



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**03.10.2012 Bulletin 2012/40**

(51) Int Cl.:  
**F01C 21/10** (2006.01) **F04C 23/00** (2006.01)

(21) Application number: **12161683.3**

(22) Date of filing: **28.03.2012**

(84) Designated Contracting States:  
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**  
Designated Extension States:  
**BA ME**

(30) Priority: **31.03.2011 JP 2011077020**

(71) Applicant: **Kabushiki Kaisha Toyota Jidoshokki**  
**Kariya-shi**  
**Aichi 448-8671 (JP)**

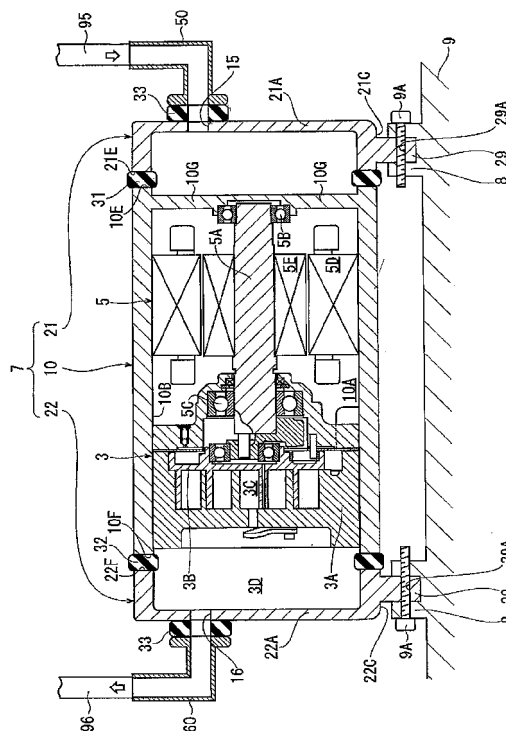
(72) Inventors:  
• **Ota, Takayuki**  
**Kariya-shi, Aichi 448-8671 (JP)**  
• **Murakami, Kazuo**  
**Kariya-shi, Aichi 448-8671 (JP)**  
• **Suitou, Ken**  
**Kariya-shi, Aichi 448-8671 (JP)**

(74) Representative: **TBK**  
**Bavariaring 4-6**  
**80336 München (DE)**

(54) **Motor-driven compressor**

(57) A motor-driven compressor that suppresses the transmission of vibration and noise to the exterior. The motor-driven compressor includes a housing and a compressor mechanism and motor mechanism, which are arranged in the housing. The compressor mechanism draws refrigerant into the housing, compresses the refrigerant, and discharges the refrigerant from the housing. The motor mechanism actuates the compressor mechanism. The housing includes a first housing, in which the compressor mechanism and the motor mechanism are fixed, and a second housing, which includes a mounting portion that can be mounted to another member. An anti-vibration member is arranged between the first housing and the second housing.

FIG. 2



## Description

### BACKGROUND OF THE INVENTION

**[0001]** The present invention relates to a motor-driven compressor.

**[0002]** Japanese Laid-Open Patent Publication No. 2009-221969 discloses a motor-driven compressor of the prior art. The motor-driven compressor includes a housing, a compressor mechanism, and a motor mechanism. The housing includes a compressor housing member, a front housing member, and a rear housing member. The compressor mechanism is fixed in the compressor housing. The motor mechanism is fixed in the rear housing member.

**[0003]** A suction port is formed in the front housing member. A discharge port is formed in the rear housing member. The rear housing member and the like include mounting portions that can be mounted to another member. The compressor mechanism draws refrigerant into the housing, compresses the refrigerant, and discharges the refrigerant from the housing. The motor mechanism actuates the compressor mechanism.

**[0004]** Each of the suction port and discharge port are coupled to a pipe by a pipe coupling. An anti-vibration member is arranged between the rim of the suction port and the corresponding pipe coupling. An anti-vibration member is also arranged between the rim of the discharge port and the corresponding pipe coupling.

**[0005]** The motor-driven compressor uses the anti-vibration members to suppress the transmission of vibration and noise from the compressor mechanism and motor mechanism to the exterior through the pipes.

**[0006]** In the motor-driven compressor of the prior art, however, the vibration and noise of the compressor mechanism and motor mechanism may be transmitted to the exterior through the mounting portions.

### SUMMARY OF THE INVENTION

**[0007]** Accordingly, it is an object of the present invention to provide a motor-driven compressor that does not transmit vibration and noise to the exterior.

