in which it cannot be crushed any further, the sealing material can be interposed between an inner peripheral sealing surface of the terminal cover and an outer peripheral surface of the hermetic housing by compressing the sealing material by a constant compression allowance. Thus, even if a pressing force for tightening and fixing the terminal cover is large and its tolerance is wide, the sealing material can be interposed in a state capable of preventing the sealing material from being excessively crushed and sufficiently securing the sealing performance. In addition, the terminal cover can be easily mounted by reliably preventing a tightening torque from being insufficient and also preventing a terminal cover from loosening.

{Brief Description of Drawings}

[0018]

{Fig. 1}
Fig. 1 is a front view of a terminal cover mounting portion of a hermetic electric compressor according to an embodiment of the present invention.
{Fig. 2}
Fig. 2 is an explanatory drawing of a terminal cover mounting state illustrated in Fig. 1.
{Fig. 3}
Fig. 3 is a sectional view along line A-A of Fig. 2.
{Fig. 4}
Fig. 4 is a partially enlarged view of a portion tightened and fixed by a bolt and a nut on a bottom right side of the terminal cover illustrated in Fig. 2.
{Fig. 5}
Fig. 5 is a sectional view along line B-B of Fig. 4.

{Description of Embodiments}

[0019] Hereinafter, with reference to Figs 1 to 5, an embodiment of the present invention will be described. Fig. 1 is a front view of a terminal cover mounting portion of a hermetic electric compressor according to an embodiment of the present invention. Fig. 2 is an explanatory drawing of the terminal cover mounting state. Fig. 3 is a sectional view along line A-A of Fig. 2.
The hermetic electric compressor 1 includes a hermetic housing 2 made of a steel plate, sealed by welding, and formed in a cylindrical shape. The interior of the hermetic housing 2 includes a compressor and a motor which are housed and installed in a state of being connected to each other via a drive shaft so that the compressor is driven by rotation of the motor.
[0020] The hermetic housing 2 includes a suction pipe 3 provided so as to pass through the housing 2 for sucking a low-pressure refrigerant gas; a discharge pipe 4 for discharging a compressed high-pressure refrigerant gas to outside; and a terminal 5 for supplying power to a motor therein. The terminal 5 connects to a power line 6 from an inverter device and the like. So as to cover the outside thereof, a terminal cover 7 having a waterproof property and made of resin is tightened and fixed by a bolt 9 and a nut 10 with a sealing material 8 interposed therebetween.
[0021] The terminal cover 7 is a member for protecting the terminal 5 and a connection portion between the terminal 5 and the power line 6. The terminal cover 7 is a vessel-like member having an opening surface on a side contacting an outer surface of the hermetic housing 2 and including an inner peripheral sealing surface 7A on a peripheral edge thereof. The inner peripheral sealing surface 7A is illustrated in Fig. 2. The terminal cover 7 is configured such that an upper portion thereof is formed in an arc shape and an opening 7B for passing through the power line 6 is provided on a side surface of the bottom side. The inner peripheral sealing surface 7A has an arc surface along an outer surface of the hermetic housing 2.
[0022] The sealing material 8 is made of sponge or rubber for making the interior of the terminal cover 7 waterproof and sealed by compressing the thickness of about 5 mm before compression to the thickness of 10% to 30% (0.5 mm to 1.5 mm) and then interposing the sealing material 8 between an outer surface of the hermetic housing 2 and an inner peripheral sealing surface 7A of the terminal cover 7. As illustrated in Fig. 2, the planar shape of the sealing material 8 is a little larger than the planar shape of the terminal cover 7. Accordingly, when the terminal cover 7 is tightened and fixed, the peripheral edge portion extends from an outer periphery of the terminal cover 7. Note that the center portion of the sealing material 8 is punched so as to allow the terminal 5 to pass therethrough.
[0023] The bolt 9 for tightening and fixing the terminal cover 7 is configured as a welding bolt provided by welding on an outer surface of the hermetic housing 2. The bolts 9 are provided at upper and lower three positions on the outer surface of the hermetic housing 2. Specifically, the three positions are each vertex position of a triangle corresponding to an arc-shaped top portion of the terminal cover 7 and both left and right sides of the bottom side thereof. Each bolt 9 is installed in a radial direction of the cylindrical shape of the hermetic housing 2, namely, in a normal direction of the cylindrical shaped outer surface thereof.
[0024] A bolt-through-hole or a notch 7C passing through each bolt 9 is provided at a position corresponding to each bolt 9 provided at upper and lower three positions of the terminal cover 7. Thus, the configuration is made such that the terminal cover 7 can be tightened and fixed to the outer surface of the hermetic housing 2 with the sealing material 8 interposed therebetween by passing each bolt 9 through the bolt-through-hole or the

notch 7C and then tightening the nut 10 with a specified torque.

