



(11) **EP 2 431 611 A1**

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

(43) Date of publication:
21.03.2012 Bulletin 2012/12

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

(21) Application number: **10774928.5**

(86) International application number:
PCT/JP2010/058021

(22) Date of filing: **12.05.2010**

(87) International publication number:
WO 2010/131671 (18.11.2010 Gazette 2010/46)

(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 SE SI SK SM TR**

(30) Priority: **13.05.2009 JP 2009116275**
04.09.2009 JP 2009204684

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

(72) Inventors:
• **FUJIMURA Eisuke**
Isesaki-shi
Gunma 372-8502 (JP)

- **TAGUCHI Masanori**
Isesaki-shi
Gunma 372-8502 (JP)
- **OSATO Kazumi**
Isesaki-shi
Gunma 372-8502 (JP)
- **MIZUNO Jun**
Isesaki-shi
Gunma 372-8502 (JP)
- **SHIBUYA Makoto**
Isesaki-shi
Gunma 372-8502 (JP)

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

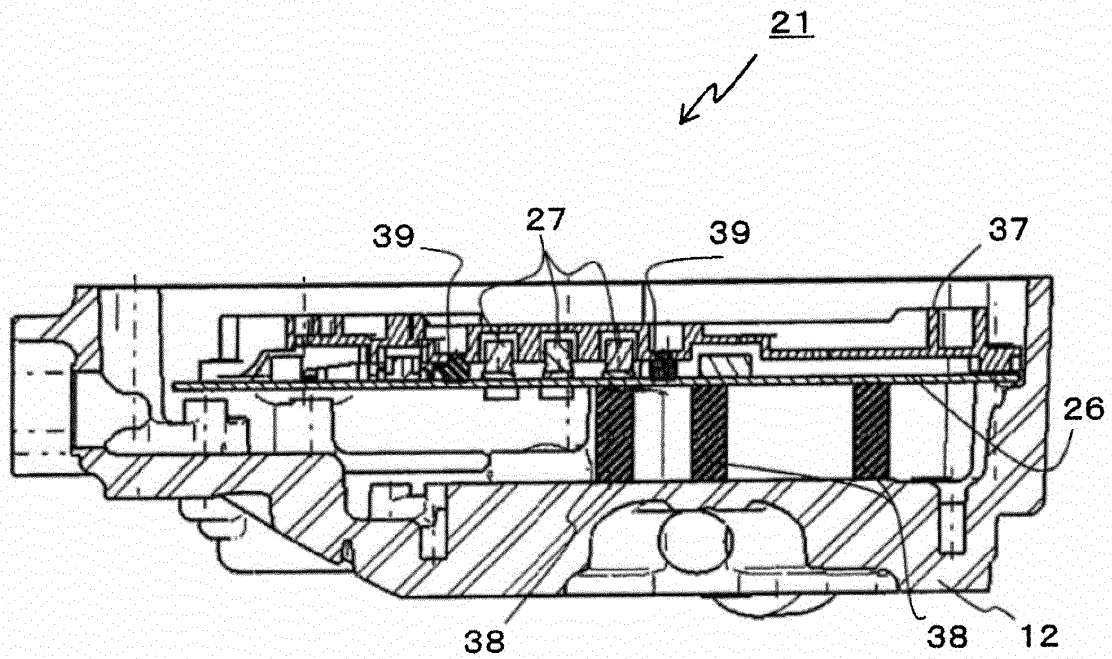
(54) **INVERTER-INTEGRATED ELECTRIC COMPRESSOR**

(57) An inverter-integrated electric compressor configured in such a manner that a motor is incorporated within a compressor, a control circuit board is provided to an inverter section which is provided with a motor drive circuit for driving the motor, and electric component parts including the control circuit board is fixed within a containment space surrounded by a compressor housing, wherein the control circuit board is fixed within the housing space through a board-fixing section, and a board vibration-isolating member, said board vibration-isolating member consisting of an electrically insulative elastic material, is provided between the control circuit board

and the board-fixing section. A frame member having a concave holding section may be loaded on the control circuit board, and a board vibration-isolating member, said board vibration-isolating member consisting of an electrically insulative elastic material, may be provided between the control circuit board and the frame member. The inverter-integrated electric compressor has highly reliable performance and configured in such a manner that the vibration of the control circuit board of the motor drive circuit is suppressed as much as possible.

EP 2 431 611 A1

FIG. 7



Description

Technical Field of the Invention

5 **[0001]** The present invention relates to an inverter-integrated electric compressor which incorporates a motor drive circuit including an inverter, and specifically relates to an inverter-integrated electric compressor which prevents external vibration from transmitting to a control circuit board of the motor drive circuit.

Background Art of the Invention

10 **[0002]** Such a structure as disclosed in Patent document 1 is known as a structure of an inverter-integrated electric compressor which incorporates a motor drive circuit including an inverter therein. In such a structure, a printed circuit board is fixed so as to be clipped between a structural body extending from an electric motor housing and a top lid, in order to enhance the vibration resistance of the printed circuit board composing a part of the motor drive circuit.

