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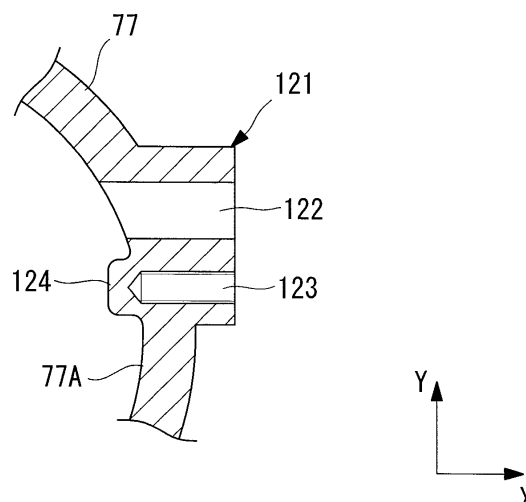
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(54) **ELECTRIC COMPRESSOR FOR VEHICLE-MOUNTED AIR CONDITIONER**

(57) An electric compressor for a vehicle air conditioner capable of preventing refrigerant leakage is provided. A case (77) is formed by injecting a molten metal into a mold, and a compression unit for compressing a refrigerant is accommodated inside, wherein a machined portion (123) is formed on one of an inner circumferential surface (77A) in contact with the refrigerant and an outer circumferential surface adjacent to the inner circumferential surface.

FIG. 6



Description

Technical Field

[0001] The present invention relates to an electric compressor for a vehicle air conditioner.

Background Art

[0002] With conventional integrated-inverter electric compressors for vehicle air conditioners (electric compressors for vehicle air conditioners), a method for driving a scroll compressor using a fixed scroll and an orbiting scroll with an electric motor is widely used (for example, see Patent Documents 1 to 7).

[0003] In the above-described electric compressor, an inverter case that accommodates an inverter unit for supplying electrical power to the electric motor and a pressure case that accommodates, for example, the electric motor or a compression unit are integrally formed by die-casting using, for example, aluminum as a material.

[0004] Many screw holes used for attaching an inverter unit are often formed in the interior of such an inverter case.

Patent Document 1: Japanese Unexamined Patent Application, Publication No. 2007-162661

Patent Document 2: The Publication of Japanese Patent No. 3802477

Patent Document 3: The Publication of Japanese Patent No. 3843809

Patent Document 4: Japanese Unexamined Patent Application, Publication No. 2005-188441

Patent Document 5: Japanese Unexamined Patent Application, Publication No. 2007-128756

Patent Document 6: Japanese Unexamined Patent Application, Publication No. 2005-180292

Disclosure of Invention

[0005] As described above, when many screw holes are formed inside the inverter case, shrinkage cavities communicate between the screw holes and a machined surface, in the pressure case, facing the screw holes, and thus, refrigerant in the pressure case tends to leak outside through the shrinkage cavities.

[0006] The present invention has been conceived to solve the above-described problems, and an object thereof is to provide an electric compressor for a vehicle air conditioner capable of preventing refrigerant leakage.

[0007] To realize the object described above, the present invention provides the following solutions.

[0008] The present invention provides an electric compressor for a vehicle air conditioner, wherein a case is formed by injecting a molten metal into a mold, and a compression unit for compressing a refrigerant is accommodated inside, and wherein a machined portion is formed on only one of an inner circumferential surface in

contact with the refrigerant and an outer circumferential surface adjacent to the inner circumferential surface.

[0009] According to the present invention, it is possible to prevent the machined portion formed at the inner circumferential surface side of the case and the machined portion formed at the outer circumferential surface side from becoming adjacent, thus preventing the refrigerant from leaking from the inside to the outside of the case.

[0010] Specifically, because the inner circumferential surface or the outer circumferential surface adjacent to the machined portion is not processed, it is possible to leave a casting surface including a chill layer that has fewer cavities, such as shrinkage cavities, on the inner circumferential surface or the outer circumferential surface. Therefore, it is possible to reduce the probability of the above-described cavities passing through from the inside to the outside of the case, thus reducing the incidence of refrigerant leaks.

[0011] In the invention described above, a thickness between the machined portion and an inner circumferential portion, or a thickness between the machined portion and an outer circumferential portion is preferably larger than that between the inner circumferential surface and the outer circumferential surface.

[0012] In this way, it is possible to ensure sufficient thickness between the machined portion and the inner circumferential portion or between the machined portion and the outer circumferential portion in the case, thus preventing refrigerant leaks.