[0025] Further, according to the present embodiment, as illustrated in Figs. 4 and 5, a pair of protruded portions 7D for regulating the compression allowance of the sealing material 8 are provided corresponding to each bolt 9 at symmetrical positions on a straight line passing through substantially the center of each bolt 9 on an inner peripheral sealing surface 7A of the terminal cover 7. The protrusion height H of the protruded portion 7D is a height allowing the sealing material 8 to be compressed to a thickness t1 corresponding to about 10% to 30% of the thickness before compression, namely, a height dimension corresponding to 10% to 30% of the thickness before the sealing material 8 is compressed.

[0026] In other words, according to the present embodiment, the thickness of the sealing material 8 before compression is 5 mm and thus the protrusion height H of the protruded portion 7D is a height of 0.5 to 1.5 mm corresponding to 10% to 30% thereof. Thereby, the sealing material 8 is compressed to a thickness of about 10% to 30% of the thickness before compression, namely, a thickness t1 from 0.5 to 1.5 mm, and the sealing material 8 is interposed between the outer surface of the hermetic housing 2 and the inner peripheral sealing surface 7A of the terminal cover 7. In addition, the thickness t2 of a portion where the sealing material 8 is crushed by the protruded portion 7D when the terminal cover 7 is tightened and fixed is about 0.1 to 0.2 mm when the nut 10 is tightened with a specified torque.

Note that in Fig. 5, H, t1, and t2 are exaggerated for clarity of illustration.

[0027] In addition, the pair of protruded portions 7D provided on an inner peripheral sealing surface 7A corresponding to the bolt 9 for tightening and fixing both left and right sides of the bottom side of the terminal cover 7 is configured to be placed at symmetrical positions on a vertically inclined straight line passing through the center of the bolt 9. The configuration allows the protruded portion 7D to be installed without expanding the inner peripheral sealing surface 7A.

[0028] As described above, the configuration according to the present embodiment exerts the following effects.

The hermetic electric compressor 1 can protect the terminal 5 by covering the outside of the terminal 5 passing through the hermetic housing 2 with the terminal cover 7. The terminal cover 7 is configured to be tightened and fixed to the outer surface of the hermetic housing 2 by the bolt 9 and the nut 10 with the sealing material 8 interposed therebetween, and thus the waterproof property of the terminal 5 can be secured as well.

[0029] In addition, when the terminal cover 7 is tightened and fixed to the outer surface of the hermetic housing 2 by the bolt 9 and the nut 10, a pair of protruded portions 7D for regulating the compression allowance of the sealing material 8 are provided corresponding to each bolt 9 at symmetrical positions on a straight line passing through substantially the center of each bolt 9 on an inner peripheral sealing surface 7A of the terminal cover 7 contacting and pressing the sealing material 8. Thus, when the terminal cover 7 is tightened and fixed by the bolt 9 and the nut 10, even if the nut 10 is tightened and fixed with a specified tightening torque into a state in which the front end of the protruded portion 7D provided on an inner peripheral sealing surface 7A is press-contacted to an outer surface of the hermetic housing 2 by crushing the sealing material 8 into a state in which it cannot be crushed any further, the sealing material 8 can be interposed between an inner peripheral sealing surface 7A of the terminal cover 7 and an outer peripheral surface of the hermetic housing 2 by compressing the sealing material 8 by a constant compression allowance.

[0030] Thus, even if a pressing force for tightening and fixing the terminal cover 7 is large and its tolerance is wide, the sealing material 8 can be interposed in a state capable of preventing the sealing material 8 from being excessively crushed and sufficiently securing the sealing performance. In addition, the terminal cover 7 can be easily mounted by reliably preventing a tightening torque from being insufficient and also preventing a terminal cover 7 from loosening.

[0031] Further, the bolts 9 at a plurality of positions are provided at three positions: a top portion position of the terminal cover 7 formed in an arc shape and both left and right side positions on a bottom side along a peripheral direction of the hermetic housing 2, and the protruded portions 7D provided on an inner peripheral sealing surface 7A of the terminal cover 7 are provided in pairs corresponding to the bolts 9 at three positions at symmetrical positions on a straight line passing through substantially the center of each bolt 9.