**[0008]** One aspect of the present invention is a motor-driven compressor including a housing. A compressor mechanism is arranged in the housing. The compressor mechanism draws refrigerant into the housing, compresses the refrigerant, and discharges the refrigerant from the housing. Further, a motor mechanism is arranged in the housing. The motor mechanism actuates the compressor mechanism. The housing includes a first housing, in which the compressor mechanism and the motor mechanism are fixed, and a second housing, which includes a mounting portion that can be mounted to another member. An anti-vibration member is arranged between the first housing and the second housing.

**[0009]** Other aspects and advantages of the present invention will become apparent from the following de-

scription, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

### BRIEF DESCRIPTION OF THE DRAWINGS

**[0010]** The invention, together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

Fig. 1 is a block diagram of an air conditioner including a motor-driven compressor according to one embodiment of the present invention;

Fig. 2 is a cross-sectional view of the motor-driven compressor of the embodiment shown in Fig. 1; and Fig. 3 is a cross-sectional view of a modified example of a motor-driven compressor according to the present invention.

### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0011]** One embodiment of the present invention will now be described with reference to the drawings.

**[0012]** Referring to Fig. 1, a motor-driven compressor 1 of the present embodiment is applied to an air conditioner installed in a vehicle to adjust the temperature of a passenger compartment. In addition to the motor-driven compressor 1, the air conditioner includes a switch valve 91, a passenger compartment exterior heat exchanger 92, an expansion valve 93, and a passenger compartment interior heat exchanger 94.

**[0013]** Referring to Fig. 2, the motor-driven compressor 1 includes a housing 7 and a compressor mechanism 3 and motor mechanism 5, which are arranged in the housing 7. The details of the housing 7 will be described later.

**[0014]** The compressor mechanism 3 includes a fixed scroll 3A, which is fixed to an inner wall surface 10B of a first housing 10, and a movable scroll 3B, which is arranged to face the fixed scroll 3A. The fixed scroll 3A and movable scroll 3B are engaged with each other and form a compression chamber 3C. A drive shaft 5A is accommodated in the first housing 10. The drive shaft 5A includes a distal portion (right side as viewed in Fig. 2), which is supported in a rotatable manner by a bearing 5B, and a proximal portion (left side as viewed in Fig. 2), which is supported in a rotatable manner by a bearing 5C. A plurality of (two in Fig. 2) bearing holders 10G are arranged in the inner wall surface 10B of the first housing 10 to hold the bearing 5B. The bearing holders 10G project inward in the radial direction from the inner wall surface 10B and are rib-shaped. The two bearing holders 10G of the present embodiment are arranged at the upper side and lower side of the plane of Fig. 2 and separated from each other.

**[0015]** The motor mechanism 5 is located closer to a second housing 21 than the compressor mechanism 3. A stator 5D is fixed to the inner wall surface 10B of the first housing 10. A drive circuit (not shown) supplies the stator 5D with three-phase current. A rotor 5E is arranged in the stator 5D. The rotor 5E is fixed to the drive shaft 5A. The rotor 5E is rotated and driven by the current supplied to the stator 5D. The drive shaft 5A, stator 5D, and rotor 5E form the motor mechanism 5.

**[0016]** Referring to Figs. 1 and 2, when the motor mechanism 5 rotates and actuates the compressor mechanism 3, the compressor mechanism 3 draws refrigerant into the housing 7 through a suction pipe 95 and compresses the refrigerant. Then, the compressor mechanism 3 discharges the compressed refrigerant from the housing 7 through a discharge pipe 96.

**[0017]** Referring to Fig. 1, the switch valve 91 is connected to the motor-driven compressor 1 by the suction pipe 95 and the discharge pipe 96. Further, the switch valve 91 is connected to the passenger compartment exterior heat exchanger 92 by a pipe 97 and the passenger compartment interior heat exchanger 94 by a pipe 99. The expansion valve 93 is connected to the passenger compartment exterior heat exchanger 92 by a pipe 98A and the passenger compartment interior heat exchanger 94 by a pipe 98B.

**[0018]** The switch valve 91, which is controlled by a control unit installed in the vehicle, can switch communication states of pipes. When the switch valve 91 communicates the discharge pipe 96 and pipe 97 and communicates the suction pipe 95 and pipe 99, the refrigerant discharged from the motor-driven compressor 1 through the discharge pipe 96 flows in direction D1 as shown in Fig. 1. When the switch valve 91 communicates the discharge pipe 96 and pipe 99 and communicates the suction pipe 95 and pipe 97, the refrigerant discharged from the motor-driven compressor 1 through the discharge pipe 96 flows in direction D2 as shown in Fig. 1.

