(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 113 665 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
04.11.2009 Bulletin 2009/45

(21) Application number: **08711343.7**

(22) Date of filing: **15.02.2008**

(51) Int Cl.:
F04B 39/12 *(2006.01)* ***F04B 39/02*** *(2006.01)*
F04C 29/02 *(2006.01)*

(86) International application number:
PCT/JP2008/052513

(87) International publication number:
WO 2008/102698 (28.08.2008 Gazette 2008/35)

(84) Designated Contracting States:
DE FR GB

(30) Priority: **20.02.2007 JP 2007039778**
12.07.2007 JP 2007183105

(71) Applicant: **Calsonic Kansei Corporation**
Saitama-shi, Saitama 331-8501 (JP)

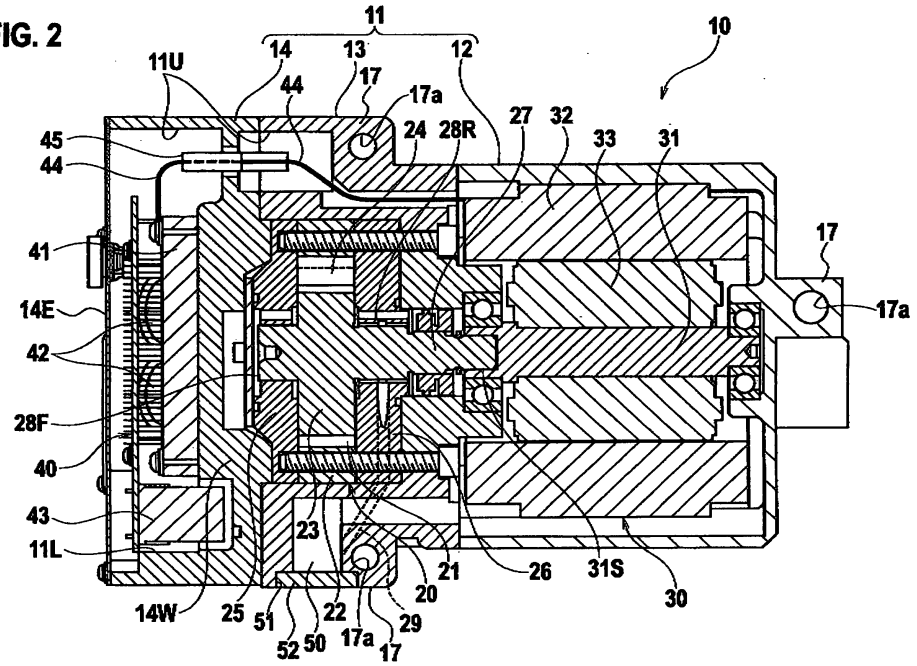
(72) Inventors:
- **Toshiharu, Watanabe**
  Saitama 331-8501 (JP)
- **Yutaka, Satou**
  Saitama 331-8501 (JP)
- **Masaki, Watanabe**
  Saitama 331-8501 (JP)

(74) Representative: **Grünecker, Kinkeldey,**
Stockmair & Schwanhäusser
Anwaltssozietät
Leopoldstrasse 4
80802 München (DE)

(54) ELECTRIC COMPRESSOR

(57) A lubricating oil reservoir provided at the bottom of a housing is placed under the compression mechanism or electric motor in the vicinity of the mounting bracket provided on the lower outside of a middle case. The lubricating oil reservoir can be provided efficiently using dead space formed under the compression mechanism in the housing, and the rigidity of the mounting bracket can secure the strength of the lubricating oil reservoir.

FIG. 2



EP 2 113 665 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to an electric compressor integrally including a compression mechanism and an electric motor.

BACKGROUND ART

[0002] In one of conventionally known electric compressors, a compression mechanism and an electric motor driving the same are accommodated in a housing, at the bottom of which a reservoir of lubricating oil for lubrication of required lubrication portions of the compression mechanism is provided.

[0003] Patent Literature 1 discloses a transverse-mounted electric compressor. In such a structure, for example, part of the housing accommodating the electric motor is extended axially outward, and the lubricating oil reservoir is provided for the extended part. The lubricating oil within the reservoir is supplied to the required lubrication portions of the compression mechanism, and the lubricating oil is returned to the lubricating oil reservoir.

[0004] However, in such a conventional electric compressor, the lubricating oil reservoir is provided for the axially extended part of the housing. The housing is inevitably elongated in the axial direction, thus resulting in an increase in size of the electric compressor.