15 **[0003]** Patent document 2 discloses an automotive electric compressor which is filled with insulation gel agent as covering a circuit board for a countermeasure against vibration of circuit boards, etc. Patent document 3 discloses an electric compressor in which a heavy load made of potting material is placed on the center of a circuit board so as to function as a vibration-isolating member, in order to prevent vibration of the circuit board without filling gel thereinto.

20 Prior art documents

Patent documents

[0004]

25

Patent document 1 : JP2006-177214-A

Patent document 2: JP2006-316754-A

Patent document 3: JP2008-133729-A

30 Summary of the Invention

Problems to be solved by the Invention

35 **[0005]** The vibration of the control circuit board of a motor drive circuit including an inverter can be prevented to some extent by introducing such structures as disclosed in Patent documents 1-3. However, the vibration of the control circuit board cannot be perfectly restrained even by applying such structures. Particularly, because external vibration transmitted to the control circuit board makes the control circuit board itself generate bending and vibration, it has been difficult to eradicate the possibility that component parts which have been placed on the control circuit board might fall away from the control circuit board.

40 **[0006]** Therefore, being focused on the above-described problems, an object of the present invention is to provide an inverter-integrated electric compressor, of which control circuit board of a motor drive circuit is prevented from vibrating as much as possible, having high performance reliability.

Means for solving the Problems

45

[0007] To achieve the above described object, an inverter-integrated electric compressor according to the present invention is an inverter-integrated electric compressor, wherein a compressor incorporates a motor, an inverter section having a motor drive circuit to drive the motor is provided with a control circuit board, and electric component parts including the control circuit board are fixed in a housing space surrounded by a compressor housing, **characterized in**
50 **that** the control circuit board is fixed through a board-fixing section in the housing space and a board vibration-isolating member, which is made of an electrically insulative elastic material, is provided so as to interpose between the control circuit board and the board-fixing section. The board-fixing section can be realized by a plate-like fixing member (board-fixing plate) which fixes the control circuit board, for example. Alternatively, the control circuit board can be fixed directly to a compressor housing itself as a board-fixing section, with no fixing member.

55 **[0008]** The inverter-integrated electric compressor according to the present invention makes it possible that the control circuit board is prevented from bending and vibrating which are accompanied by vibration transmitted from outside, because the control circuit board is fixed through the board-fixing section in the housing space surrounded by a compressor housing while the board vibration-isolating member made of electrically insulative elastic material is provided

so as to interpose between the control circuit board and the board-fixing section. It is preferable that the board vibration-isolating member is bonded to the control circuit board or the board-fixing section, from a viewpoint of an easy assembling.

[0009] In the inverter-integrated electric compressor according to the present invention, it is preferable that a frame member having a concave holding section with a concave part formed into a concave shape is loaded onto the control circuit board while the board vibration-isolating member made of an electrically insulative elastic material is provided so as to interpose between the control circuit board and the frame member. In addition, the concave part of the concave holding section can be formed into a concave shape along outlines of electric component parts loaded onto the control circuit board so as to improve vibration prevention ability of the electric component parts. When the frame member with the concave holding section is loaded onto the control circuit board while the board vibration-isolating member made of electrically insulative elastic material is provided as interposing between the control circuit board and the frame member, the control circuit board can be further prevented from bending and vibrating which are accompanied by vibration transmitted from the outside. It is preferable that the board vibration-isolating member is bonded to the frame member or the control circuit board from a viewpoint of an easy assembling. Alternatively, it is possible that a plurality of board vibration-isolating members are provided at either obverse side or reverse side of the control circuit board respectively.

[0010] In the inverter-integrated electric compressor according to the present invention, it is preferable that the electric component parts are sealed at least partially by an electrically insulative filler filled in the housing space. When the electrically insulative filler, such as urethane resin, is filled in the housing space and at least a part of the electric component parts are sealed, the motor drive circuit is kept electrically insulative while the control circuit board is further prevented from vibrating.

[0011] In the inverter-integrated electric compressor according to the present invention, it is preferable that the board vibration-isolating member is made of a material harder than the electrically insulative filler. Specifically when urethane resin is employed as the electrically insulative filler, synthetic rubber such as ethylene propylene rubber (EPDM) and silicone rubber or natural rubber can be employed as the board vibration-isolating member. Besides, being harder than the electrically insulative filler means that a hardness which is measured with a durometer in conformity with JISK6253 is higher than the electrically insulative filler.

[0012] In the inverter-integrated electric compressor according to the present invention, it is preferable that the control circuit board is provided with an insertion hole through which a part of the board vibration-isolating member is inserted so as to fix the vibration-isolating member onto the control circuit board, and that the board vibration-isolating member is provided with a neck part having a smaller diameter than the insertion hole and a locking part having a greater diameter than the insertion hole. When such an insertion hole is provided, the board vibration-isolating member can be easily set to a fixing position on the control circuit board.