**[0019]** The passenger compartment exterior heat exchanger 92 dissipates heat to or absorbs heat from the ambient air. The passenger compartment interior heat exchanger 94 dissipates heat to or absorbs heat from the air in the passenger compartment. The passenger compartment exterior heat exchanger 92, the passenger compartment interior heat exchanger 94, and the expansion valve 93 are known in the art and will not be illustrated or described in detail.

**[0020]** The housing 7 of the motor-driven compressor 1 will now be described. As shown in Fig. 2, the housing 7 includes the first housing 10 and second housings 21 and 22. A first anti-vibration member 31 is arranged between the first housing 10 and the second housing 21. Further, a first anti-vibration member 32 is arranged between the first housing 10 and the second housing 22.

**[0021]** The first housing 10, which is cylindrical and long, includes a first end (left end as viewed in Fig. 2) and a second end (right end as viewed in Fig. 2). In the first housing 10, the first end is an open end 10F, and

the second end is an open end 10E. The second housing 21 faces the open end 10E, and the second housing 22 faces the open end 10F. The second housings 21 and 22 are arranged to sandwich the first housing 10 from opposite sides. The second housing 21 is cylindrical and short and includes one open end facing the first housing 10 and an opposite closed end, which defines a lid 21A. In the same manner as the second housing 21, the second housing 22 is cylindrical and short and includes one open end facing the first housing 10 and an opposite closed end, which defines a lid 22A.

**[0022]** To obtain the durability required to endure the vibration and heat, which are generated from the compressor mechanism 3 and motor mechanism 5, and the high-temperature and high-pressure refrigerant, it is preferable that the first housing 10 and the second housings 21 and 22 be formed from a metal, such as steel or aluminum.

**[0023]** The first anti-vibration members 31 and 32 are formed from a material having an anti-vibration property, such as rubber, elastomer, resin, or a fiber reinforced resin. In the present embodiment, the first anti-vibration members 31 and 32 are formed from a fiber reinforced resin and are annular.

**[0024]** The first anti-vibration member 31 is arranged between the open end 10E of the first housing 10 and an open end 21E of the second housing 21. The first anti-vibration member 31 seals the open end 10E and open end 21E and joins the first housing 10 and the second housing 21. The first anti-vibration member 32 is arranged between the open end 10F of the first housing 10 and an open end 22F of the second housing 22. The first anti-vibration member 32 seals the open end 10F and open end 22F and joins the first housing 10 and the second housing 21.

**[0025]** A sealed cavity 10A, which accommodates the compressor mechanism 3 and the motor mechanism 5 in a sealed state, is defined in the first housing 10 and second housings 21 and 22. In the sealed cavity 10A, the compressor mechanism 3 is fixed in the vicinity of the first end, or the open end 10F, of the first housing 10, and the motor mechanism 5 is fixed in the vicinity of the second end, or the open end 10E, of the first housing 10.

**[0026]** The compressor mechanism 3 and the motor mechanism 5 are fixed to an inner wall surface 10B of the first housing 10 by undergoing a known fastening process, such as shrinkage fitting, pressurized fitting, or bolt fastening. A fastening structure involving such a fastening process fixes the compressor mechanism 3 and the motor mechanism 5 with high rigidity. However, it is difficult to attenuate vibration and noise generated by the compressor mechanism 3 and motor mechanism 5 with such a structure. As a result, the vibration and noise of the compressor mechanism 3 and motor mechanism 5 are easily transmitted to the first housing 10.

**[0027]** A suction port 15 extends through the lid 21A of the second housing 21. A suction coupling 50, which serves as an outer pipe, is fixed to the suction port 15

with a second anti-vibration member 33 located in between. A refrigerant supply passage is formed in the sealed cavity 10A between the suction port 15 and the compressor mechanism 3.

**[0028]** A discharge chamber 3D is defined between the first housing 10 and the second housing 22. A discharge port 16 extends through the lid 22A of the second housing 22. A discharge coupling 60, which serves as an outer pipe, is fixed to the discharge port 16 with a second anti-vibration member 33 located in between.

**[0029]** In the same manner as the first anti-vibration members 31 and 32, the second anti-vibration members 33 are formed from a material having an anti-vibration property, such as rubber, elastomer, resin, or a fiber reinforced resin. In the present embodiment, the second anti-vibration members 33 are cylindrical bodies having thick walls and formed from fiber reinforced resin.

