



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

(43) Date of publication:
13.04.2011 Bulletin 2011/15

(51) Int Cl.:
F04B 39/00 (2006.01) F04C 29/00 (2006.01)

(21) Application number: **09773412.3**

(86) International application number:
PCT/JP2009/061749

(22) Date of filing: **26.06.2009**

(87) International publication number:
WO 2010/001834 (07.01.2010 Gazette 2010/01)

(84) Designated Contracting States:
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 SE SI SK TR
Designated Extension States:
AL BA RS

- **OHSATO Kazumi**
Isesaki-shi
Gunma 372-8502 (JP)
- **KOBAYASHI Eiji**
Isesaki-shi
Gunma 372-8502 (JP)
- **KURIBARA Tadashi**
Isesaki-shi
Gunma 372-8502 (JP)

(30) Priority: **02.07.2008 JP 2008173462**

(71) Applicant: **Sanden Corporation**
Isesaki-shi
Gunma 372-8502 (JP)

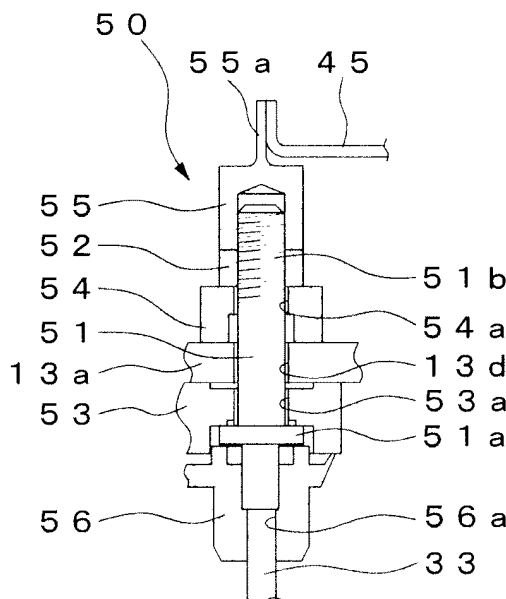
(74) Representative: **Grünecker, Kinkeldey, Stockmair & Schwanhäusser**
Anwaltssozietät
Leopoldstrasse 4
80802 München (DE)

(72) Inventors:
• **TAGUCHI Masanori**
Isesaki-shi
Gunma 372-8502 (JP)

(54) **ELECTRIC COMPRESSOR**

(57) The present invention provides an electric compressor in which a lead wire on the motor driving circuit side can be electrically connected positively to a sealed terminal. Because the sealed terminal is formed from a terminal body which is made of a metal having electrical conductivity and whose end is provided with a male threaded portion, and a joining nut made of a metal having electrical conductivity and which is different from the material for the terminal body, and is threadably mounted on the male threaded portion of the terminal body, it is possible to positively join the joining nut of a different material to the terminal body and to positively join the lead wire of the same material as the joining nut to the joining nut by welding, whereby it becomes possible to electrically connect a lead wire on the driving circuit housing chamber side positively to the sealed terminal.

FIG. 2



Description

Technical Field

[0001] The present invention relates to an electric compressor provided with a motor for driving a compression section, a motor driving circuit for driving the motor, and a sealed terminal for electrically connecting the motor and the motor driving circuit.

Background Art

[0002] As an electric compressor of this kind, there has hitherto been known an electric compressor which is provided with a compression section for compressing a cooling medium, a motor for driving the compression section, a motor driving circuit for driving the motor, and a sealed terminal which is provided in a partition wall for partitioning a space between the motor and the motor driving circuit and is intended for electrically connecting a lead wire on the motor side and a lead wire on the motor driving circuit side (refer to Patent Document 1, for example).

Prior Art Document

Patent Document

[0003]

Patent Document 1: Japanese Patent Publication No. 11-324920

Summary of The Invention

Problems to be Solved by The Invention

[0004] In conventional electric compressor, in connecting a lead wire on the motor driving circuit side to a sealed terminal, the lead wire is welded to the sealed terminal or connecting is performed by using a connector. However, because the sealed terminal is made of a ferrous metal and the lead wire on the motor driving circuit side is made of a cuprous metal, in welding the lead wire on the motor driving circuit side to the sealed terminal, welding becomes difficult because these have different melting points. Also, in connecting the lead wire on the motor driving circuit side to the sealed terminal by using a connector, the connection is accomplished only by the elastic force of the metal material for the connector. Therefore, the area of contact between the sealed terminal and the lead wire is small and hence this connection method is not suitable for the application of a large current.