[0013] In the inverter-integrated electric compressor according to the present invention, it is preferable that the board vibration-isolating members are disposed as being plane-symmetrical viewed from the control circuit board. When the board vibration-isolating members are disposed as plane-symmetrical as viewed from the control circuit board, the control circuit board is sandwiched from both top and bottom sides by the board vibration-isolating member, as more firmly achieving vibration prevention.

[0014] In the inverter-integrated electric compressor according to the present invention, it is preferable that the insertion hole is a through-hole and that one board vibration-isolating member between the control circuit board and the frame member is formed integrally with another board vibration-isolating member between the control circuit board and the board-fixing section. Thus, board vibration-isolating members provided at both top/bottom sides may be formed integrally, so as to decrease the number of component parts which compose the electric compressor while the board vibration-isolating member is easily fixed onto the control circuit board without bonding the board vibration-isolating member onto the control circuit board, and therefore, the electric compressor can be improved in assembly easiness. It is preferable that the board vibration-isolating member is formed such that the locking part is deformed elastically so as to come to have smaller diameter than the insertion hole when compression force is applied from outside and such that it is restored elastically so as to come to have greater diameter than the insertion hole when the compression force is removed. The board vibration-isolating member of which locking part is formed as such makes it easier to fix the board vibration-isolating member onto the control circuit board.

[0015] In the inverter-integrated electric compressor according to the present invention, it is possible that the frame member is formed integrally with the board vibration-isolating member. If the frame member is formed integrally with the board vibration-isolating member made of electrically insulative elastic material, the number of component parts which compose the electric compressor can be decreased and the frame member can absorb a shock even when the frame member is shocked from outside.

[0016] It is suitably preferable that the inverter-integrated electric compressor according to the present invention is used in an air conditioning system for vehicles. Namely, because the control circuit board which composes the motor drive circuit is highly prevented from vibrating in the inverter-integrated electric compressor, required performance reliability can be ensured even in an air conditioning system for vehicles, which is attached to engines and required to have superior vibration resistance.

Effect according to the Invention

[0017] The inverter-integrated electric compressor according to the present invention makes it possible that the control circuit board is efficiently prevented from vibrating, because the control circuit board composing a part of the inverter section is fixed through the board-fixing section and the frame member is loaded onto the control circuit board while the board vibration-isolating member made of electrically insulative elastic material is interposed between the control circuit board and the board-fixing section as well as between the control circuit board and the frame member. Further, the vibration resistance of the electric compressor can be improved much more because the electric components are sealed at least partially by the electrically insulative filler which is filled into the housing space surrounded by the compressor housing.

Brief explanation of the drawings**[0018]**

[Fig. 1] Fig. 1 is a longitudinal section view showing an inverter-integrated electric compressor according to an embodiment of the present invention.

[Fig. 2] Fig. 2 is a perspective view showing the inverter section of Fig. 1

[Fig. 3] Fig. 3 is an elevation view showing a fixing structure of the control circuit board of Fig. 2 in the housing space.

[Fig. 4] Fig. 4 is a plan view showing the frame member of Fig. 3.

[Fig. 5] Fig. 5 is an elevation view showing examples (A)-(C), for combinations of a board vibration-isolating member and an insertion hole according to the present invention.

[Fig. 6] Fig. 6 is a section view showing an embodiment of an inverter section according to the present invention.

[Fig. 7] Fig. 7 is a section view showing another embodiment of the inverter section according to the present invention.

Embodiments for carrying out the Invention

[0019] Hereinafter, desirable embodiments of the present invention will be explained as referring to figures.

Fig. 1 shows a whole of inverter-integrated electric compressor 1 according to an embodiment of the present invention. In Fig. 1, compression mechanism 2 is comprised of fixed scroll 3 and movable scroll 4. Movable scroll 4 is made to swing relative to fixed scroll 3 as being prevented from rotation with a rotation-preventing mechanism. Motor 7 is incorporated in compressor housing (center housing) 6. Main shaft 8 (rotation shaft) is driven to rotate by motor 7. The rotation of main shaft 8 is converted into the swing of movable scroll 4, through eccentric pin 9 which is provided at a side of main shaft 8 and eccentric bush 10 which is engaged rotatably therewith. In this embodiment, refrigerant, which has been sucked as fluid to be compressed, is led to compression mechanism 2 through a providing-section for motor 7. The refrigerant which has been compressed by compression mechanism 2 is delivered via discharge hole 13 and discharge chamber 14 into an external circuit out of compressor housing (rear housing) 15.