**[0030]** The second housings 21 and 22 respectively include outer wall surfaces 21C and 22C. Block-shaped mounting portions 29, which can be mounted to other members, are formed on the outer wall surfaces 21C and 22C. The mounting portions 29 project outward in the radial direction of the outer housing 20. An insertion hole 29A extends through each mounting portion 29 parallel to the longitudinal direction of the first housing 10. A plurality of supports 8 project from a mounting object 9, such as a frame or engine of the vehicle. The mounting portions 29 are engaged with the supports 8. Bolts 9A are fastened to the mounting portions 29 and supports 8. This fixes the motor-driven compressor 1 to the mounting object 9. The fastening structure of the mounting portions 29, supports 8, and bolts 9A fix the second housings 21 and 22 to the mounting object 9 with high rigidity. However, it is difficult to attenuate the vibration and noise transmitted from the second housings 21 and 22 to the mounting object 9.

**[0031]** The air conditioner, to which the motor-driven compressor 1 of the present embodiment is applied, adjusts the temperature of the passenger compartment as described below.

**[0032]** Referring to Fig. 1, when cooling the passenger compartment, the switch valve 91 communicates the discharge pipe 96 and pipe 97 and communicates the suction pipe 95 and pipe 99. As a result, the high-temperature and high-pressure refrigerant compressed by the compressor mechanism 3 flows in direction D1. The refrigerant dissipates heat into the ambient air and liquefies at the passenger compartment exterior heat exchanger 92. Then, the pressure of the refrigerant is decreased at the expansion valve 93. Subsequently, the refrigerant absorbs heat from the air in the passenger compartment and vaporizes at the passenger compartment interior heat exchanger 94. This cools the air in the passenger compartment. The refrigerant then returns to the motor-driven compressor 1 via the pipe 99, the switch valve 91, and the suction pipe 95.

**[0033]** When heating the passenger compartment, the switch valve 91 communicates the discharge pipe 96 and

pipe 99 and communicates the suction pipe 95 and pipe 97. As a result, the high-temperature and high-pressure refrigerant compressed by the compressor mechanism 3 flows in direction D2. The refrigerant dissipates heat into the air in the passenger compartment and liquefies at the passenger compartment interior heat exchanger 94. This heats the air in the passenger compartment. Then, the pressure of the refrigerant is decreased at the expansion valve 93. Subsequently, the refrigerant absorbs heat from the ambient air and vaporizes at the passenger compartment exterior heat exchanger 92. The refrigerant then returns to the motor-driven compressor 1 via the pipe 97, the switch valve 91, and the suction pipe 95.

**[0034]** In the motor-driven compressor 1 of the present embodiment, the compressor mechanism 3 and motor mechanism 5 are fixed to the first housing 10 with high rigidity. Further, the mounting portions 29, the supports 8, and the bolts 9A fix the second housings 21 and 22 to the mounting object 9 with high rigidity. Thus, if the transmission of vibration and noise cannot be suppressed between the first housing 10 and the second housings 21 and 22, the vibration and noise from the compressor mechanism 3 and motor mechanism 5 would be transmitted by the first housing 10 and second housings 21 and 22 to the mounting object 9 without being attenuated. This may adversely affect comfort in the environment of the passenger compartment.

**[0035]** In this regard, the motor-driven compressor 1 of the first embodiment includes the first anti-vibration member 31, which is arranged between the first housing 10 and the second housing 21, and the first anti-vibration member 32, which is arranged between the first housing 10 and the second housing 22. Due to the first anti-vibration members 31 and 32, the motor-driven compressor 1 suppresses the transmission of vibration and noise, which are generated by the compressor mechanism 3 and motor mechanism 5, from the first housing 10 to the second housings 21 and 22. This, in turn, suppresses the transmission of vibration and noise from the mounting portions 29 of the second housings 21 and 22 to the mounting object 9.

**[0036]** Accordingly, the motor-driven compressor 1 of the present embodiment does not transmit vibration and noise to the exterior.

**[0037]** The present embodiment also has the advantages described below.

**[0038]** The first anti-vibration member 31 is arranged between the first housing 10 and the second housings 21, and the anti-vibration member 32 is arranged between the first housing 10 and the second housings 22. Thus, the compressor mechanism 3 and motor mechanism 5, the structure for fastening the compressor mechanism 3 and motor mechanism 5 to the first housing 10, and the mounting portions 29 formed on the second housings 21 and 22 are not required to have anti-vibration properties and such parts may have simplified structures.