[0005] The object of the present invention is to provide an electric compressor in which a lead wire on the motor driving circuit side can be electrically connected positively to a sealed terminal.

Means for Solving The Problem

[0006] In order to achieve the above object, the present invention provides an electric compressor which includes: a compression section for compressing a cooling medium, a motor for driving the compression section, a motor driving circuit for driving the motor, a sealed terminal which is provided in a partition wall for partitioning a space between the motor and the motor driving circuit and is intended for electrically connecting a lead wire on the motor side and a lead wire on the motor driving circuit side. In this electric compressor, the sealed terminal has a terminal body which is made of a metal having electrical conductivity and whose end is provided with a male threaded portion, and a joining member made of a metal having electrical conductivity and which is different from the material for the terminal body. The joining member is provided so as to be capable of being screwed to the male threaded portion of the terminal body.

[0007] As a result of this, the joining member is screwed to the male threaded portion of the terminal body and, therefore, it becomes possible to positively join the joining member made of a different material to the terminal body.

Effects of The Invention

[0008] According to the present invention, because it is possible to positively join the joining member of a different material to the terminal body and to positively join the lead material of the same material as the joining member to the joining nut by welding, it becomes possible to electrically connect a lead wire on the motor driving circuit side positively to the sealed terminal.

Brief Description of The Drawings

[0009]

Figure 1 is a side sectional view of an electric compressor in an embodiment of the present invention. Figure 2 is a sectional view of a sealed terminal.

Figure 3 is an exploded perspective view of the sealed terminal.

Figure 4 is a sectional view showing another example of a sealed terminal.

Preferred Embodiment of The Invention

[0010] Figures 1 to 3 show an embodiment of the present invention.

[0011] The electric compressor of the present invention is a scroll-type electric compressor which is provided with a housing 10 formed in cylindrical shape, a compression section 20 for compressing a cooling medium, a motor 30 for driving the compression section 20, and a driving circuit section 40 as a motor driving circuit for performing the operation control of the motor 30, and for

example, HFC-134a and carbon dioxide are used as a cooling medium.

[0012] The housing 10 is composed of a first housing 11 in which the compression section 20 is housed, a second housing 12 in which the motor 30 is housed, and a third housing 13 in which the driving circuit section 40 is housed.

[0013] The first housing 11 is such that one end surface thereof is closed and the other end surface thereof is joined to one end surface of the second housing 12. A cooling medium discharge port, which is not shown, is provided on a peripheral surface of the first housing 11 on the side of the one end surface.

[0014] The second housing 12 is such that one end surface thereof is joined to the first housing 11 and the other end surface thereof is joined to one end surface of the third housing 13.

[0015] The first housing 11 and the second housing 12 are joined together by a bolt 14 via a center plate 25, which will be described later, for rotatably supporting the side of one end of a driving shaft, which will be described later, for driving the compression section 20.

[0016] The third housing 13 is such that the side of one end surface thereof is joined to the second housing 12 and the side of the other end surface thereof is closed by a closing plate 15 so as to be openable. A cooling medium suction port is provided on a peripheral surface of the third housing 13 on the side of one end surface thereof. Furthermore, the third housing 13 is such that the interior thereof is partitioned by a partition wall 13a into the side of one end surface including the cooling medium suction port and the side of the other end surface, and the third housing 13 is provided with a driving circuit housing chamber 13b for housing the driving circuit section 40 and a cooling medium suction chamber 13c in communication with the motor 30 side.

[0017] The compression section 20 has a fixed scroll member 21 fixed to the side of one end of the first housing 11 and a turning scroll member 22 provided on the side of the other end of the first housing 11 so as to be rotatable with respect to the fixed scroll member 21.