[0020] Inverter section 21 having a circuit for driving motor 7 is provided in a housing space surrounded by compressor housing 12 (front housing). In further detail, inverter section 21 is provided at an outer side of partition wall 22, which is provided against the side of passageway for sucking refrigerant in compressor housing 12. Inverter section 21 supplies electricity to motor 7 through lead wire and through seal terminal 23 (output terminal of inverter section 21) which is provided as penetrating partition wall 22. In a providing-section for seal terminal 23, the side of passageway for sucking refrigerant and the side of provided inverter section 21 are sealed. Thus inverter section 21 is provided at an outer side of partition wall 22, so that electric component parts composing inverter section 21 can be at least partially cooled through partition wall 22 by sucked refrigerant.

[0021] Inverter section 21 is comprised of electrical components such as IPM (Intelligent Power Module) 25, which has an inverter function, and control circuit board 26 and is also comprised of other electric component parts such as capacitor 27 which is provided separately or integrally therewith. The opening side to the outside of compressor housing 12 which mounts inverter section 21 is covered as being sealed with lid member 29, and motor drive circuit 21 is protected by lid member 29.

[0022] Fig. 2 is a perspective view showing inverter section 21 of Fig. 1. Inverter section 21 is composed of noise filter 30, HV connector 31, LV connector 32, etc., other than IPM 25 and control circuit board 26. Because a lot of electric component parts are loaded onto control circuit board 26, performance reliability of the electric compressor tends to be lost if vibration is not sufficiently prevented. Above all electric component parts, capacitor 27 is a component part which tends to fall away from a control circuit board under vibration thereof because of its great height when mounted on control circuit board 26.

[0023] Fig. 3 shows a structure where control circuit board 26 of Fig. 2 is fixed in a housing space surrounded by compressor housing 12 where compressor housing 12, board-fixing plate 36, control circuit board 26 and frame member

37 are placed according to placement order at the time of assembling, being depicted as an elevation view from the lower side of Fig. 2. Control circuit board 26 is fixed on compressor housing 12 (front housing) by bolts through board-fixing plate 36. Board vibration-isolating member 38 made of columned EPDM rubber is fixed to board-fixing plate 36 by bonding. Control circuit board 26 and board-fixing member 36 are fastened by bolts, so that board vibration-isolating member 38 is pushed to contact control circuit board 26, as preventing vibration of control circuit board 26. Board vibration-isolating member 39 is bonded to be fixed to frame member 37 as being positioned symmetrically from board vibration-isolating member 38 with respect to plane of control circuit board 26. Thus board-fixing plate 36 and frame member 37, to which board vibration-isolating members 38, 39 are fixed by bonding respectively, are fixed by bolts as sandwiching control circuit board 26, so that control circuit board 26 is prevented from bending and vibrating.

[0024] Fig. 4 is a plan view of frame member 37 of Fig. 3 from the upper side of Fig. 3. Frame member 37 has concave holding section 40 which has a concave part formed into a concave shape and vent hole 41 which is perforated in concave holding section 40. Frame member 37, when loaded as covering control circuit board 26 as shown in Fig. 3, forms the gap which can be filled with urethane resin as electrically insulative filler together with control circuit board 26. This gap is sealed by filling with urethane resin, so that circuit component parts, such as control circuit board 26 and capacitor 27 placed on control circuit board 26, can be further firmly prevented from vibrating. In addition, because providing with vent hole 41 makes it possible to prevent air from generating and staying inside urethane resin, circuit component parts such as capacitor 27 can be firmly fixed onto control circuit board 26 after the urethane resin is hardened. In addition, because board vibration-isolating member 39 is formed by material harder than urethane resin, even after the urethane resin is hardened the effect of vibration isolating for the control circuit board can be maintained.

[0025] Fig. 5 is an elevation view showing examples (A)-(C) for combination of a board vibration-isolating member and an insertion hole for fixing the board vibration-isolating member onto the control circuit board. In example (A), insertion holes 44,45, through which neck parts 42,43 of board vibration-isolating members 38,39 are inserted, are positioned symmetrically from each other with respect to plane of control circuit board 26, where board vibration-isolating members 38,39 are locked onto control circuit board 26 by locking parts 46,47. As in example (A), insertion holes 44,45 are positioned symmetrically from each other with respect to plane of control circuit board 26, so that board-fixing plate 36 and frame member 37 push control circuit board 26 from both top and bottom sides with board vibration-isolating members 38,39, so as to make it possible to prevent vibration of control circuit board 26, and therefore, the effect of vibration isolating can be improved. In example (B), a tip of neck part 50 of board vibration-isolating member 49 is provided with stopper part 51 having greater diameter than insertion hole 48 which is a through-hole. After stopper part 51 is elastically deformed and inserted into insertion hole 48, stopper part 51 is elastically restored at the opposite side of locking part 52 as viewed from control circuit board 26, so as to achieve a structure where board vibration-isolating member 49 cannot easily fall away from insertion hole 48 of control circuit board 26. Example (C) is developed one of examples (A) and (B). Board vibration-isolating member 53 is fixed onto control circuit board 26 by inserting neck part 54 of board vibration-isolating member 53 into insertion hole 48 which is a through-hole. One locking part 55 of board vibration-isolating member 53 is elastically deformed and inserted into insertion hole 48, and is elastically restored at the opposite side of the other locking part 56 with respect to control circuit board 26, so as to achieve a structure where board vibration-isolating member 53 cannot easily fall away from insertion hole 48 of control circuit board 26, as with example (B). In example (C), as with example (A) board-fixing plate 36 and frame member 37 push control circuit board 26 from both top and bottom sides with board vibration-isolating member 53, so as to prevent vibration of control circuit board 26. Namely, example (C) is a developed example where board vibration-isolating members 38,39 in example (A) are combined.