**[0039]** The suction port 15 and the discharge port 16

are respectively formed in the second housings 21 and 22 and not the first housing 10. This allows the first anti-vibration members 31 and 32 to suppress the transmission of vibration and noise, which are generated by the compressor mechanism 3 and the motor mechanism 5, from the first housing 10 to the exterior via the suction port 15 and the discharge port 16 of the second housings 21 and 22. As a result, the transmission of vibration and noise to the exterior is further suppressed.

**[0040]** The second anti-vibration members 33 are also arranged between the suction port 15 and suction coupling 50 and between the discharge port 16 and discharge coupling 60. Thus, the second anti-vibration members 33 suppress the transmission of vibration and noise, which are generated by the compressor mechanism 3 and the motor mechanism 5, between the second housing 21 and the suction coupling 50 and between the second housing 22 and discharge coupling 60. As a result, the transmission of vibration and noise to the exterior is further suppressed.

**[0041]** The first housing 10 is cylindrical and includes a first end, which is the open end 10F, and a second end, which is the open end 10E. The second housing 21 faces the open end 10E, and the second housing 22 faces the open end 10F. This structure simplifies the first housing 10 and lowers the manufacturing cost. Further, the second housings 21 and 22 are easily arranged facing the open ends 10E and 10F of the first housing 10. This simplifies the assembling of the motor-driven compressor 1.

**[0042]** The compressor mechanism 3 is fixed in the vicinity of the first end of the first housing 10. The motor mechanism 5 is fixed in the vicinity of the second end of the first housing 10. This structure increases the rigidity of the cylindrical first housing 10.

**[0043]** It should be apparent to those skilled in the art that the present invention may be embodied in many other specific forms without departing from the spirit or scope of the invention. Particularly, it should be understood that the present invention may be embodied in the following forms.

**[0044]** The first housing 10 does not have to be cylindrical and does not have to include two open ends. The first housing 10 may be formed by combining a plurality of members and include two closed ends. Further, as shown in Fig. 3, the first housing 10 may include only one open end (left end as viewed in Fig. 3). In this case, the first housing 10 includes another end (right end as viewed in Fig. 3) closed by a disk-shaped end wall 10H. An opening 101 extends through the end wall 10H. A rim 10J extends along the periphery of the end wall 10H. Refrigerant is drawn into the compressor mechanism 3 through the suction port 15 and the opening 101. The second housing 21 faces the rim 10J of the first housing 10. In this case, one end of the first housing 10 is closed by the end wall 10H. This increases the rigidity of the first housing 10.

**[0045]** The fastening structure and shapes of the mounting portions 29, the supports 8, and the bolts 9A are not limited to those of the above embodiments. Any

structure can be employed as long as the mounting portions 29 can fix the motor-driven compressor 1 to the mounting object 9.

**[0046]** The second anti-vibration members 33 are arranged between the suction port 15 and suction coupling 50 and between the discharge port 16 and discharge coupling 60. However, either one of the second anti-vibration members 33 may be eliminated. Alternatively, both second anti-vibration members 33 may be eliminated. In this case, the suction port 15 and suction coupling 50 are directly coupled to each other, and the discharge port 16 and discharge coupling 60 are directly coupled to each other.

**[0047]** At least one of the suction port 15 and discharge port 16 may be arranged on the first housing 10.

**[0048]** The compressor mechanism 3 is not limited to a scroll type and may be of a reciprocating type, a vane type, or any other known compression type.

**[0049]** The present examples and embodiments are to be considered as illustrative and not restrictive, and the invention is not to be limited to the details given herein, but may be modified within the scope and equivalence of the appended claims.

**[0050]** A motor-driven compressor that suppresses the transmission of vibration and noise to the exterior. The motor-driven compressor includes a housing and a compressor mechanism and motor mechanism, which are arranged in the housing. The compressor mechanism draws refrigerant into the housing, compresses the refrigerant, and discharges the refrigerant from the housing. The motor mechanism actuates the compressor mechanism. The housing includes a first housing, in which the compressor mechanism and the motor mechanism are fixed, and a second housing, which includes a mounting portion that can be mounted to another member. An anti-vibration member is arranged between the first housing and the second housing.