[0018] The fixed scroll member 21 is formed from a member in the shape of a disk provided so as to divide the interior of the first housing 11, and a convoluted body 21a is provided on a surface on the turning scroll member 22 side. In the radially middle part of the fixed scroll member 21, there is provided a cooling medium discharge hole 21b for discharging a cooling medium compressed in the compression section 20. A cooling medium discharge chamber 11a is provided between one end surface in the first housing 11 and the fixed scroll member 21 so that a cooling medium discharged from the cooling medium discharge port flows into the cooling medium discharge chamber 11a.

[0019] The turning scroll member 22 is such that a convoluted body 22a is provided on the surface thereof on the fixed scroll member 21 side, and to the surface on the opposite side, there is connected, via a driving bush

24, the side of one end of a driving shaft 23 for transmitting the torque of the motor 30.

[0020] The driving shaft 23 is provided so as to extend along the central axis of the second housing 12. The driving shaft 23 is provided in such a manner that a connection 23a to the driving bush 24 is eccentric from the rotation center of the driving shaft 23. Also, the driving shaft 23 is such that the side of one end thereof is rotatably supported by a center plate 25 provided between the compression section 20 and the motor 30 via a ball bearing 26 and the side of the other end thereof is rotatably supported via a bearing 12a (a ball bearing 27) provided on the side of the other end surface of the second housing 12. That is, the driving shaft 23 is rotated by the motor 30 and is adapted to cause the turning scroll member 22 to rotate on a prescribed circular orbit.

[0021] The center plate 25 is provided so as to divide the space on the compression section 20 side and the space on the motor 30 side in the housing 10, and there is provided a communication hole for providing communication between the space on the compression section 20 side and the space on the motor 30 side. Also, the center plate 25 is provided with a flanged portion 25a extending in the circumferential direction of an outer circumferential surface so that the flanged portion 25a becomes sandwiched between the first housing 11 and the second housing 12.

[0022] Between the turning scroll member 22 and the center plate 25, there are provided a rotating position regulating mechanism 28 consisting of pins which are each fixed to the turning scroll member 22 and the center plate 25 in order to regulate the rotating position of turning scroll member 22, and a connecting member for connecting the pins together.

[0023] The motor 30 is composed of a three-phase induction motor and the like and has a rotor 31 formed from a permanent magnet fixed to the driving shaft 23, and a stator 32 which is provided so as to surround the rotor 31 and is fixed in the second housing 12.

[0024] The driving circuit section 40 is composed of an inverter circuit 41 having, on a substrate, power semiconductor elements 41a as a plurality of heat generating parts, a power circuit part 42, such as a smoothing capacitor and a noise filter, a control section 43 of a micro-computer configuration, and the like. The driving circuit section 40 is housed in the driving circuit housing chamber 13b and is fixed in the driving circuit housing chamber 13b by use of a molded resin 44.

[0025] This motor compressor is provided with three sealed terminals 50 provided in the partition wall 13a positioned below the cooling medium suction chamber 13c and intended for supplying the electrical power from the inverter circuit 41 to the winding of the stator 32.

[0026] Each of the sealed terminals 50 is composed of a terminal body 51 inserted into a through hole 13d provided in the partition wall 13a, a fixing nut 52 for fixing the terminal body 51 to the partition wall 13a, a first insulating member 53 to be interposed on the second hous-

ing 12 side of the partition wall 13a, a second insulating member 54 to be interposed between the fixing nut 52 and the partition wall 13a, a joining nut 55 which is connectably provided to an end portion of the terminal body 51 on the driving circuit housing chamber 13b side and to which a lead wire 45 on the driving circuit housing chamber 13b side is joined by welding, and an insulating cover 56 for covering the terminal body 51 from the second housing 12 side. The lead wire 45 on the driving circuit housing chamber 13b side is formed from a cuprous material.

[0027] The terminal body 51 is made of a ferrous metal and is such that an end portion thereof on the second housing 12 side is provided with a flange 51a and an end portion thereof on the driving circuit housing chamber 13b side is provided with a male threaded portion 51b and it is ensured that the lead wire 33 on the motor 30 side is connected to the end portion on the second housing 12 side. The terminal body 51 is attached to the partition wall 13a by screwing the fixing nut 52 to the male threaded portion 51b, with the first insulating member 53 interposed on the second housing 12 side of the partition wall 13a and the second insulating member 54 interposed on the driving circuit housing chamber 13b side of the partition wall 13a.