[0032] This configuration makes it possible to tighten and fix the terminal cover 7 on an outer peripheral surface of the hermetic housing 2 at each vertex position of a triangle by bolts 9 and nuts 10 with a specified torque, to crush the sealing material 8 at a pair of protruded portions 7D each provided at symmetrical positions on a straight line passing through substantially the center of each bolt 9 at each fixing position, to compress the sealing material 8 by a constant compression allowance, and thereby to interpose the sealing material 8 between the inner peripheral sealing surface 7A of the terminal cover 7 and the outer peripheral surface of the hermetic housing 2. Thus, the terminal 5 can be protected by tightening and fixing the terminal cover 7 at three positions with a specified torque while reliably securing sealing performance by the sealing material 8 and mounting the terminal cover 7 so as not to be loosened.

[0033] In addition, the present embodiment is configured such that each pair of protruded portions 7D provided at both left and right side positions on a bottom side of the terminal cover 7 are provided at symmetrical positions on an inclined straight line passing through substantially the center of the bolt 9. Thus, when each pair of protruded portions 7D is provided at both left and right

side positions on a bottom side of the terminal cover 7, the protruded portions 7D are provided on an inclined straight line passing through substantially the center of the bolt 9. Thereby, the protruded portions 7D can be provided without expanding the inner peripheral sealing surface 7A. This eliminates the need to change the shape of the terminal cover 7, and thus the terminal cover 7 can be mounted simply by providing protruded portions 7D on the inner peripheral sealing surface 7A.

[0034] Further, the protruded portion 7D has a protrusion height H equivalent to 10% to 30% of the thickness of the sealing material 8 before compression. Thus, in the case of a relatively soft sponge-like or rubber-like sealing material 8, the terminal cover 7 is tightened and fixed by crushing the sealing material 8 at each protruded portion 7D into a state in which it cannot be crushed any further and compressing the sealing material 8 to a thickness about 10% to 30% of the thickness on the inner peripheral sealing surface 7A. This configuration makes it possible to reliably hold the sealing material 8 within an elastic deformation region and to secure the sealing performance without excessively crushing the sealing material 8 while tightening and fixing the terminal cover 7 with a specified torque, thus facilitating the management of the tightening torque and the compression allowance when the terminal cover 7 is tightened and fixed.

[0035] It should be noted that the present invention is not limited to the aforementioned embodiment, but appropriate modifications can be made to the present invention without departing from the spirit and scope of the present invention. For example, according to the aforementioned embodiment, the terminal cover 7 is tightened and fixed at three positions by bolts 9 and nuts 10, but may be tightened and fixed at four or more positions and the terminal cover 7 itself may be appropriately changed in shape.

Further, the embodiment describes an example in which the terminal 5 and the terminal cover 7 are provided on an outer surface of a side portion of the cylindrical-shaped hermetic housing 2, but the present invention is not limited to this example. It is to be understood that the terminal 5 and the terminal cover 7 may be provided on an outer surface on a top portion side thereof.

{Reference Signs List}

[0036]

1	hermetic electric compressor
2	hermetic housing
5	terminal
7	terminal cover
7A	inner peripheral sealing surface
7D	protruded portion
8	sealing material
9	bolt
10	nut

(continued)

H	protrusion height of protruded portion

Claims

1. A hermetic electric compressor (1) in which a terminal cover (7) protecting a terminal (5) passing through a hermetic housing (2) is tightened and fixed by a nut (10) to a bolt (9) provided at a plurality of positions on a side of the hermetic housing (2) with a sealing material (8) interposed therebetween, wherein
a pair of protruded portions (7D) regulating a compression allowance of the sealing material (8) are provided corresponding to the each bolt (9) at symmetrical positions on a straight line passing through substantially the center of the each bolt on an inner peripheral sealing surface (7A) of the terminal cover (7) contacting and pressing the sealing material (8).

2. The hermetic electric compressor (1) according to claim 1, wherein the bolts (9) at the plurality of positions are provided at three positions: a top portion position of the terminal cover formed in an arc shape and both left and right side positions on a bottom side along a peripheral direction of the hermetic housing (2), and the protruded portions (7D) are provided in pairs corresponding to the bolts (9) at three positions at symmetrical positions on a straight line passing through substantially the center of each bolt.