[0005] The lubricating oil reservoir is provided at the portion of the housing just extended. Accordingly, it is necessary to employ a reinforcing structure, such as increasing wall thickness of the housing or providing a reinforcement rib, in order to reinforce the lubricating oil reservoir, thus causing an increase in weight.

[0006] An object of the present invention is to provide an electric compressor in which the lubricating oil reservoir can be reinforced using an existing constituent member while the housing is prevented from being elongated in the axial direction.

Patent Literature 1: Japanese Patent Laid-open Publication No. 6-2684

DISCLOSURE OF THE INVENTION

[0007] In the present invention, an electric compressor includes: a housing accommodating at least a compression mechanism and an electric motor driving the compression mechanism; and a mounting bracket protruded at least at lower outside of the housing, in which a lubricating oil reservoir provided at the bottom of the housing is placed under the compression mechanism or electric motor in the vicinity of the mounting bracket.

[0008] Moreover, in the present invention, the electric compressor further includes: a discharge port opened in the housing, through which fluid compressed by the compression mechanism is discharged to the outside of the housing; a pressure introduction path allowing the discharge port and lubricating oil reservoir to communicate with each other; and a lubricating oil feeding path allowing the lubricating oil reservoir and a sliding portion of the compression mechanism to communicate with each other.

BRIEF DESCRIPTION OF TO DRAWINGS

[0009]

[FIG.1] FIG. 1 is a perspective view of a whole electric compressor according to a first embodiment of the present invention.

[FIG.2] FIG. 2 is a longitudinal section view of the electric compressor according to the first embodiment of the present invention.

[FIG.3] FIG. 3 is a longitudinal section view of an electric compressor according to a second embodiment of the present invention.

[FIG.4] FIG. 4 is a cross section view taken along a line IV-IV of FIG. 3.

[FIG.5] FIG. 5 is a rear view of the electric compressor according to the second embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0010] Hereinafter, a description is given of preferred embodiments of the present invention in detail with reference to the drawings. The embodiments are examples of an electric compressor applied to a refrigeration cycle of an air conditioner of a vehicle. In this case, fluid compressed by the electric compressor is a refrigerant of the refrigeration cycle.

(First Embodiment)

[0011] FIG. 1 is a perspective view of a whole electric compressor according to a first embodiment of the present invention, and FIG. 2 is a longitudinal section view of the electric compressor.

[0012] In an electric compressor 10 according to this embodiment, as shown in FIGS. 1 and 2, a rear case 12, a middle case 13, and a front case 14, which are separated in the axial direction (in the horizontal direction of FIG. 2), are joined to each other to constitute a housing 11. As shown in FIG. 2, the middle case 13 accommodates a compression mechanism 20; the rear case 12 accommodates an electric motor 30; and the front case 14 accommodates a motor drive circuit 40 controlling energization of the electric motor 30.

[0013] As shown in FIG. 1, refrigerant introduced into the housing 11 through an introduction port 15 formed in the middle case 13 is compressed by the compression mechanism 20 and is then discharged through a discharge port 16 formed in the rear case 12.

[0014] The compression mechanism 20 is configured

as a rotary type with vanes. The compression mechanism 20 schematically includes a cylinder block 22, a compressor rotor 23, a plurality of vanes 24, and inlet and outlet side blocks 25 and 26. The cylinder block 22 includes a cylinder chamber 21 formed in a non-circular shape with a smooth inner circumference as shown in FIG. 2. The compressor rotor 23 is rotatably accommodated in the cylinder chamber 21. The vanes 24 are provided on the outer circumference of the compressor rotor 23 so as to be freely retracted and extended and are arranged circumferentially at predetermined intervals. The tips of the vanes 24 slide on the inner circumferential surface of the cylinder chamber 21. The inlet and outlet side blocks 25 and 26 are arranged on the both sides of the cylinder block 22 in the axial direction and close both axial ends of the cylinder chamber 21. The compressor rotor 23 slides on the inlet and outlet side blocks 25 and 26.

[0015] In the inlet side block 25 on the left side of FIG. 2, an inlet port (not shown) is formed so that the refrigerant introduced from the introduction port 15 is introduced into the cylinder chamber 21 through the inlet port. In outer peripheral part of the cylinder block 22 or the right outlet side block 26, an outlet port (not shown) is formed, through which the compressed refrigerant in the cylinder chamber 21 is discharged.