[0028] The first insulating member 53 and the second insulating member 54 are each formed from a member having insulating properties, such as ceramics and resins. The first insulating member 53 are provided with three holes 53a, through each of which three terminal bodies 51 are inserted, and one first insulating member 53 is interposed for the three terminal bodies 51. The second insulating member 54 is provided with a hole 54a through which the terminal body 51 is inserted, and one second insulating member 54 is interposed for one terminal body 51.

[0029] The joining nut 55 is made of a cuprous metal and is formed in the shape of a cap nut which is such that the side of one end thereof is closed. The joining nut 55 is provided with a weld 55a so as to protrude from the side of one end and it is ensured that the lead wire 45 on the driving circuit housing chamber 13b side is jointed to the weld 55a by welding. The joining nut 55 is provided in such a manner that the length along which the joining nut 55 fits over the male threaded portion 51b of the terminal body 51 is at least not less than 0.4 times the diameter of the male threaded portion 51b.

[0030] The insulating cover 56 is made of a material having elasticity and insulating properties, such as rubber. The insulating cover 56 is formed so as to cover the whole area of one end surface of the first insulating member 53, and end portions of the three terminal bodies 51 are covered. The insulating cover 56 are provided with three holes 56a, through each of which three lead wires 33 on the motor 30 side are inserted.

[0031] In the electric compressor configured as described above, the driving shaft 23 is rotated by passing a current to the motor 30, whereby in the compression

section 20 the turning scroll member 22 performs a rotating motion with respect to the fixed scroll member 21. As a result of this, a cooling medium which flows into the housing 10 from the cooling medium suction port cools each of power semiconductor elements 41a of the inverter circuit 41 of the driving circuit section 40 via the partition wall 13a of the cooling medium suction chamber 13c and cools the motor 30 by flowing through the interior of the second housing 12. The cooling medium which has flown through the interior of the second housing 12 flows between the turning scroll member 22 and the center plate 25 via the communication hole of the center plate 25, cools the rotating position regulating mechanism 50 and then flows into the compression section 20. The cooling medium compressed in the compression section 20 flows from the cooling medium discharge hole 21b into the cooling medium discharge chamber 11a and is discharged from the cooling medium discharge port.

[0032] In each of the sealed terminals 50, in performing the work to connect the lead wire 45 on the driving circuit housing chamber 13b side, the joining nut 55 is screwed to the male threaded portion 51b, with the terminal body 51 attached to the partition wall 13a, and the lead wire 45 is joined to the weld 55a of the joining nut 55 by welding.

[0033] As described earlier, according to the electric compressor of this embodiment, the sealed terminal 50 has a terminal body 51 which is made of a metal having electrical conductivity and whose end is provided with a male threaded portion 51b, and a joining nut 55 made of a metal having electrical conductivity and which is different from the material for the terminal body 51, and is threadably mounted on the male threaded portion 51b of the terminal body 51. As a result of this, it is possible to positively join the joining nut 55 of a different material to the terminal body 51 and to positively join the lead wire 45 of the same material as the joining nut 55 to the joining nut 55 by welding, and hence it becomes possible to electrically connect a lead wire 45 on the driving circuit housing chamber 13b side positively to the sealed terminal 50.

[0034] Because the above-described terminal body 51 is made of a ferrous metal and the joining nut 55 is made of a cuprous metal, it is possible to easily weld the lead wire 45 made of a cuprous metal to the joining nut 55 and it becomes possible to positively connect the lead wire 45 made of a cuprous metal to the terminal body 51 made of a ferrous metal.

[0035] Because the length along which the joining nut 55 fits over the male threaded portion 51b of the terminal body 51 is not less than 0.4 times the diameter of the male threaded portion 51b, it is possible to positively attach the joining nut 55 to the terminal body 51 and it is possible to ensure a contact area of not less than a prescribed contact area between the terminal body 51 and the joining nut 55. This enables the strength of the sealed terminal 50 to be increased and the electric resistance thereof to be reduced.