[0013] In other words, by ensuring sufficient thickness of the case, it is possible to reduce the probability of the above-described cavities passing through from the inside to the outside of the case, thus reducing the incidence of refrigerant leaks.

[0014] In the invention described above, a pressure case that accommodates the compression unit and an electrical-equipment case that accommodates electrical parts that control an electric motor for driving the compression unit are preferably integrally provided in the case, and the molten metal is preferably injected from the pressure case side.

[0015] In this way, by injecting the molten metal from the pressure case side to form the case, it is possible to reduce the incidence of cavities in the pressure case. Accordingly, it is possible to reduce the probability of the above-described cavities passing through from the inside to the outside of the pressure case, thus reducing the incidence of refrigerant leaks.

[0016] In the configuration described above, it is preferable that the pressure case be a substantially cylindrical member having at least a bottom surface, a plurality of ribs that radially extend being provided on the bottom surface, and a suction hole through which the refrigerant flows into the pressure case from outside be provided so as to pass through between the plurality of ribs in the case.

[0017] In this way, it is possible to prevent interference between the suction hole and the ribs, thus ensuring the

strength of the pressure case. More specifically, because the ribs do not block the flow of the refrigerant flowing inside through the suction hole, the shape of the ribs is not restricted. Therefore, the ribs can be formed in any shape required to ensure the strength of the pressure case, thus ensuring the strength of the pressure case.

[0018] In addition, to avoid interference between the suction hole and the ribs, compared with a case in which the positions of the suction hole and the ribs are shifted relative to each other in the center axis direction of the pressure case, it is possible to reduce the size of the pressure case in the center axis direction.

[0019] In the configuration described above, it is preferable that the pressure case be a substantially cylindrical member having at least a bottom surface, a plurality of ribs that radially extend be provided on the bottom surface, a suction hole through which the refrigerant flows into the pressure case from outside be provided so as to pass through between the plurality of ribs in the case, a boss that supports a rotation shaft of the compression unit be provided at the center portion of the bottom surface, and the suction hole be a through-hole extending toward the boss.

[0020] In this way, when the refrigerant flowing into the pressure case through the suction hole includes lubricant, such as lubricating oil, the lubricant flows toward the boss together with the refrigerant and is supplied between the rotation shaft and the boss. Accordingly, lubrication between the rotation shaft and the boss can be ensured.

[0021] In the configuration described above, it is preferable that the pressure case be a substantially cylindrical member having at least a bottom surface, a plurality of ribs that radially extend be provided on the bottom surface, a suction hole through which the refrigerant flows into the pressure case from outside be provided so as to pass through between the plurality of ribs in the case, a discharge hole in which the refrigerant flows out from the pressure case be provided in the pressure case, and the suction hole and the discharge hole be formed substantially in the same direction with respect to the case.

[0022] In this way, compared with a case in which the suction hole and the discharge hole are formed in different directions, because both directions are substantially the same, it is possible to reduce the size in the width direction of the pressure case, i.e., the size in a direction orthogonal to the center axis.

[0023] In the configuration described above, it is preferable that the pressure case be a substantially cylindrical member having at least a bottom surface, a plurality of ribs that radially extend be provided on the bottom surface, a suction hole through which the refrigerant flows into the pressure case from outside be provided so as to pass through between the plurality of ribs in the case, and the suction hole be located at a position higher than the central axis of the pressure case when the pressure case is attached to a desired attachment position.

[0024] In this way, when attaching the pressure case to a desired attachment position, the lubricant retained in the pressure case can be prevented from flowing out from the suction hole.

[0025] The electric compressor for the vehicle air conditioner according to the present invention provides advantages in that it is possible to prevent a machined portion formed at an inner circumferential surface side and a machined portion formed at an outer circumferential surface side in a case from becoming adjacent, as well as to prevent refrigerant from leaking from the inside to the outside of the case.

Brief Description of Drawings

[0026]

[FIG. 1] Fig. 1 is a sectional view for explaining, in outline, the configuration of an electric compressor according to an embodiment of the present invention.

[FIG. 2] Fig. 2 is a perspective view for explaining the configuration of a motor case in Fig. 1.

[FIG. 3] Fig. 3 is a diagram of a box, viewed from an opening side, for explaining the configuration of the motor case in Fig. 2.

[FIG. 4] Fig. 4 is a diagram of a cylindrical portion, viewed from an opening side, for explaining the configuration of the motor case in Fig. 2.

[FIG. 5] Fig. 5 is a sectional view for explaining the configuration of a portion where a terminal portion is attached in the motor case in Fig. 1.

[FIG. 6] Fig. 6 is a sectional view for explaining the configuration of a suction portion in the motor case in Fig. 3.