[0016] Accordingly, in the compression mechanism 20, the compressor rotor 23 is rotated with a drive shaft 31 of the electric motor 30 to change the circumferential volume of the cylinder chamber 21 while retracting and advancing the vanes 24. The refrigerant at low pressure which is sucked into the cylinder 21 through the inlet port is compressed, and the compressed refrigerant at high pressure is discharged through the outlet port.

[0017] The refrigerant at high pressure discharged from the outlet port passes through a channel between the inner circumference of the middle case 13 and the compression mechanism 20 and then passes through the rear case 12 accommodating the electric motor 30 to be discharged from the discharge port 16. At this time, the refrigerant passing through the rear case 12 cools part of the electric motor 30 generating heat.

[0018] The electric motor 30 includes a cylindrical stator 32 pressed into and fixed to the inner circumference of the rear case 12 and a rotor 33 rotatably accommodated in the stator 32. A plurality of coil portions provided on the stator 32 circumferentially at constant intervals are energized to excite the stator 32, thus rotating the rotor 33.

[0019] In the center of the rotor 33, the drive shaft 31 is inserted and engaged so as not to move relative to the rotor 33 in a rotating direction. An end (the left end in the drawing) of the drive shaft 31 is coupled with an end (the right end in the drawing) of the compressor rotor 23 of the compression mechanism 20 with a non-circular fitting portion 31S. The rotation of the drive shaft 31 is thus transmitted to the compressor rotor 23.

[0020] In the middle case 13 side of the front case 14, as shown in FIG. 2, a partition wall 14W is provided. The other end of the front case 14 is opened. The open end is closed by an end plate 14E after the motor drive circuit 40 is accommodated in the front case 14 from the open side.

The motor drive circuit 40 is provided with a substrate 41. On the substrate 41, an inverter including electronic parts such as a switching device switching on and off of a circuit (for example, a MOS-FET, an IGBT, or the like) is mounted.

[0021] The motor drive circuit 40 and the coil portions provided for the stator 32 of the electric motor 30 are electrically connected through a harness 44. In the middle of the harness 44, a hermetic terminal 45 is provided. The connection terminal 45 is located within an upper space portion 11U formed by projecting upper part of the middle and front cases 13 and 14.

[0022] On the outside of the housing 11, mounting brackets 17 are partially protruded, with which the electric compressor 10 is mounted in an engine room, for example, on a cylinder block of the engine or the like.

[0023] The mounting brackets 17 are protruded at total three places on the upper and lower outside of the middle case 13 (see FIGS. 1 and 2) and an end of the rear case 12 (see FIG. 2). Each of the mounting brackets 17 is integrally protruded on the outer circumference of the middle or rear case 13 or 12 in a rib shape. In each mounting bracket 17, a mounting hole 17a is formed, through which a mounting bolt (not shown) is inserted so as to penetrate perpendicular to the axial direction of the housing 11.

[0024] In this embodiment, a lubricating oil reservoir 50 provided at the bottom of the housing 11 is placed under the compression mechanism 20 in the vicinity of the mounting bracket 17 (the mounting bracket 17 provided at the lower outside of the middle case 13).

[0025] As shown in FIG. 2, at the bottom of the front case 14, a lower space portion 11L for accommodating an electronic part 43 of the motor drive circuit 40 is projected so as to have a width W2 slightly smaller than a horizontal width W1 of the attachment bracket 17. The lubricating oil reservoir 50 is formed between the lower space portion 11L and the mounting bracket 17 so that bottom part of the middle case 13 is projected to have a width W1 equal to the mounting bracket 17.

[0026] At the bottom of the lubricating oil reservoir 50, an opening 51 is formed which is air-tightly closed detachably with a plug 52.

[0027] On the other hand, in the compression mechanism 20, a rotation shaft 27 of the compressor rotor 23 is rotatably supported through sliding bearings 28F and 28R which are respectively formed in the side blocks 25 and 26 on both sides thereof in the axial direction. An oil path 29 (a lubricating oil feeding path) allowing the sliding bearing 28R (in the right side in the drawing) and the bottom of the lubricating oil reservoir 50 to communicate with each other is formed. The lubricating oil within the lubricating oil reservoir 50 is sucked into the sliding bear-

ing 28R along with rotation of the compressor rotor 23.

[0028] According to the electric compressor 10 of this embodiment, the lubricating oil reservoir 50 provided at the bottom of the housing 11 is placed under the compression mechanism 20. Accordingly, the lubricating oil reservoir 50 can be provided by effectively using dead space within the housing 11 formed under the compression mechanism 20. The lubricating oil reservoir 50 can be thus provided without extending the housing 11 in the axial direction. It is therefore possible to prevent the housing 11 from being elongated in the axial direction and prevent the electric compressor 10 from increasing in size.