3. The hermetic electric compressor (1) according to claim 2,
wherein a pair of the protruded portions (7D) provided at both left and right side positions on a bottom side of the terminal cover are provided at symmetrical positions on an inclined straight line passing through substantially the center of the bolt (9).

4. The hermetic electric compressor (1) according to any one of claims 1 to 3, wherein the protruded portion (7D) has a protrusion height equivalent to 10% to 30% of the thickness of the sealing material (8) before compression.

FIG. 1

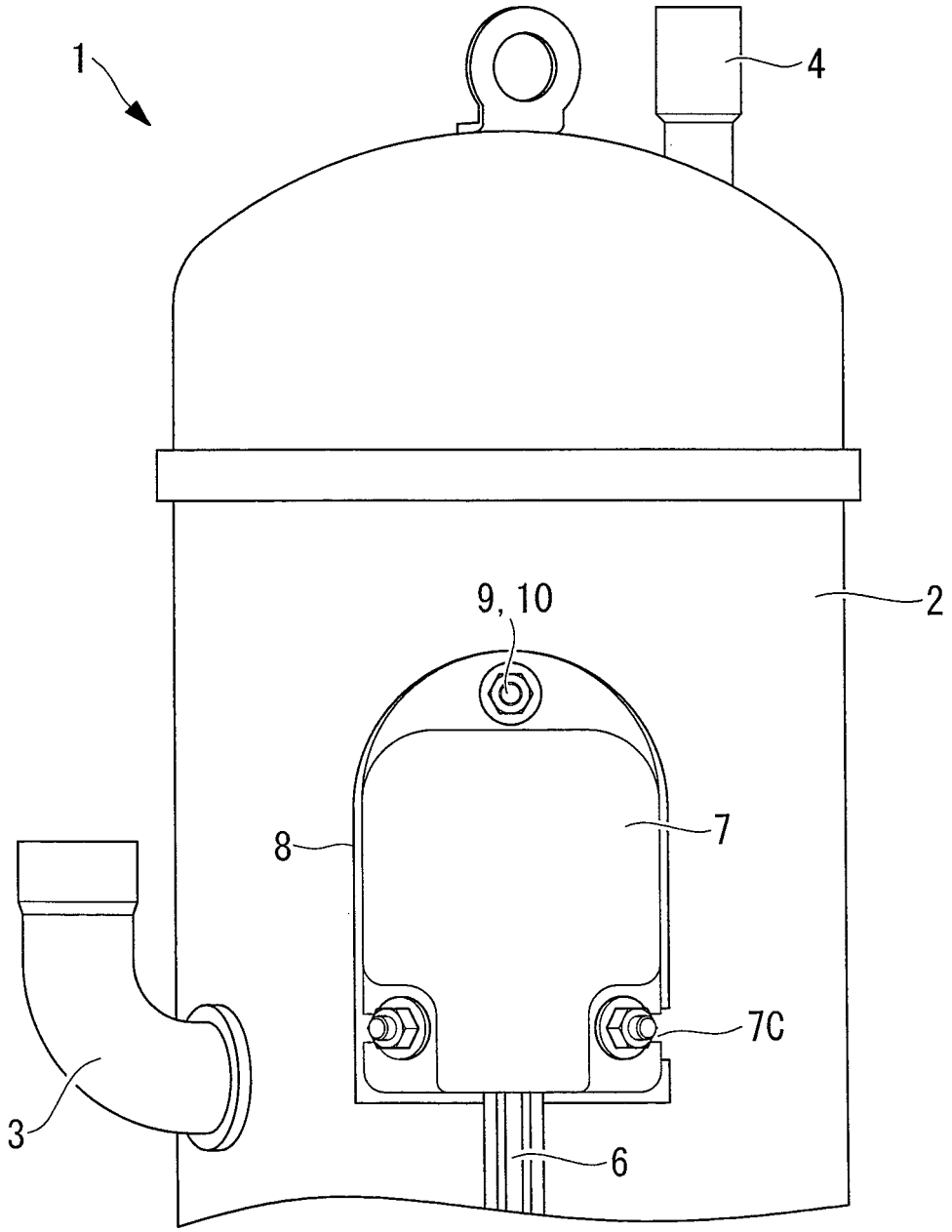