Explanation of Reference Signs:

[0027]

- 1: electric compressor (electric compressor for vehicle air conditioner)
- 3: scroll compression unit (compression unit)
- 11: main shaft (rotation shaft)
- 13: housing (case, pressure case)
- 15: upper bearing case (case, pressure case)
- 67: motor case (case, pressure case)
- 69: inverter unit (electrical part)
- 77: cylindrical portion (case, pressure case)
- 77A: inner circumferential surface
- 83: box (electrical-equipment case)
- 101: screw hole (machined portion)
- 113: securing bolt hole (machined portion)
- 91: sub-boss (boss)
- 93: rib
- 122: suction hole
- 123: mounting bolt hole (machined portion)

Best Mode for Carrying Out the Invention

[0028] An electric compressor according to an embodiment of the present invention will be described with reference to Figs. 1 to 6.

[0029] Fig. 1 is a sectional view for explaining, in outline, the configuration of an electric compressor according to an embodiment of the present invention.

[0030] In this embodiment, a description will be given where an electric compressor (electric compressor for a vehicle air conditioner) 1 is applied to the electric compressor that is used for a vehicle air conditioner and whose rotational speed for driving thereof is controlled by an inverter.

[0031] As shown in Fig. 1, the electric compressor 1 is provided with a scroll compression unit (compression unit) 3 that compresses a refrigerant used for a vehicle air conditioner, and a motor unit 5 that drives the scroll compression unit 3.

[0032] The scroll compression unit 3 is provided with a fixed scroll (not shown) and an orbiting scroll (not shown) that compress the refrigerant, a main shaft (rotation shaft) 11 that transmits a rotational driving force of the motor unit 5 to the orbiting scroll, a housing (case, pressure case) 13 that accommodates the fixed scroll and the orbiting scroll therein, and an upper bearing case (case, pressure case) 15, described below, that supports the main shaft 11.

[0033] The main shaft 11 is a cylindrical member extending from the motor unit 5 toward the scroll compression unit 3 and transmits the generated rotational driving force by the scroll compression unit 3 to the orbiting scroll to orbitally drive the orbiting scroll.

[0034] The motor unit 5 is provided with a stator 63 and a rotor 65 that drive the main shaft 11, a motor case (case, pressure case) 67 that accommodates the stator 63 and the rotor 65, and an inverter unit (electrical part) 69 that controls an AC current supplied to the stator 63.

[0035] Fig. 2 is a perspective view for explaining the configuration of the motor case in Fig. 1.

[0036] As shown in Fig. 2, the motor case 67 is provided with a cylindrical portion (case, pressure case) 77, with a cylindrical shape, that accommodates the stator 63 and the rotor 65, and a box (electrical-equipment case) 83 that accommodates the inverter unit 69.

[0037] Fig. 3 is a diagram of the box, viewed from an opening side, for explaining the configuration of the motor case in Fig. 2. Fig. 4 is a diagram of the cylindrical portion, viewed from an opening side, for explaining the configuration of the motor case in Fig. 2.

[0038] As shown in Fig. 3, a plurality of screw holes (machined portions) 101 used for securing the inverter unit 69 are formed in the box 83.

[0039] As shown in Fig. 3, the screw holes 101 are formed at edges of the box 83. As shown in Fig. 4, thick portions 102 that have machining allowance for the screw holes 101 and that have a thickness (plate thickness) substantially the same as that of other portions are

formed on a surface of the box 83 facing the cylindrical portion 77. The thick portions 102 have casting surfaces that are not processed.

[0040] Fig. 5 is a sectional view for explaining the configuration of a portion where a terminal portion is attached in the motor case in Fig. 1.

[0041] As shown in Figs. 1 and 5, an opening 111 for connecting the inverter unit 69 and the motor unit 5 is provided in the cylindrical portion 77, and securing bolt holes (machined portions) 113 are formed. Securing bolts for securing a terminal portion 112 that covers the opening 111 are screwed into the securing bolt holes 113.

[0042] The securing bolt holes 113 are holes that extend from the box 83 toward the cylindrical portion 77 and formed in the box 83.

[0043] Protrusions 114 that have machining allowance for the securing bolt holes 113 and have a thickness (plate thickness) substantially the same as that of other portions are formed at positions corresponding to the securing bolt holes 113 on an inner circumferential surface 77A of the cylindrical portion 77. The protrusions 114 have casting surfaces that are not processed.

[0044] By doing so, with the protrusions 114, it is possible to absorb the depth of a screw required for forming the securing bolt holes 113. Accordingly, the terminal portion 112 can be disposed close to the cylindrical portion 77, thus reducing the size of the electric compressor 1.