[0029] Moreover, the lubricating oil reservoir 50 is placed in the vicinity of the mounting bracket 17 protruded on the lower outside of the housing 11. Accordingly, the rigidity of the existing mounting bracket 17 can secure the strength of the lubricating oil reservoir 50. It is therefore possible to prevent the electric compressor 10 from increasing in weight.

(Second Embodiment)

[0030] FIG. 3 is a longitudinal section view of an electric compressor according to the second embodiment of the present invention; FIG. 4 is a cross-section view along a line IV-IV of FIG. 3; and FIG. 5 is a rear view of the electric compressor according to this embodiment. An electric compressor 10A according to this embodiment includes the same constituent elements as those of the electric compressor 10 according to the first embodiment. Hereinafter, the same constituent elements are given the same reference numerals, and the redundant description is omitted.

[0031] The electric compressor 10A according to this embodiment differs from the first embodiment (see FIG. 2) in that two mounting brackets 17 and 17 are provided on the lower outside of the housing 11 so as to be separated from each other in the axial direction.

[0032] More specifically, one of the mounting brackets 17 and 17 is protruded on the lower outside of the rear case 12, and the other mounting bracket 17 is protruded on the lower outside of the middle case 13.

[0033] In this embodiment, a lubricating oil reservoir 50A is provided across the rear and middle cases 12 and 13 between the two mounting brackets 17 and 17.

[0034] In this embodiment, the lubricating oil reservoir 50A is provided under the electric motor 30.

[0035] The lubricating oil reservoir 50A communicates through a pressure introduction path 61 with a discharge port 16A opened in the upper part of the rear end of the rear case 12. This pressure introduction path 61 penetrates through inside of the outer wall of the rear case 12.

[0036] More specifically, the pressure introduction path 61 includes a vertical path 61a extending downward from the discharge port 16A opened in the upper part of the rear end of the rear case 12 and a horizontal path 61b extending from the bottom end of the vertical path 61a in the axial direction and communicating with the lubricating oil reservoir 50A.

[0037] As shown in FIG. 3, a lubricating oil introduction path 63 extended downward and opened to the outside of the housing 11 is branched from the middle of the pressure introduction path 61. The opening of the lubricating oil introduction path 63 is plugged with a cap 64.

[0038] An oil path 62 (lubricating oil feeding path) which allows the front end (the left end in FIG. 3) of the lubricating oil reservoir 50A and a sliding portion (a bearing hole) of the compression mechanism 20 to communicate with each other penetrates through inside of the middle case 13 and side block 26 in this embodiment.

[0039] According to the electric compressor 10A of this embodiment, the lubricating oil reservoir 50A is provided between the mounting brackets 17 and 17 protruded on the lower outside of the housing 11, thus achieving an efficient use of dead space. Accordingly, the lubricating oil reservoir 50A can be provided without extending the housing 11 in the axial direction. It is therefore possible to prevent the housing 11 from being elongated in the axial direction and prevent the electric compressor 10A from increasing in size.

[0040] Moreover, the pressure of the discharge port 16A acts on oil within the lubricating oil reservoir 50A through the pressure introduction path 61, which feeds the lubricating oil to the sliding portion of the compression mechanism 20. Accordingly, it is unnecessary to provide a pump for feeding lubricating oil, thus reducing the number of components.

[0041] The pressure introduction path 61 allows the discharge port 16A and lubricating oil reservoir 50A to communicate with each other not through internal space of the rear case 12. Accordingly, the pressure introduction path 61 can be used as an oil filling path. When filling oil into the lubricating oil reservoir 50A through the discharge port 16A, oil does not adhere to any component arranged in the internal space of the rear case 12 (the electric motor 30 in this example), whereby the oil can be filled in the lubricating oil reservoir 50A more reliably.

[0042] In this embodiment, the pressure introduction path 61 allowing the discharge port 16A and lubricating oil reservoir 50A to communicate with each other is formed to be downwardly inclined. Accordingly, the oil separated from the refrigerant at the discharge port 16A is naturally fed by gravity to the lubricating oil reservoir 50A through the pressure introduction path 61. It is more effective that the discharge port 16 is provided with an oil separator.

[0043] In FIG. 3, the harness 44 from the connection terminal 45 is partially shown, and some of the constituent parts within the front case are omitted.