## Claims

1. A motor-driven compressor comprising:

a housing (7);  
a compressor mechanism (3) arranged in the housing (7), wherein the compressor mechanism (3) draws refrigerant into the housing (7), compresses the refrigerant, and discharges the refrigerant from the housing (7); and  
a motor mechanism (5) arranged in the housing (7), wherein the motor mechanism (5) actuates the compressor mechanism (3),  
the motor-driven compressor being **characterized in that:**

the housing (7) includes a first housing (10), in which the compressor mechanism (3) and the motor mechanism (5) are fixed, and

a second housing (21, 22), which includes  
 a mounting portion (29) that can be mounted  
 to another member; and  
 a first anti-vibration member (31) arranged  
 between the first housing (10) and the sec- 5  
 ond housing (21, 22).

2. The motor-driven compressor according to claim 1,  
**characterized in that** the second housing (21, 22)  
 includes a suction port (15), which draws the refrig- 10  
 erant into the compressor mechanism (3), and a dis-  
 charge port (16), which discharges the refrigerant  
 from the compressor mechanism (3).
3. The motor-driven compressor according to claim 2, 15  
**characterized in that** outer pipes (50, 60) are rela-  
 tively coupled to the suction port (15) and the dis-  
 charge port (16), and  
 a second anti-vibration member (33) is arranged be-  
 tween at least one of the suction port (15) and dis- 20  
 charge port (16) and the corresponding outer pipe  
 (50, 60).
4. The motor-driven compressor according to any one  
 of claims 1 to 3, **characterized in that** 25  
 the first housing (10) is cylindrical and includes a first  
 end and a second end,  
 at least one of the first end and second end is an  
 open end (10E, 10F); and  
 the second housing (21, 22) is arranged facing the 30  
 open end (10E, 10F) of the first housing (10).
5. The motor-driven compressor according to claim 4,  
**characterized in that**  
 the compressor mechanism (3) is fixed in the vicinity 35  
 of the first end of the first housing (10), and  
 the motor mechanism (5) is fixed in the vicinity of the  
 second end of the first housing (10).