[0045] Fig. 6 is a sectional view for explaining the configuration of a suction portion in the motor case in Fig. 3.

[0046] A bottom surface 79 is provided at one end of the cylindrical portion 77, and a suction portion 121 is provided close to the bottom surface 79, as shown in Figs. 4 and 6.

[0047] As shown in Fig. 4, a cylindrical sub-boss (boss) 91 that supports an end of the main shaft 11 is provided at the center portion of the bottom surface 79, and six ribs 93 outwardly extend from the sub-boss 91 in the radial direction at equal intervals.

[0048] The suction portion 121 is a portion to which an external refrigerant pipe is connected and through which the refrigerant flows into the cylindrical portion 77.

[0049] As shown in Fig. 4, in the state where the electric compressor 1 is attached to a desired attachment position, the suction portion 121 is disposed higher than the center axis of the electric compressor 1 or the center axis of the main shaft 11.

[0050] By doing so, when attaching the electric compressor 1 to a desired attachment position, lubricating oil retained in the cylindrical portion 77 can be prevented from flowing out from the suction hole 122.

[0051] As shown in Fig. 6, the suction portion 121 is provided with a suction hole 122 through which the refrigerant flows and a mounting bolt hole (machined portion) 123 used for securing the external refrigerant pipe.

[0052] The suction hole 122 is a through-hole that connects the inside and outside of the cylindrical portion 77 and is a channel through which the refrigerant flows inside the cylindrical portion 77 from outside.

[0053] As shown in Fig. 4, the suction hole 122 is formed so as to open between the ribs 93 and to extend toward a sub-boss 91. In addition, the suction hole 122 is formed so as to extend substantially parallel with a discharge hole of a discharge portion (not shown).

[0054] The mounting bolt hole 123 is a hole into which a bolt used for securing the external refrigerant pipe is screwed.

[0055] As shown in Fig. 6, the mounting bolt hole 123 is a hole that extends from the outside to the inside of the cylindrical portion 77 and is substantially parallel with the suction hole 122.

[0056] A thick portion 124 that has machining allowance for the mounting bolt hole 123 and has a thickness (plate thickness) substantially the same as that of other portions is formed on the inner circumferential surface 77A at a position corresponding to the mounting bolt hole 123 in the cylindrical portion 77. The thick portion 124 has a casting surface that is not processed.

[0057] The motor case 67 is formed by, for example, die-casting, i.e., injecting a molten aluminum alloy into a metal mold. An inlet (sprue gate) for the molten aluminum alloy is preferably disposed on the bottom surface 79.

[0058] By doing so, cavities are less likely to be formed in the cylindrical portion 77 constituting a pressure vessel.

[0059] Next, compression of the refrigerant at the electric compressor 1 of this embodiment will be described.

[0060] As shown in Fig. 1, a DC current is supplied from outside of the inverter, is frequency controlled by an electronic device at the inverter unit 69, and is supplied to the motor unit 5.

[0061] In the motor unit 5, a stator 63 produces an AC magnetic field based on an AC current that is frequency controlled. The rotor 65 generates a rotational driving force due to interaction with the produced AC magnetic field. The rotational driving force generated by the rotor 65 is transmitted to the main shaft 11.

[0062] The rotational driving force is transmitted to the orbiting scroll at the scroll compression unit 3 via the main shaft 11. The orbiting scroll is driven so as to revolve while restricting its movement with a rotation-preventing portion (not shown).

[0063] When the orbiting scroll is driven to revolve, a compression chamber formed between it and the fixed scroll compresses the refrigerant, whose volume is reduced as it moves from an outer circumferential end toward the center.

[0064] The refrigerant compressed in the compression chamber is discharged into a discharge chamber through a discharge hole of the fixed scroll and discharged outside the housing from the discharge chamber.

[0065] With the above-described configuration, it is possible to prevent a machined surface or the like at the inner circumferential surface side from becoming adjacent to, for example, the screw holes 101 formed at the outer circumferential surface side in the cylindrical portion 77, thus preventing the refrigerant from leaking from

the inside to the outside of the cylindrical portion 77 or the like.

[0066] Specifically, because the thick portions 102 that are not machined are provided on the inner circumferential surface adjacent to, for example, the screw holes 101, it is possible to leave a casting surface including a chill layer or the like that has fewer cavities, such as shrinkage cavities, on the inner circumferential surface. Therefore, it is possible to reduce the probability of the above-described cavities passing through from the inside to the outside of, for example, the cylindrical portion 77, thus reducing the incidence of refrigerant leaks.