[0026] Fig. 6 is a section view showing an embodiment of inverter section 21 as an application of the present invention. In this embodiment, control circuit board 26, which is provided with electric component parts such as capacitor 27, is fixed to compressor housing 12 as a board-fixing section through board vibration-isolating member 38. In such a condition where the circuit board is prevented from vibrating, electrically insulative filler such as urethane resin is filled in the housing space of compressor housing, so as to seal control circuit board 26 including electric component parts such as capacitor 27.

[0027] Fig. 7 is a section view showing another embodiment of inverter section 21 as an application of the present invention. In this embodiment, control circuit board 26, which is provided with electric component parts such as capacitor 27, is fixed to compressor housing 12 as a board-fixing section through board vibration-isolating member 38, and is covered by frame member 37 at the upper side of Fig. 7 while board vibration-isolating member 39 is interposed between control circuit board 26 and frame member 37. Thus control circuit board 26 is fixed as sandwiched between board vibration-isolating members 38,39 from obverse side and reverse side, so that control circuit board 26 is efficiently prevented from vibrating. In such a condition where the circuit board is prevented from vibrating, electrically insulative filler such as urethane resin is filled in the housing space of compressor housing 12, so as to seal control circuit board 26 including electric component parts such as capacitor 27.

Industrial Applications of the Invention

[0028] The inverter-integrated electric compressor according to the present invention is applicable to substantially all types of compressors, and is specifically suitable for a compressor to be mounted in vehicles where it is often mounted in a narrow space and its motor drive circuit is sensitive to heat and vibration.

Explanation of symbols**[0029]**

1:	inverter-integrated electric compressor
2:	compression mechanism
3:	fixed scroll
4:	movable scroll
6:	compressor housing (center housing)
7:	motor
8:	main shaft
9:	eccentric pin
10:	eccentric bush
12:	compressor housing (front housing)
13:	discharge hole
14:	discharge chamber
15:	compressor housing (rear housing)
21:	inverter section
22:	partition wall
23:	seal terminal
25:	IPM
26:	control circuit board
27:	capacitor
29:	lid member
30:	noise filter
31:	HV connector
32:	LV connector
36:	board-fixing plate
37:	frame member
38, 39, 49, 53:	board vibration-isolating member
40:	concave holding section
41:	vent hole
42, 43, 50, 54:	neck part
44, 45, 48:	insertion hole
51:	stopper part
46, 47, 52, 55, 56:	locking part

Claims

1. An inverter-integrated electric compressor, wherein a compressor incorporates a motor, an inverter section having a motor drive circuit to drive said motor is provided with a control circuit board, and electric component parts including said control circuit board are fixed in a housing space surrounded by a compressor housing, **characterized in that** said control circuit board is fixed through a board-fixing section in said housing space and a vibration isolating for board vibration-isolating member, which is made of an electrically insulative elastic material, is provided so as to interpose between said control circuit board and said board-fixing section.
2. The inverter-integrated electric compressor according to claim 1, wherein said electric component parts are sealed at least partially by an electrically insulative filler filled in said housing space.
3. The inverter-integrated electric compressor according to claim 2, wherein said board vibration-isolating member is made of a material harder than said electrically insulative filler.

- 5 4. The inverter-integrated electric compressor according to claim 1, wherein said control circuit board is provided with an insertion hole through which a part of said board vibration-isolating member is inserted so as to fix said vibration-isolating member onto said control circuit board, and that said board vibration-isolating member is provided with a neck part having a smaller diameter than said insertion hole and a locking part having a greater diameter than said insertion hole.
- 10 5. The inverter-integrated electric compressor according to claim 1, wherein a frame member having a concave holding section with a concave part formed into a concave shape is loaded onto said control circuit board while said board vibration-isolating member made of an electrically insulative elastic material is provided so as to interpose between said control circuit board and said frame member,
- 15 6. The inverter-integrated electric compressor according to claim 5, wherein said board vibration-isolating member is disposed as being plane-symmetrical viewed from said control circuit board.
- 20 7. The inverter-integrated electric compressor according to claim 5, wherein said insertion hole is a through-hole and that one board vibration-isolating member between said control circuit board and said frame member is formed integrally with another board vibration-isolating member between said control circuit board and said board-fixing section.
- 25 8. The inverter-integrated electric compressor according to claim 5, wherein said frame member is formed integrally with said board vibration-isolating member.
- 30 9. The inverter-integrated electric compressor according to claim 1, wherein said compressor is used in an air conditioning system for vehicles.
- 35
- 40
- 45
- 50
- 55