[0044] Hereinabove, the description is given of the preferred embodiments of the present invention. However, the present invention is not limited to the aforementioned embodiments and can be variously modified. For example, the present invention is not limited to the electric compressor used for a refrigeration cycle of the air con-

ditioner, and the fluid treated in the electric compressor is not limited to the refrigerant. Moreover, the compressor may be an eccentric roller type rotary compressor or may be other than the rotary compressors.

INDUSTRIAL APPLICABILITY

[0045] The present invention is available for electric compressors.

Claims

1. An electric compressor comprising:

a housing accommodating at least a compression mechanism and an electric motor driving the compression mechanism; and
a mounting bracket protruded at least at lower outside of the housing, wherein
a lubricating oil reservoir provided at the bottom of the housing is placed under the compression mechanism or electric motor in the vicinity of the mounting bracket.

2. The electric compressor according to claim 1, further comprising:

a discharge port opened in the housing, through which fluid compressed by the compression mechanism is discharged to the outside of the housing;
a pressure introduction path allowing the discharge port and lubricating oil reservoir to communicate with each other; and
a lubricating oil feeding path allowing the lubricating oil reservoir and a sliding portion of the compression mechanism to communicate with each other.

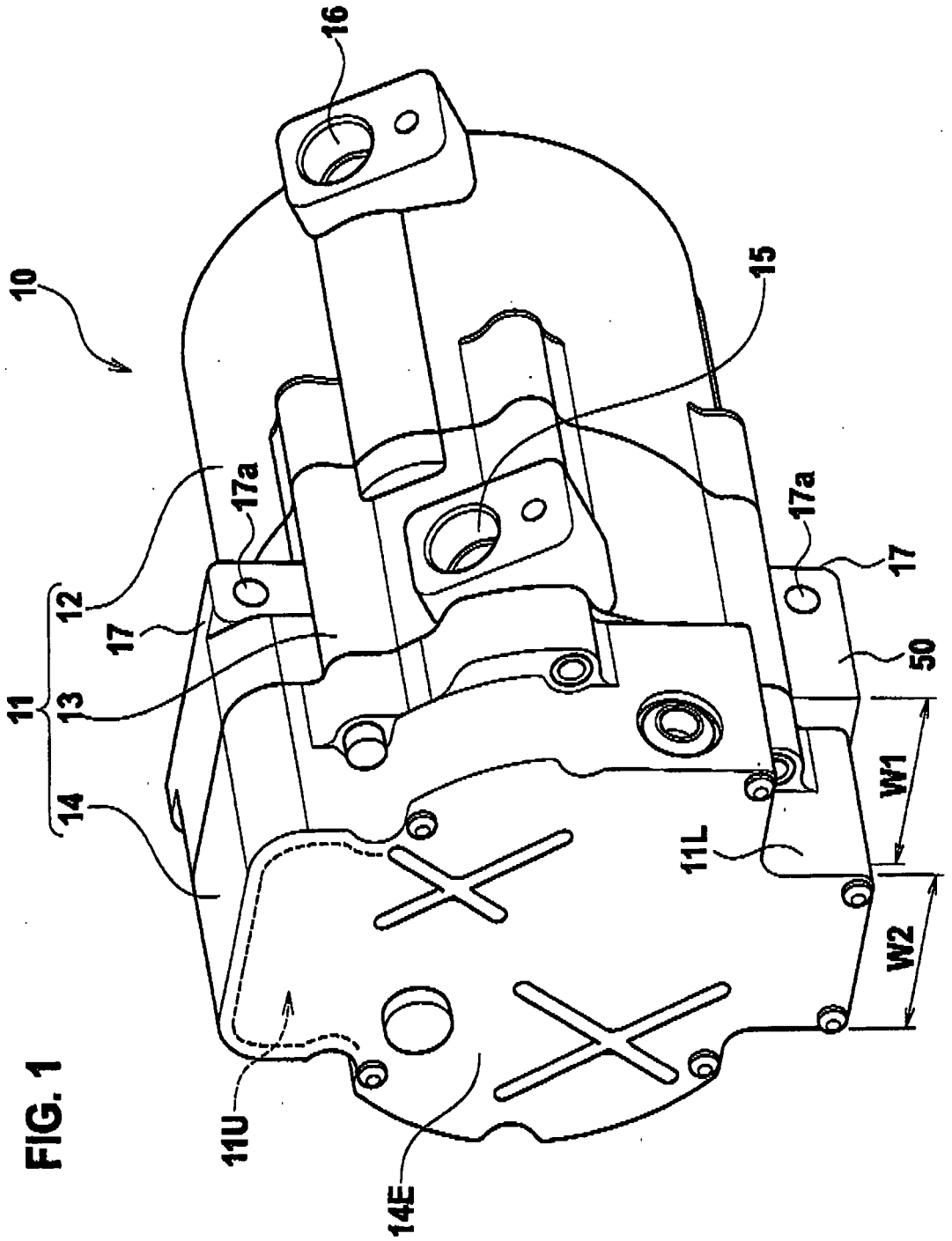


FIG. 1

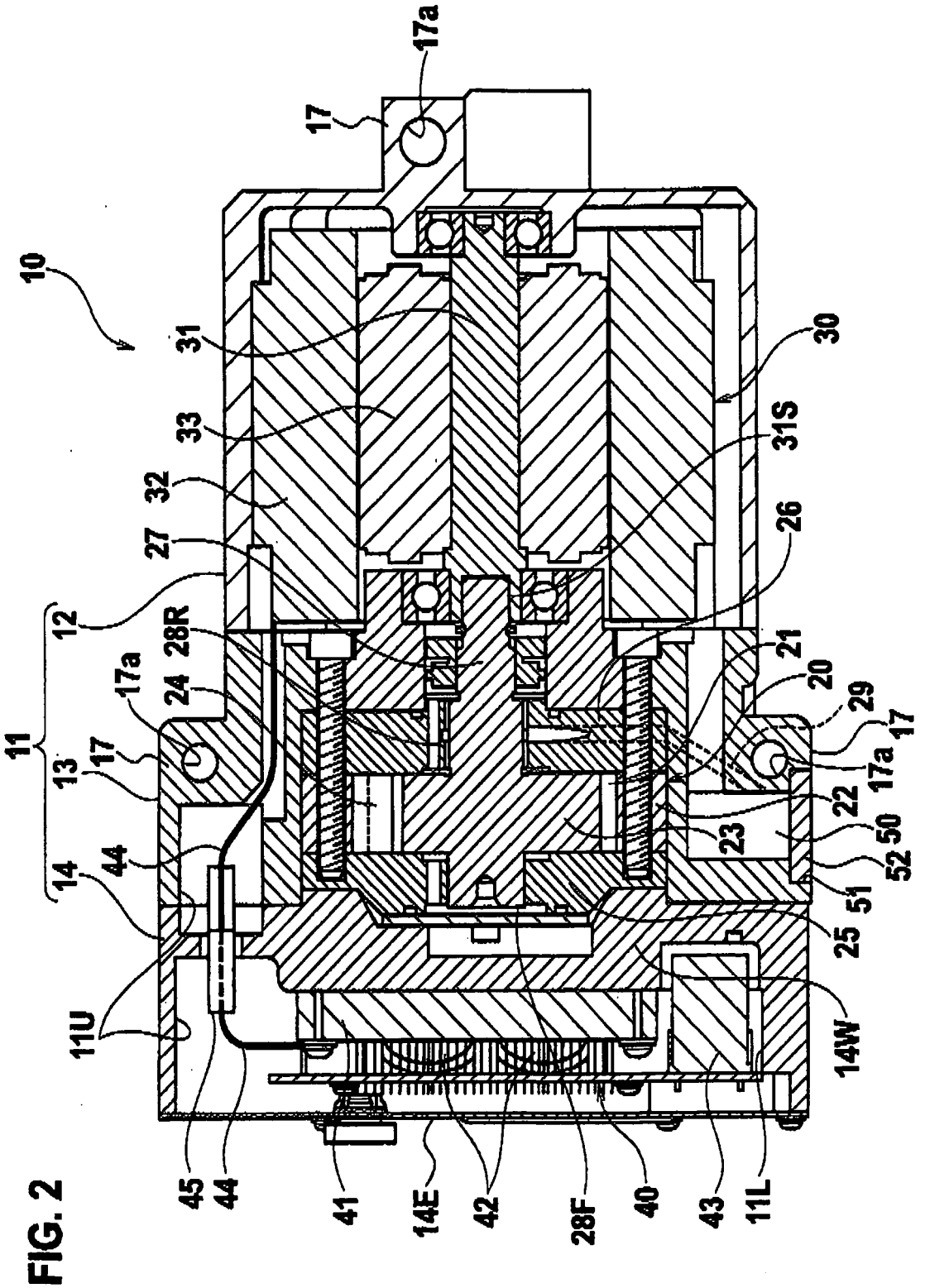

10
11
12
13
14
17
17a
24
28R
31
33
32
27
30
31S
26
21
20
29
22
23
50
52
51
25
14W
11U
45
44
41
14E
42
28F
40
43
11L

FIG. 2

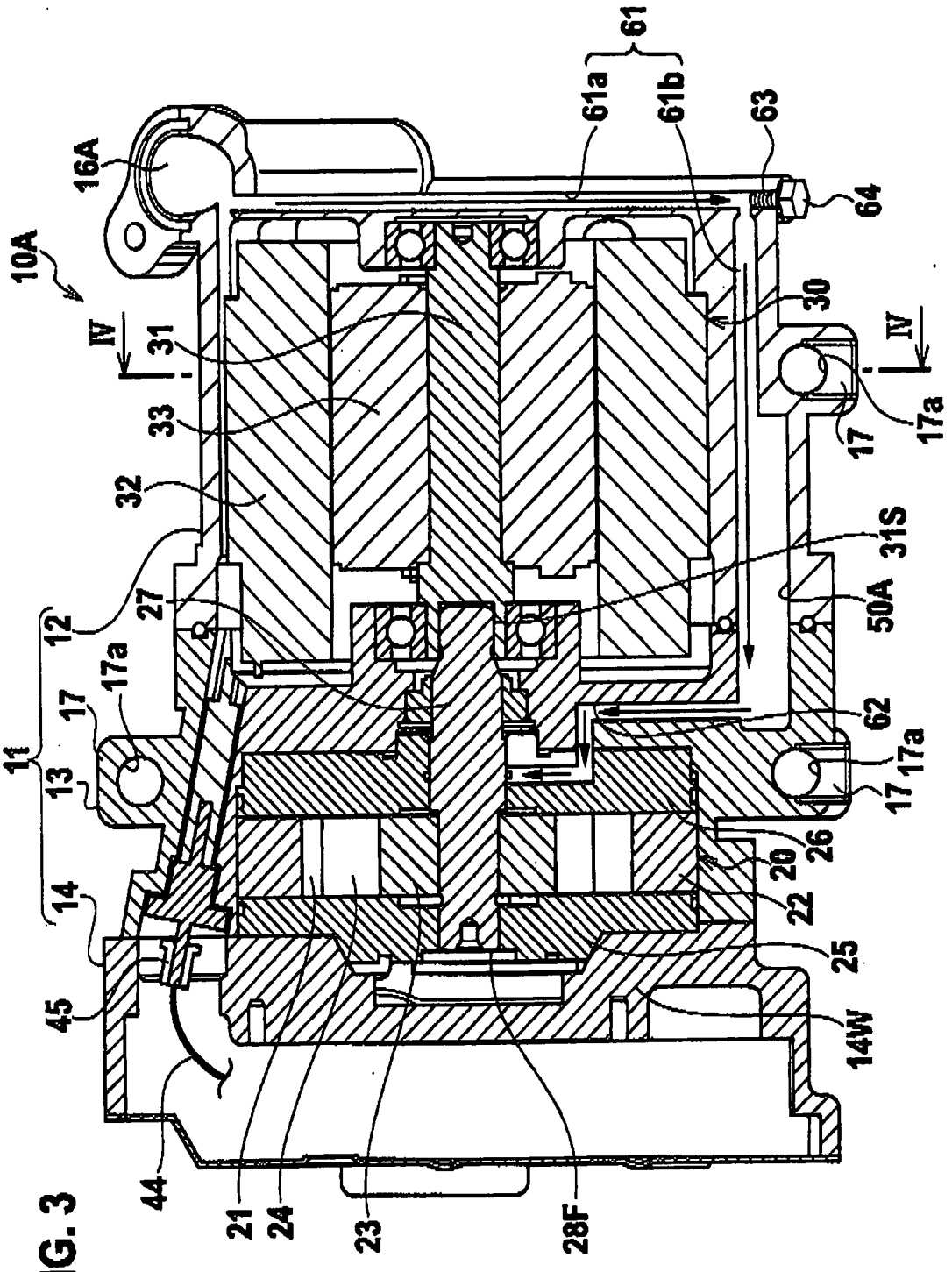

61
61a
61b
63
64
16A
10A
IV
31
30
33
32
17
17a
31S
50A
27
12
62
11
13
14
45
20
26
22
25
14W
44
21
24
23
28F