40

45

50

55

FIG. 1

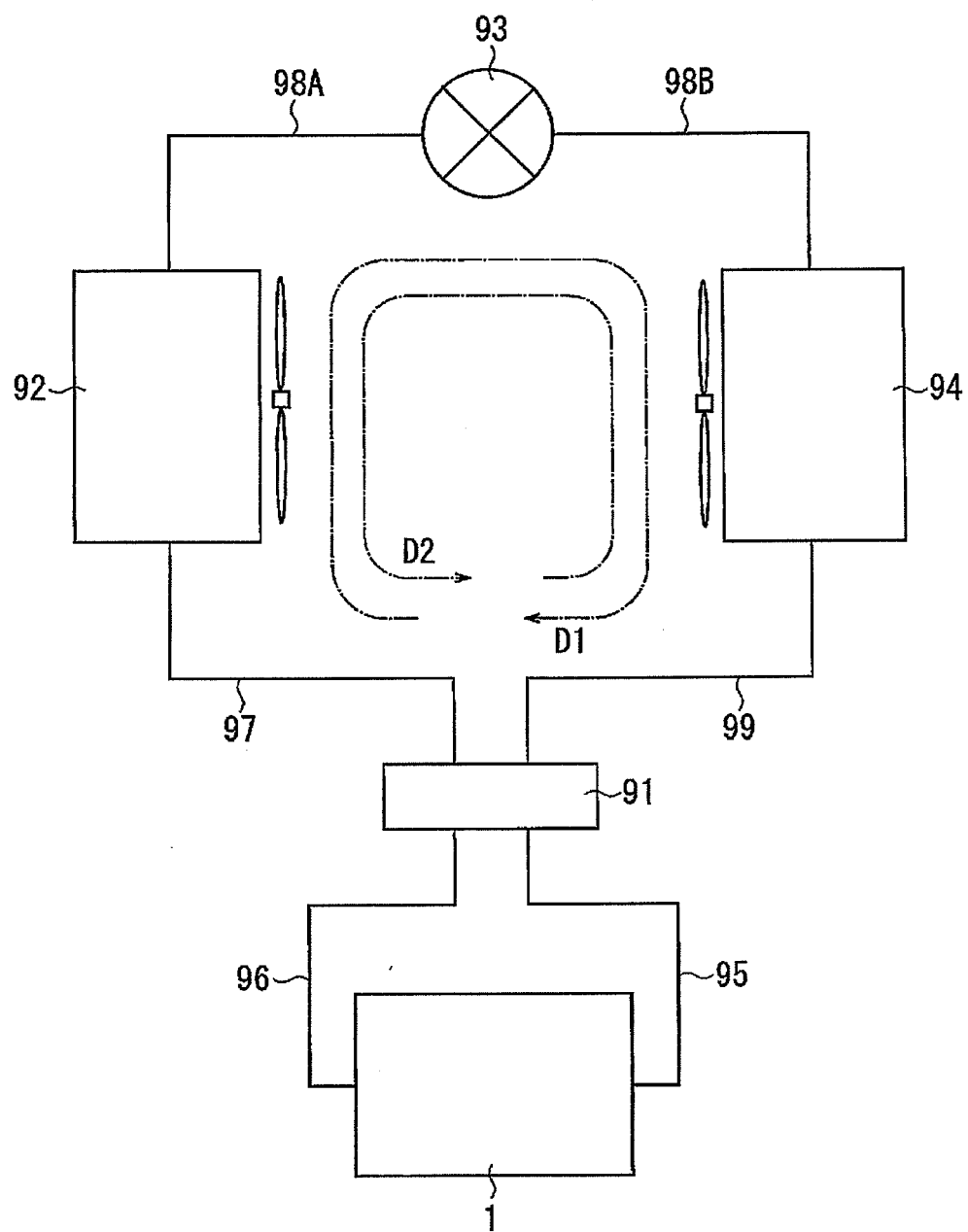


FIG. 2

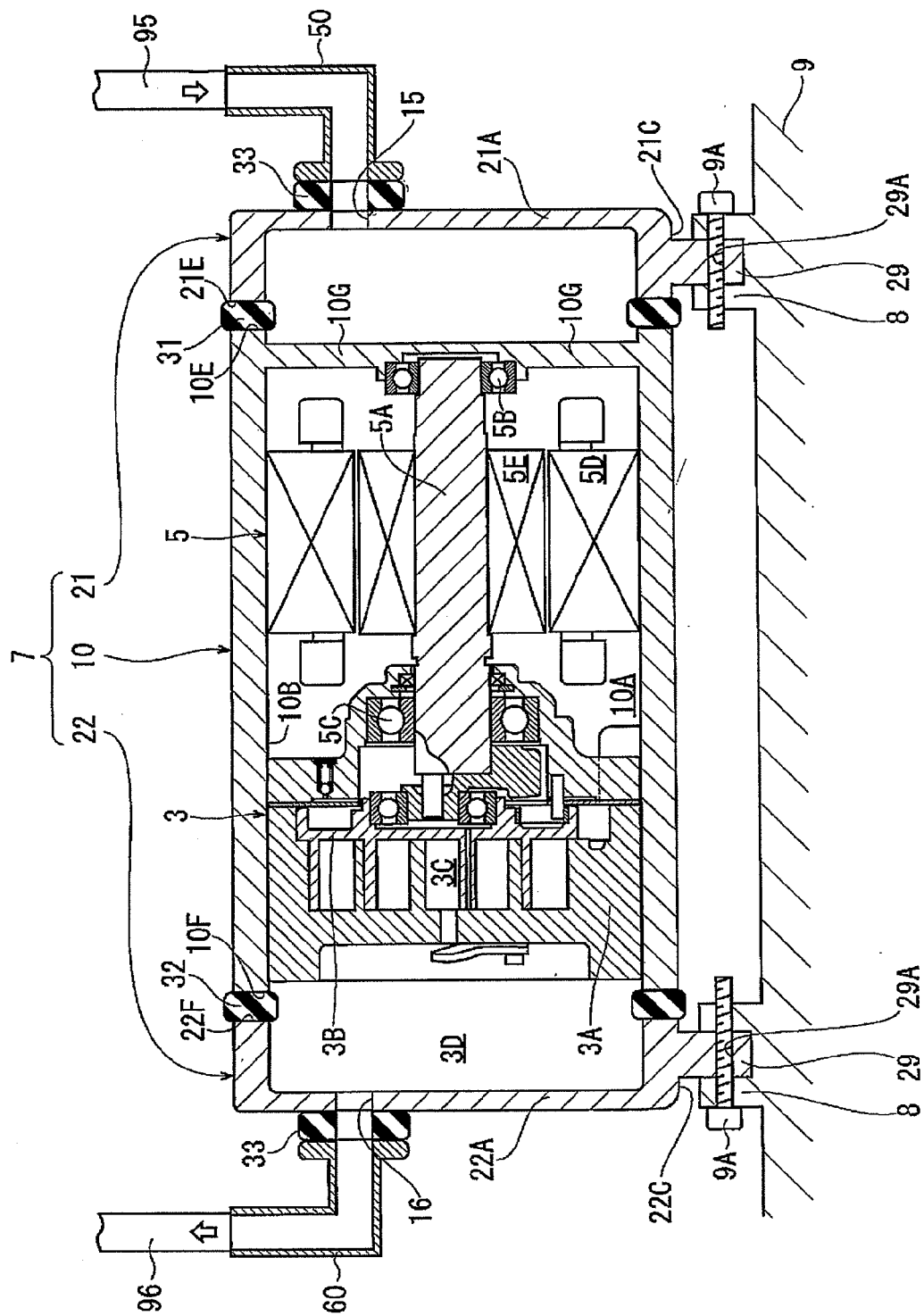