FIG. 1

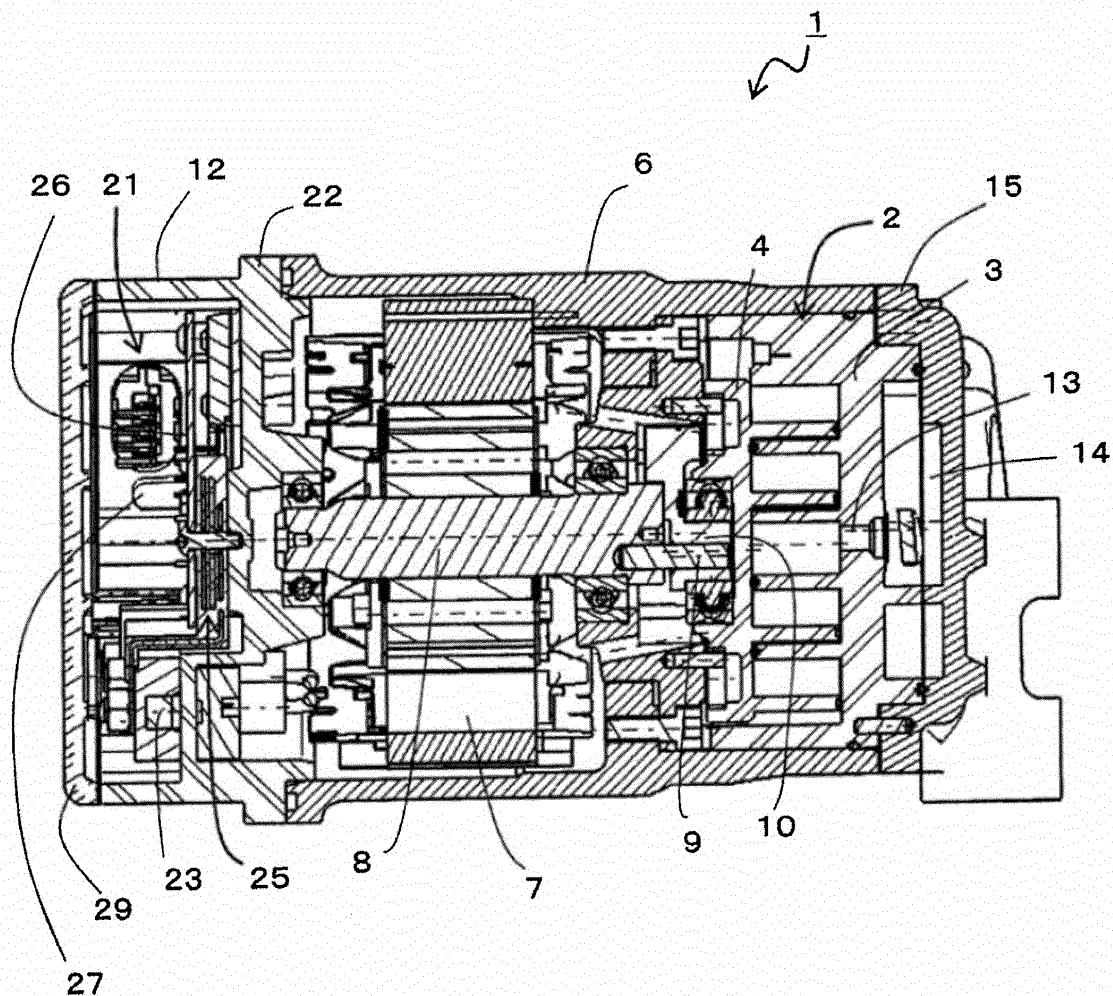


FIG. 2