FIG. 2

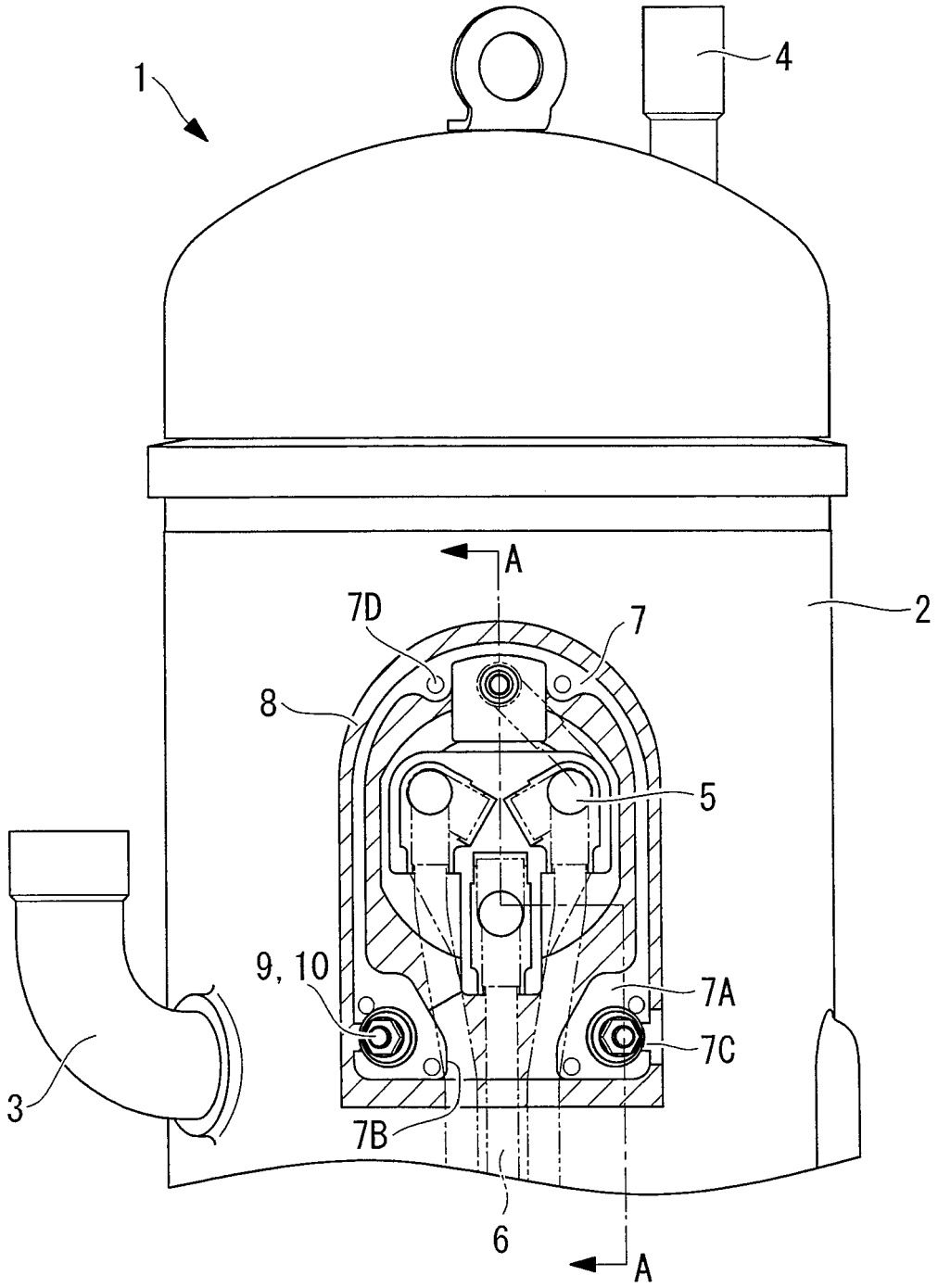


FIG. 3

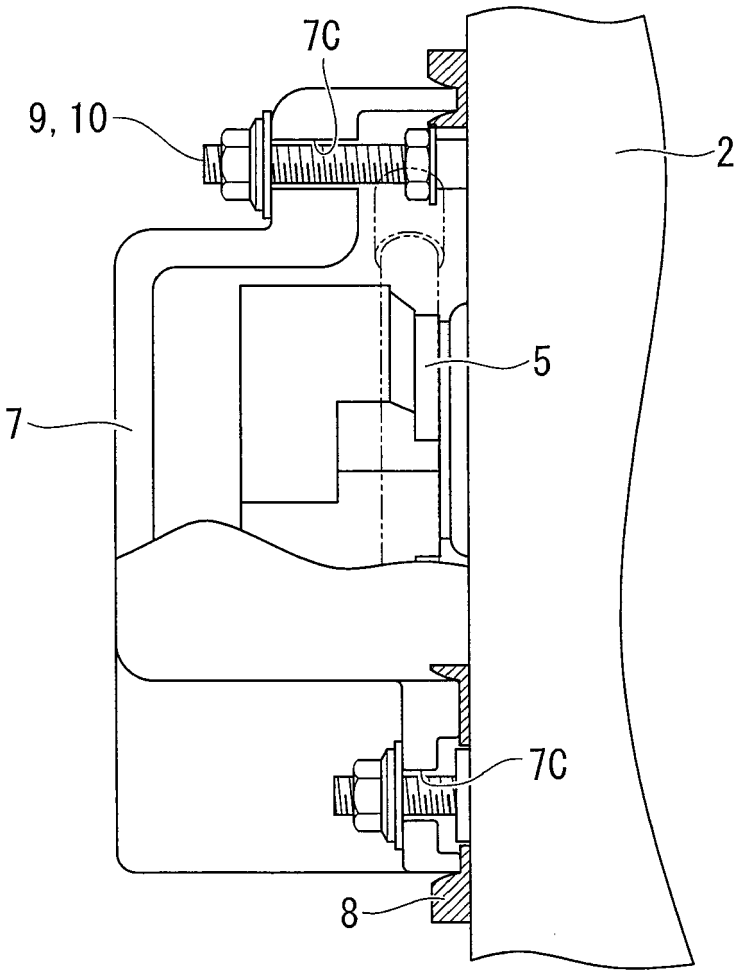


FIG. 4

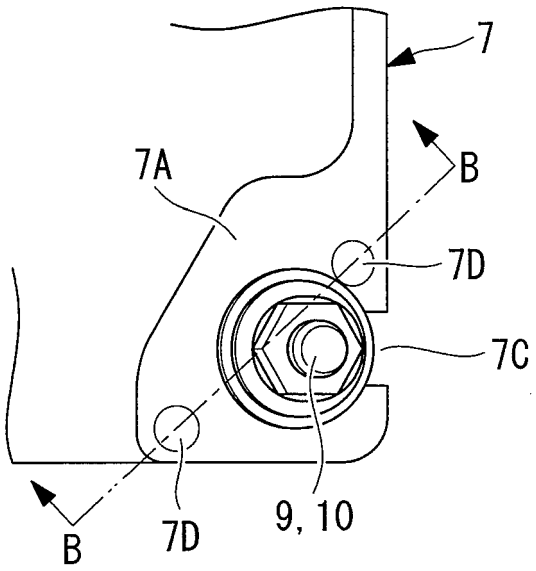
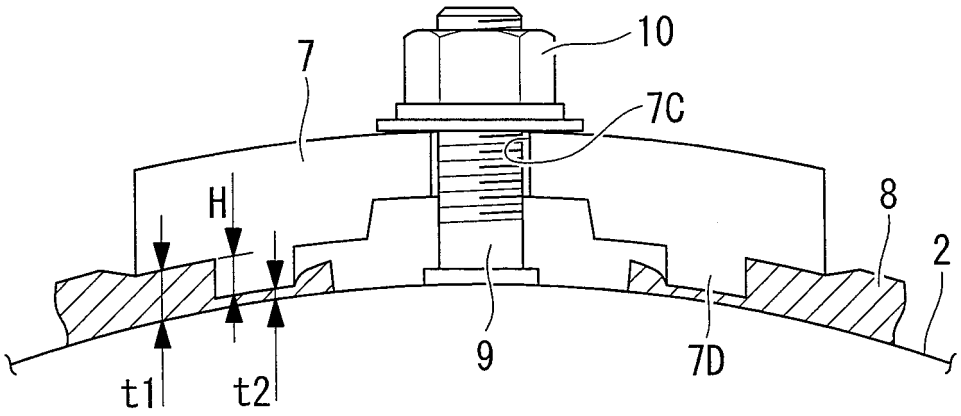


FIG. 5



REFERENCES CITED IN THE DESCRIPTION

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