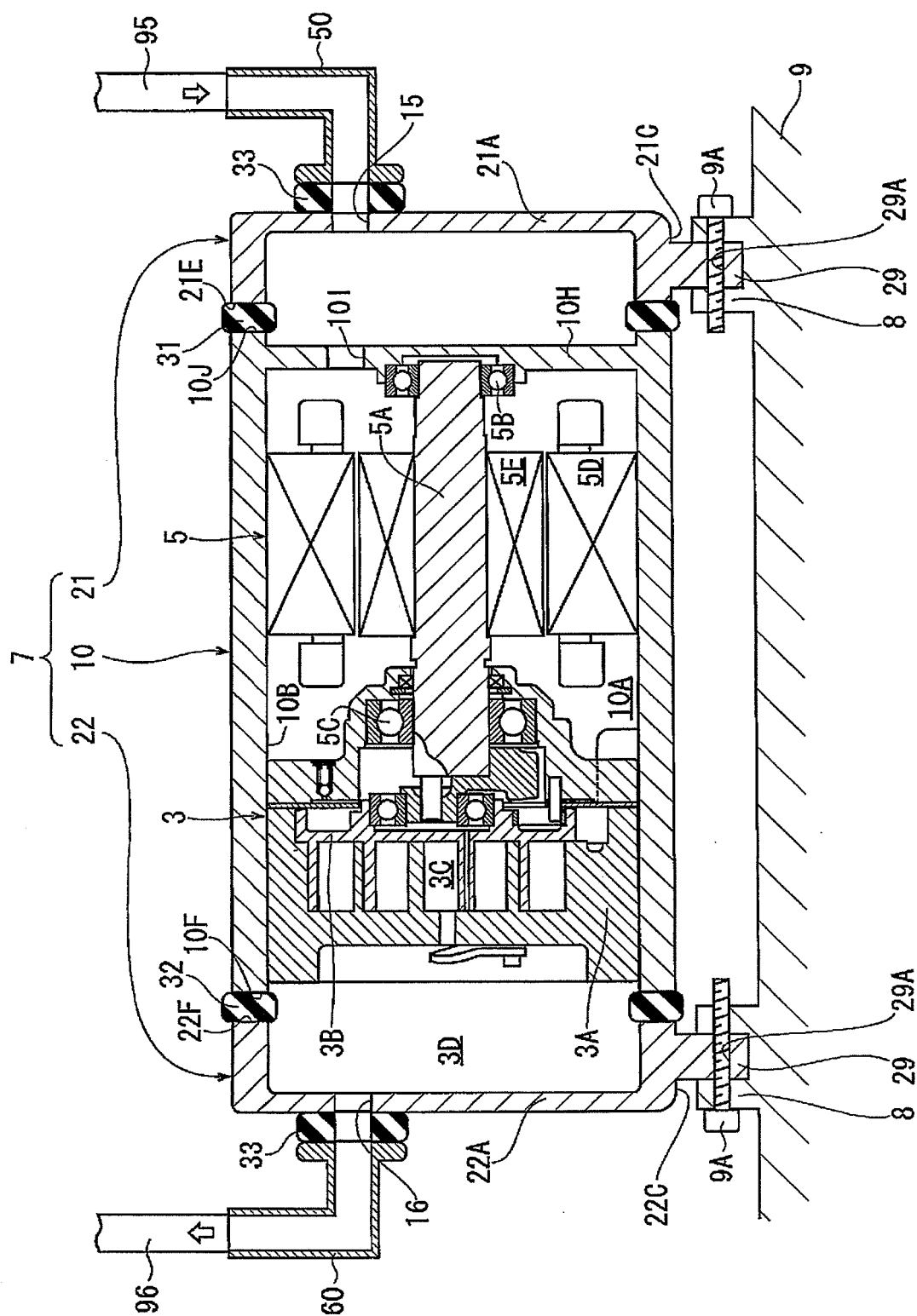


FIG. 3



**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 2009221969 A [0002]