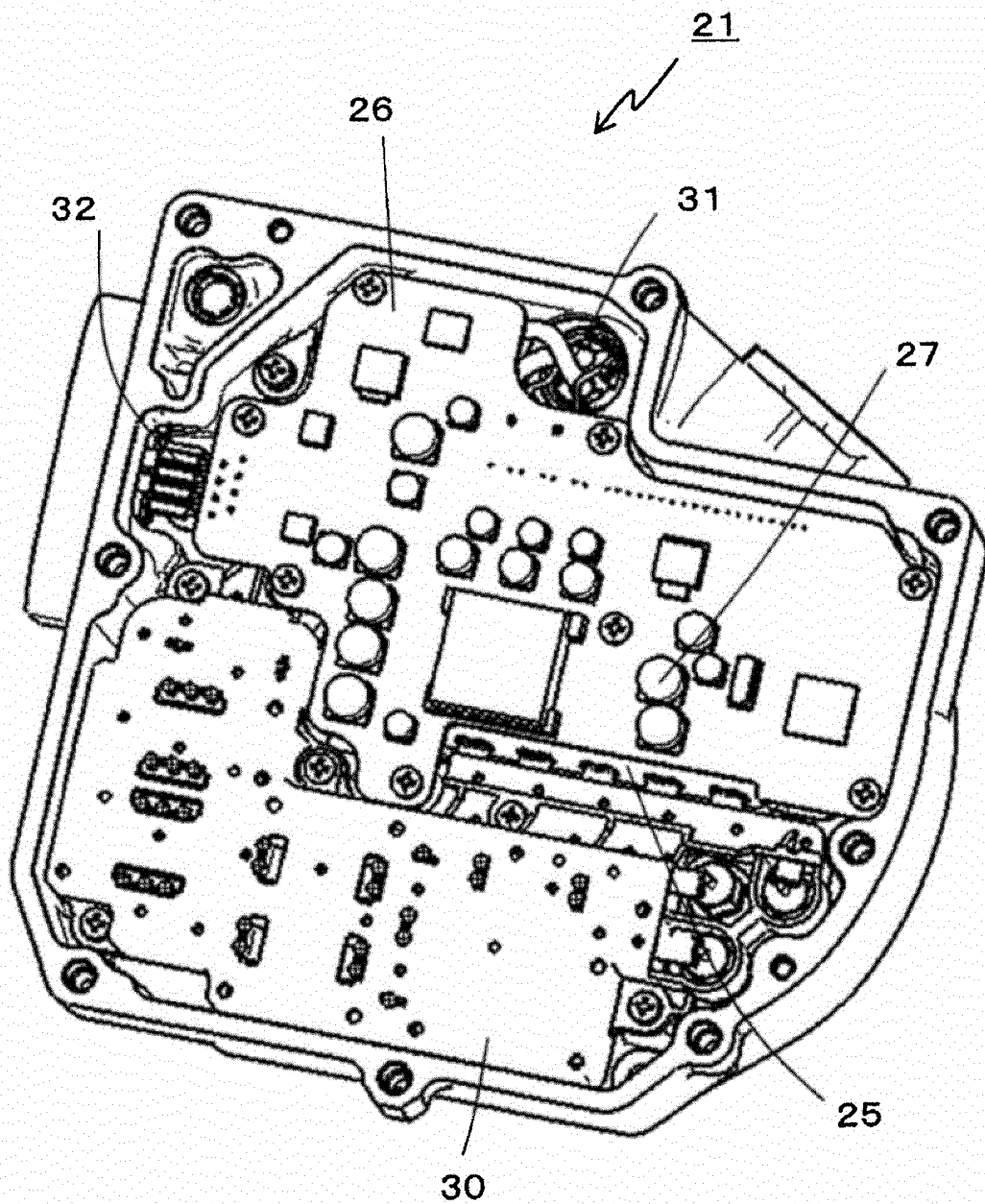


FIG. 3

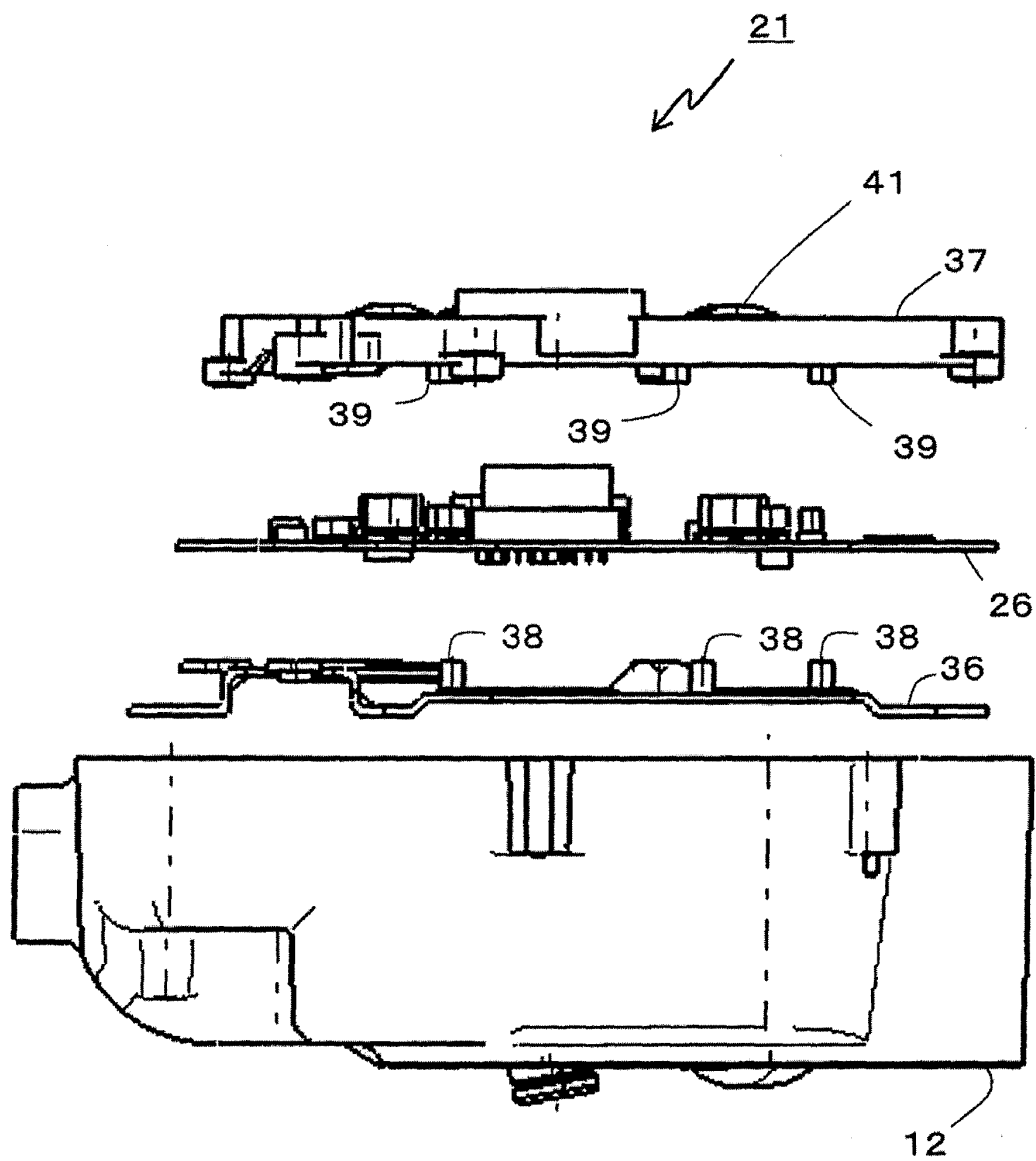