[0067] By providing the thick portions 102 or the like, it is possible to ensure sufficient thickness between, for example, the screw holes 101 and an inner circumferential portion in the cylindrical portion 77, thus preventing refrigerant leaks.

[0068] In other words, by ensuring sufficient thickness of the cylindrical portion 77, it is possible to reduce the probability of the above-described cavities passing through from the inside to the outside of the cylindrical portion 77, thus reducing the incidence of refrigerant leaks.

[0069] By injecting the molten metal from the cylindrical portion 77 to form the motor case 67 or the like, it is possible to reduce the incidence of cavities in the cylindrical portion 77. Accordingly, it is possible to reduce the probability of the above-described cavities passing through from the inside to the outside of the cylindrical portion 77, thus reducing the incidence of refrigerant leaks.

[0070] Because the suction hole 122 is formed between the ribs 93, it is possible to prevent interference between the suction hole 122 and the ribs 93, thus ensuring the strength of the cylindrical portion 77. More specifically, because the ribs 93 do not block the flow of the refrigerant flowing inside through the suction hole 122, the shape of the ribs 93 is not restricted. Therefore, the ribs 93 can be formed in any shape required to ensure the strength of the cylindrical portion 77, thus ensuring the strength of the cylindrical portion 77.

[0071] In addition, to avoid interference between the suction hole 122 and the ribs 93, compared with a case in which the positions of the suction hole 122 and the ribs 93 are shifted in the center axis direction of the cylindrical portion 77, it is possible to reduce the size of the cylindrical portion 77 in the center axis direction.

[0072] Because the suction hole 122 is formed so as to extend toward the sub-boss 91, the lubricating oil contained in the refrigerant flowing into the cylindrical portion 77 by passing through the suction hole 122 flows toward the sub-boss 91 together with the refrigerant and is supplied between the main shaft 11 and the sub-boss 91. Accordingly, lubrication between the main shaft 11 and the sub-boss 91 can be ensured.

[0073] Compared with a case in which the suction hole 122 and the discharge hole are formed in different directions, because the suction hole 122 and the discharge

hole are formed substantially in the same direction, it is possible to reduce the size in the width direction of the cylindrical portion 77, i.e., the size in a direction orthogonal to the center axis of the electric compressor 1.

[0074] In addition, in the above-described embodiment, a description is given of an example in which the machined portions, such as the screw holes 101, are formed on the outer circumferential of, for example, the cylindrical portion 77, and the casting surface is left on the inner circumferential surface 77A. However, it is not limited thereto; the casting surface may be left on the outer circumferential surface of, for example, the cylindrical portion 77, and the machined portions may be formed on the inner circumference.

Claims

1. An electric compressor for a vehicle air conditioner, wherein a case is formed by injecting a molten metal into a mold, and a compression unit for compressing a refrigerant is accommodated inside, and wherein a machined portion is formed on only one of an inner circumferential surface in contact with the refrigerant and an outer circumferential surface adjacent to the inner circumferential surface.
2. An electric compressor for a vehicle air conditioner according to Claim 1, wherein a thickness between the machined portion and an inner circumferential portion, or a thickness between the machined portion and an outer circumferential portion is larger than that between the inner circumferential surface and the outer circumferential surface.
3. An electric compressor for a vehicle air conditioner according to Claim 1 or 2, wherein a pressure case that accommodates the compression unit and an electrical-equipment case that accommodates electrical parts that control an electric motor for driving the compression unit are integrally provided in the case, and the molten metal is injected from the pressure case side.
4. An electric compressor for a vehicle air conditioner according to Claim 3, wherein the pressure case is a substantially cylindrical member having at least a bottom surface, a plurality of ribs that radially extend being provided on the bottom surface, and a suction hole through which the refrigerant flows into the pressure case from outside is provided so as to pass through between the plurality of ribs in the case.
5. An electric compressor for a vehicle air conditioner according to Claim 4, wherein a boss that supports

a rotation shaft of the compression unit is provided at the center portion of the bottom surface, and the suction hole is a through-hole extending toward the boss.

6. An electric compressor for a vehicle air conditioner according to Claim 4 or 5, wherein a discharge hole in which the refrigerant flows out from the pressure case is provided in the pressure case, and the suction hole and the discharge hole are formed substantially in the same direction with respect to the case.
7. An electric compressor for a vehicle air conditioner according to one of Claims 4 to 6, wherein the suction hole is located at a position higher than the central axis of the pressure case when the pressure case is attached to a desired attachment position.