FIG. 3

FIG. 4

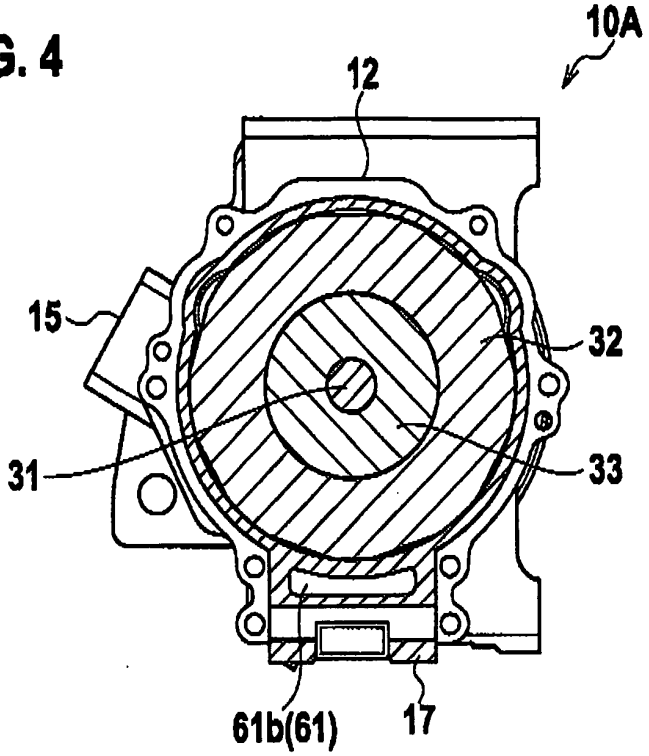
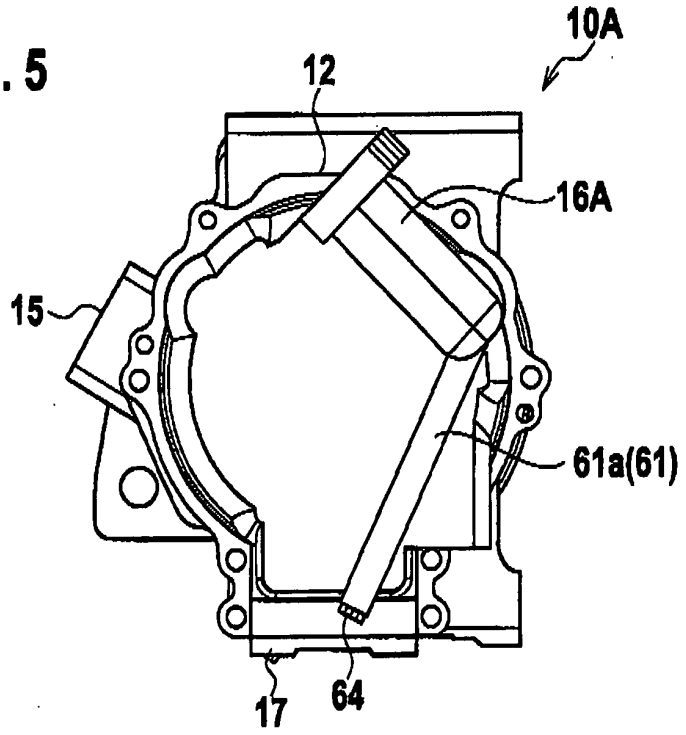


FIG. 5



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2008/052513

A. CLASSIFICATION OF SUBJECT MATTER
F04B39/12(2006.01)i, *F04B39/02*(2006.01)i, *F04C29/02*(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, F04B39/02, F04C29/02, 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.
X Y	JP 60-184984 A (Hitachi, Ltd.), 20 September, 1985 (20.09.85), Full text; Fig. 2 (Family: none)	1 2
X	JP 61-118571 A (Tecumseh Products Co.), 05 June, 1986 (05.06.86), Full text; Fig. 1 & US 4576555 A & GB 2166809 A & FR 2573135 A & BR 8505489 A & CA 1246507 A & CN 85107645 A	1
Y A	JP 2004-232569 A (Hitachi, Ltd.), 19 August, 2004 (19.08.04), Par. No. [0017]; Figs. 1 to 2 & US 2004/0208771 A1 & TW 235203 B & CN 1550673 A	2 1

☐ 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, 2008 (08.04.08)	22 April, 2008 (22.04.08)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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

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 6002684 A **[0006]**