[0036] In the above-described embodiment, a descrip-

tion was given of the weld 55a which is formed on the joining nut 55 so as to protrude from the side of one end and to which the lead wire 45 on the driving circuit housing chamber 13b is joined by welding. However, as shown in Figure 4, the lead wire 45 may be joined directly to the side of one end of the joining nut 55 by welding without the provision of the weld 55a in the joining nut 55.

Description of symbols

[0037]

13a: Partition wall 20: Compression section 30: Motor 33: Lead wire 40: Driving circuit section 45: Lead wire 50: Sealed terminal 51: Terminal body 51b: Male threaded portion 55: Joining nut

Claims

1. An electric compressor comprising:
 - a compression section (20) for compressing a cooling medium;
 - a motor (30) for driving the compression section (20);
 - a motor driving circuit (40) for driving the motor (30); and
 - a sealed terminal (50) which is provided in a partition wall (13a) for partitioning a space between the motor (30) and the motor driving circuit (40) and is intended for electrically connecting a lead wire (33) on the motor (30) side and a lead wire (45) on the motor driving circuit (40) side, wherein the sealed terminal (50) has a terminal body (51) which is made of a metal having electrical conductivity and whose end is provided with a male threaded portion (51b), and a joining member (55) made of a metal having electrical conductivity and which is different from the material for the terminal body (51), the joining member (55) being provided so as to be capable of being screwed to the male threaded portion (51b) of the terminal body (51).
2. The electric compressor according to claim 1, wherein the terminal body (51) is made of a ferrous metal and the joining member (55) is made of a cuprous metal.
3. The electric compressor according to claim 1 or 2, wherein the length along which the joining member (55) fits over the male threaded portion (51b) of the terminal body (51) is not less than 0.4 times the diameter of the male threaded portion (51b).