FIG. 1

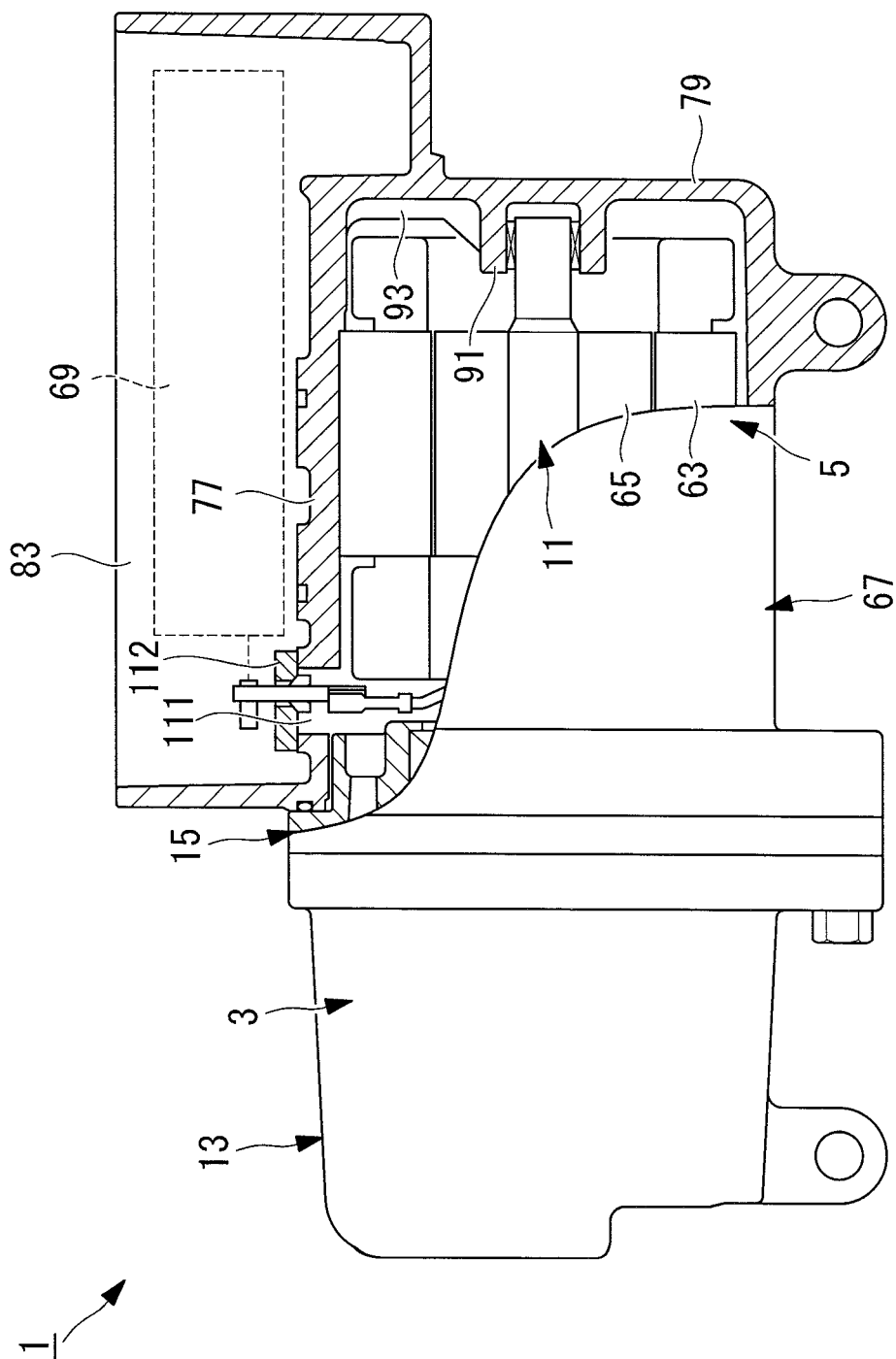


FIG. 2

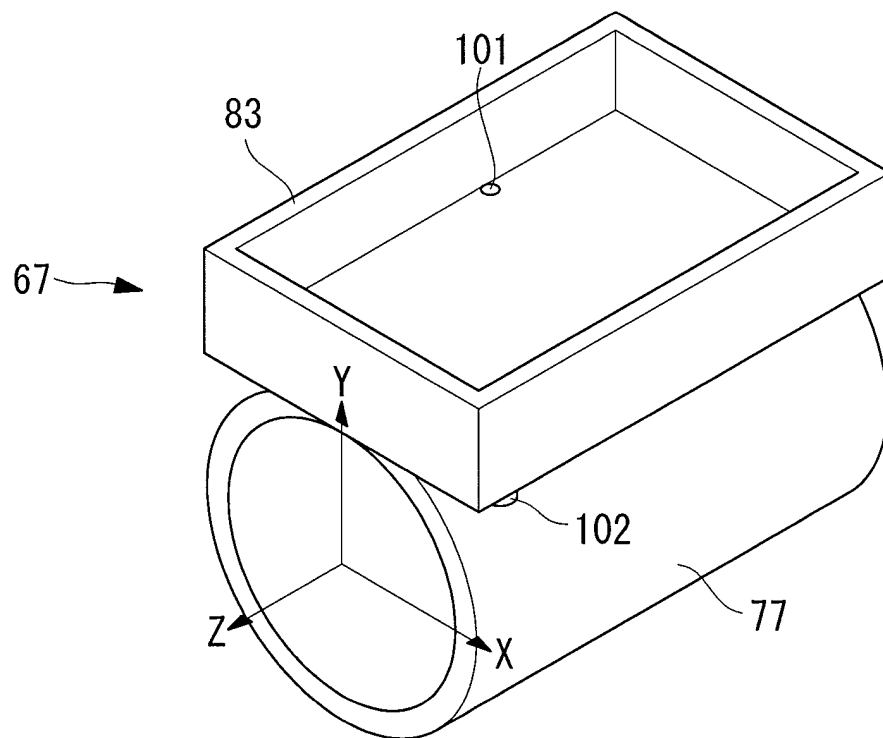


FIG. 3

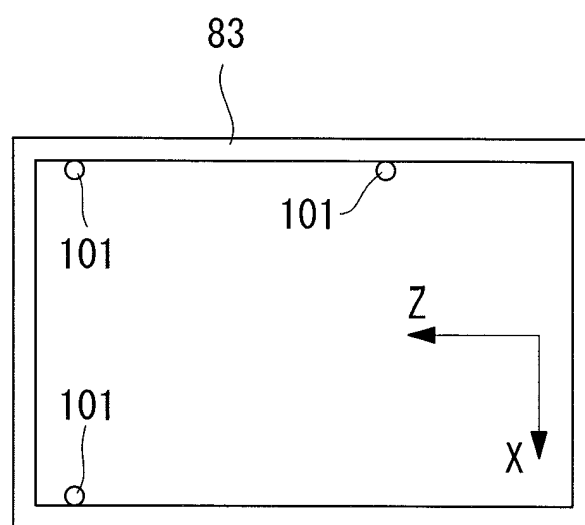


FIG. 4

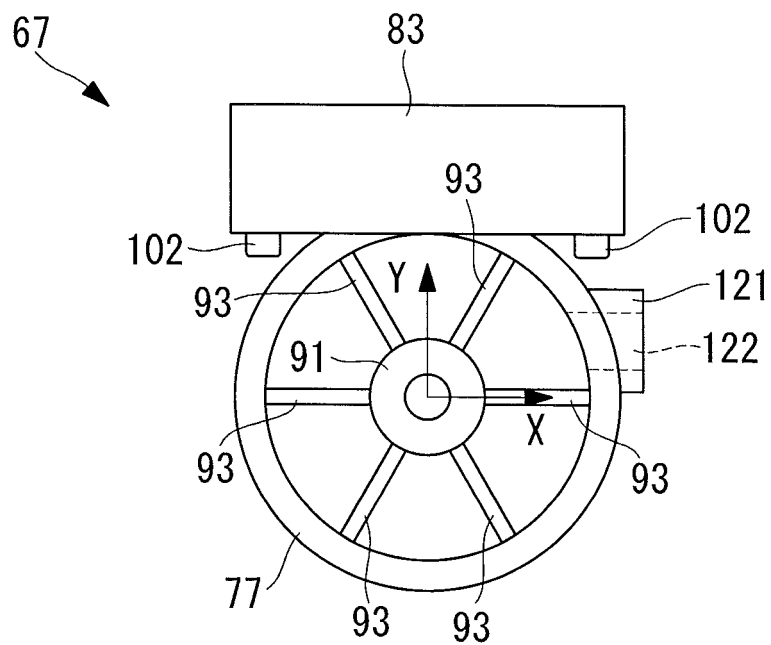


FIG. 5

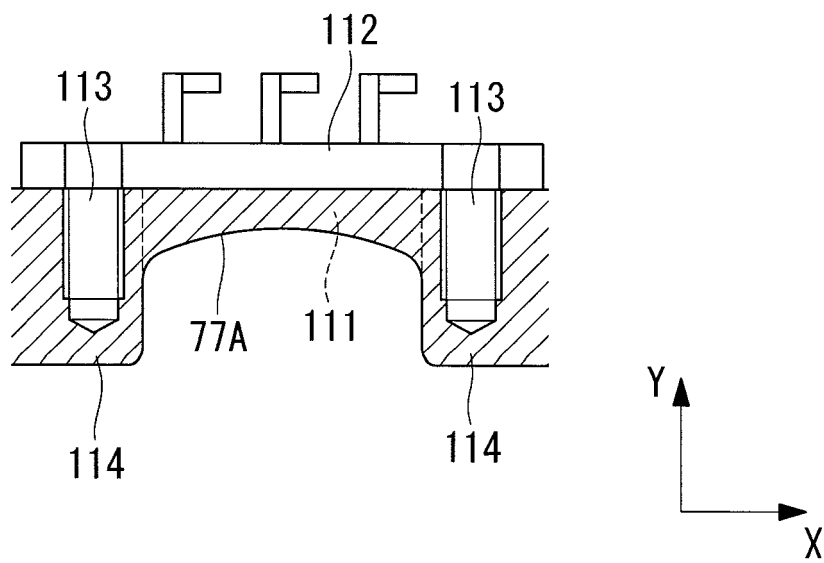
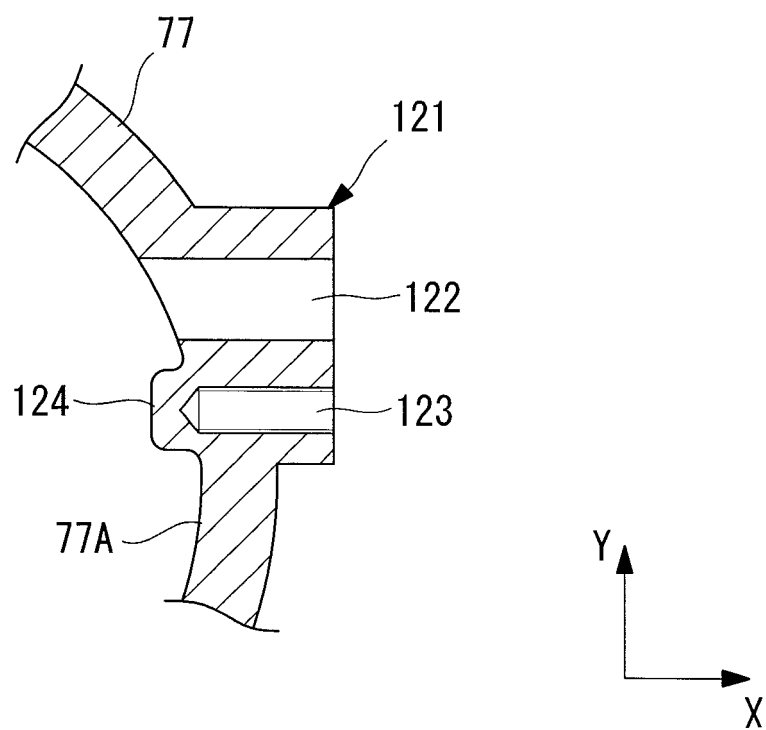


FIG. 6



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2008/067953

A. CLASSIFICATION OF SUBJECT MATTER

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

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F04B39/12, F04C29/00

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2008
Kokai Jitsuyo Shinan Koho	1971-2008	Toroku Jitsuyo Shinan Koho	1994-2008

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.
Y	JP 2004-44534 A (Toyota Industries Corp.), 12 February, 2004 (12.02.04), Par. Nos. [0014] to [0015]; all drawings & US 2004/13543 A1 & EP 1382849 A2	1-7
Y	JP 54-162217 A (Hitachi, Ltd.), 22 December, 1979 (22.12.79), Full text; all drawings (Family: none)	1-7
Y	JP 7-155928 A (Toshiyuki TSUKAMOTO, Enbishi Arumihairu Kabushiki Kaisha), 20 June, 1995 (20.06.95), Par. No. [0021] (Family: none)	3-7



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

18 December, 2008 (18.12.08)

Date of mailing of the international search report

06 January, 2009 (06.01.09)

Name and mailing address of the ISA/

Japanese Patent Office

Authorized officer

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2008/067953

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Form PCT/ISA/210 (continuation of second sheet) (April 2007)

REFERENCES CITED IN THE DESCRIPTION

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- JP 2007128756 A [0004]
- JP 2005180292 A [0004]