FIG. 1

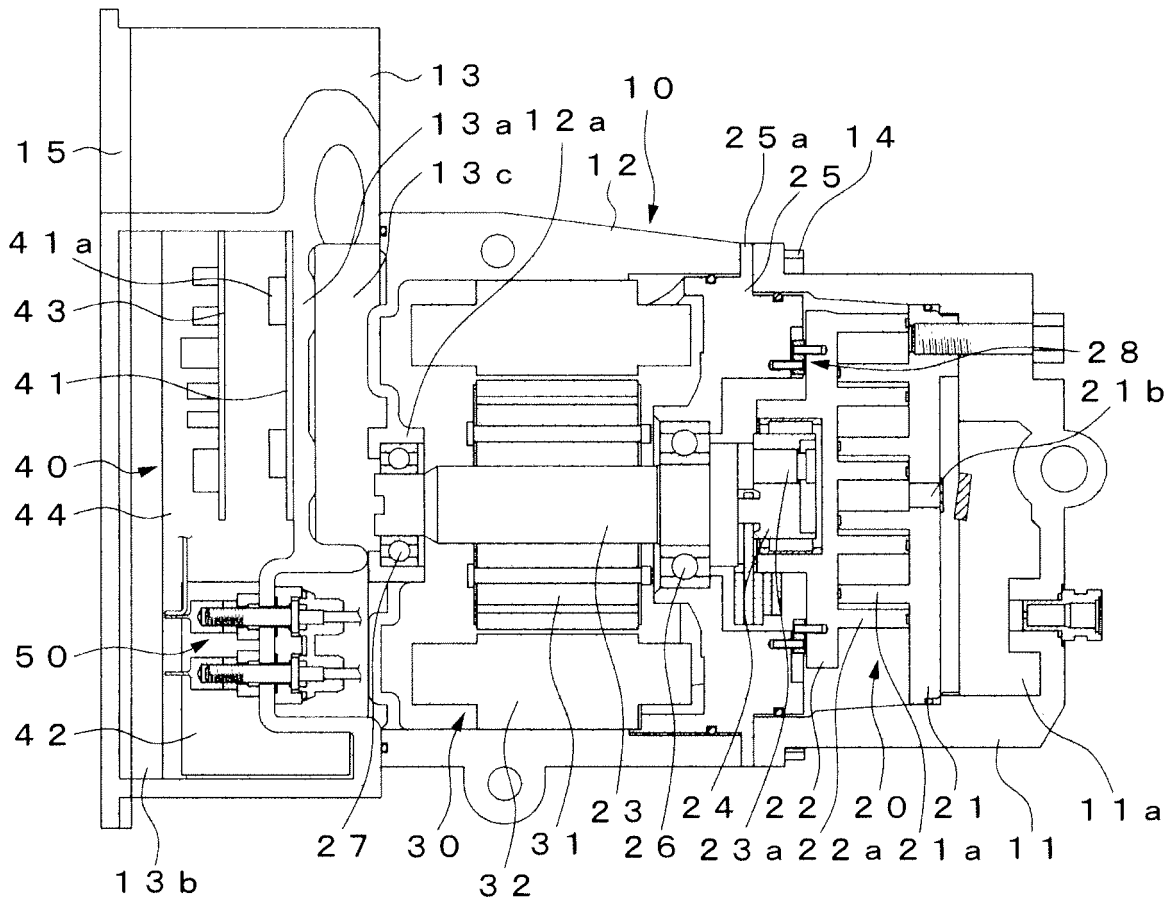


FIG. 2

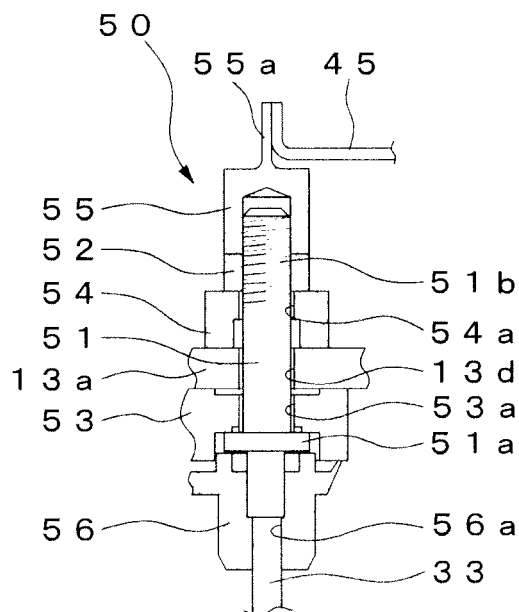


FIG. 3

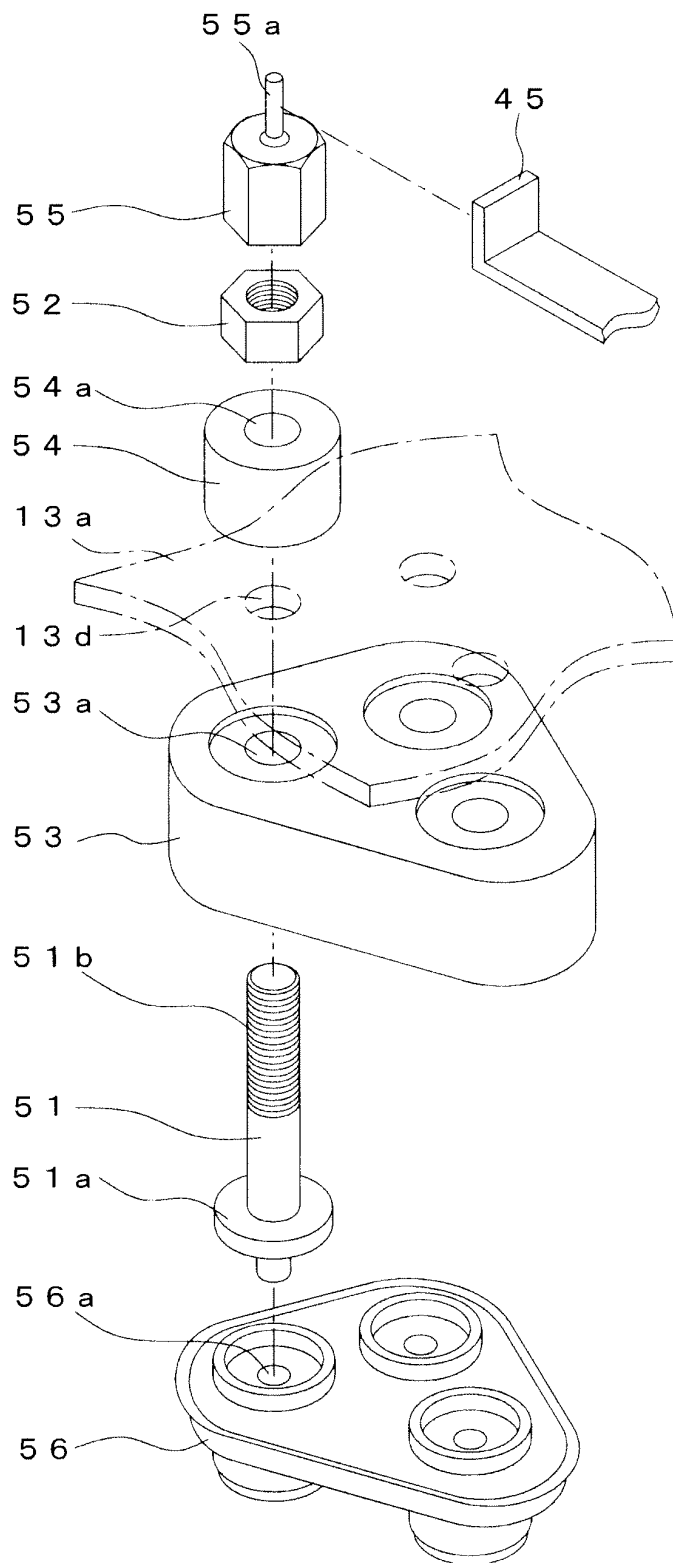
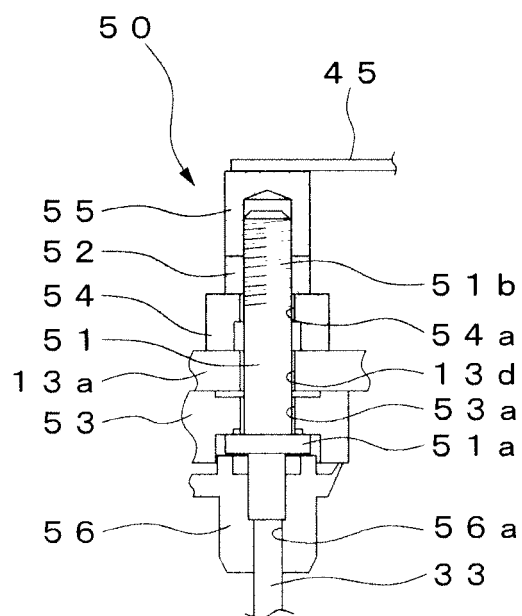


FIG. 4



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/061749

A. CLASSIFICATION OF SUBJECT MATTER F04B39/00(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) F04B39/00, 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 1996-2009 Kokai Jitsuyo Shinan Koho 1971-2009 Toroku Jitsuyo Shinan Koho 1994-2009		
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 4-358776 A (Daikin Industries, Ltd.), 11 December, 1992 (11.12.92), Par. No. [0013]; Figs. 1 to 2 (Family: none)	1-3
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 75807/1971(Laid-open No. 31589/1973) (Nippondenso Co., Ltd.), 17 April, 1973 (17.04.73), Description, page 2, line 5 to page 3, line 1; Fig. 1 (Family: none)	1-3
☒ 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 17 July, 2009 (17.07.09)		Date of mailing of the international search report 28 July, 2009 (28.07.09)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

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

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/061749

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2008-101233 A (JFE Steel Corp.), 01 May, 2008 (01.05.08), Par. No. [0012] (Family: none)	1-3
A	JP 10-9137 A (Hitachi, Ltd.), 13 January, 1998 (13.01.98), Figs. 1 to 2 (Family: none)	1-3
A	JP 2008-19732 A (Sanden Corp.), 31 January, 2008 (31.01.08), Fig. 5 & EP 2039932 A1 & WO 2008/007534 A1	1-3
A	JP 2005-54727 A (Sanden Corp.), 03 March, 2005 (03.03.05), Fig. 9 (Family: none)	1-3
A	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 68501/1992 (Laid-open No. 29011/1994) (Mayekawa Mfg., Co., Ltd.), 15 April, 1994 (15.04.94), Par. No. [0010]; Fig. 2 (Family: none)	1-3

Form PCT/ISA/210 (continuation of 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 11324920 A [0003]