FIG. 4

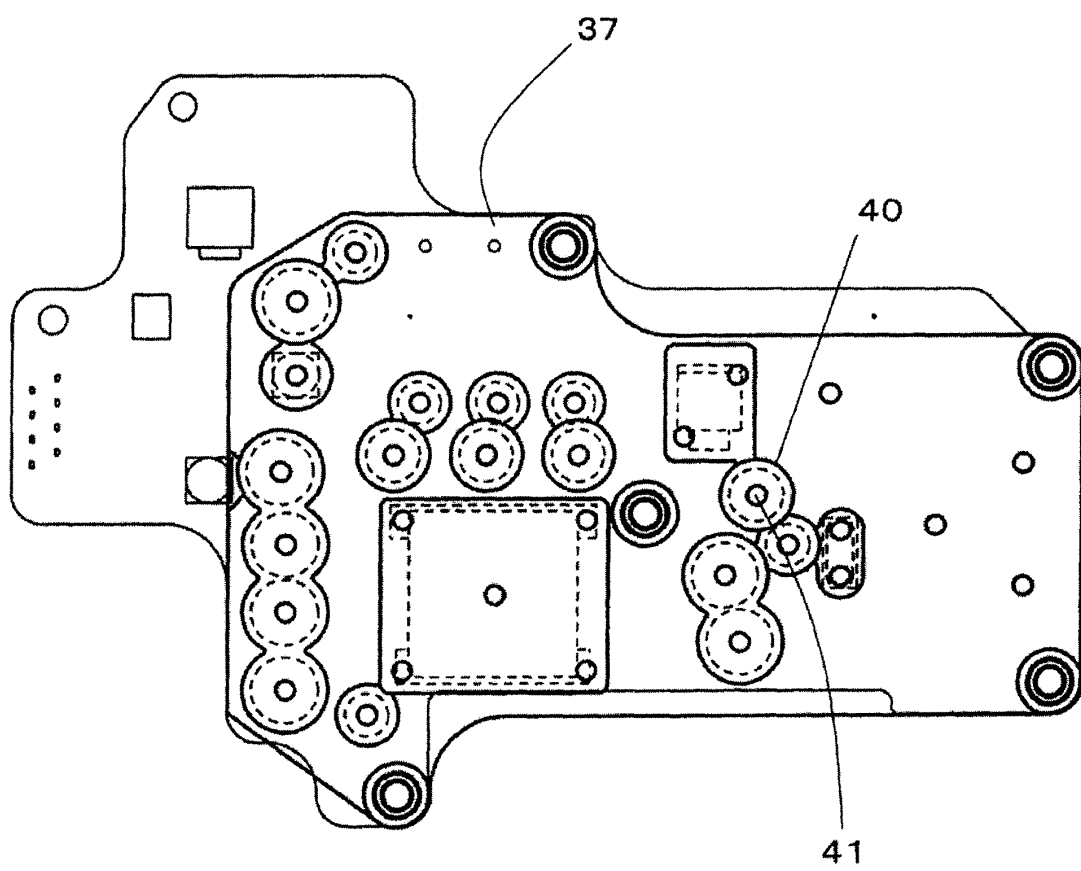


FIG. 5

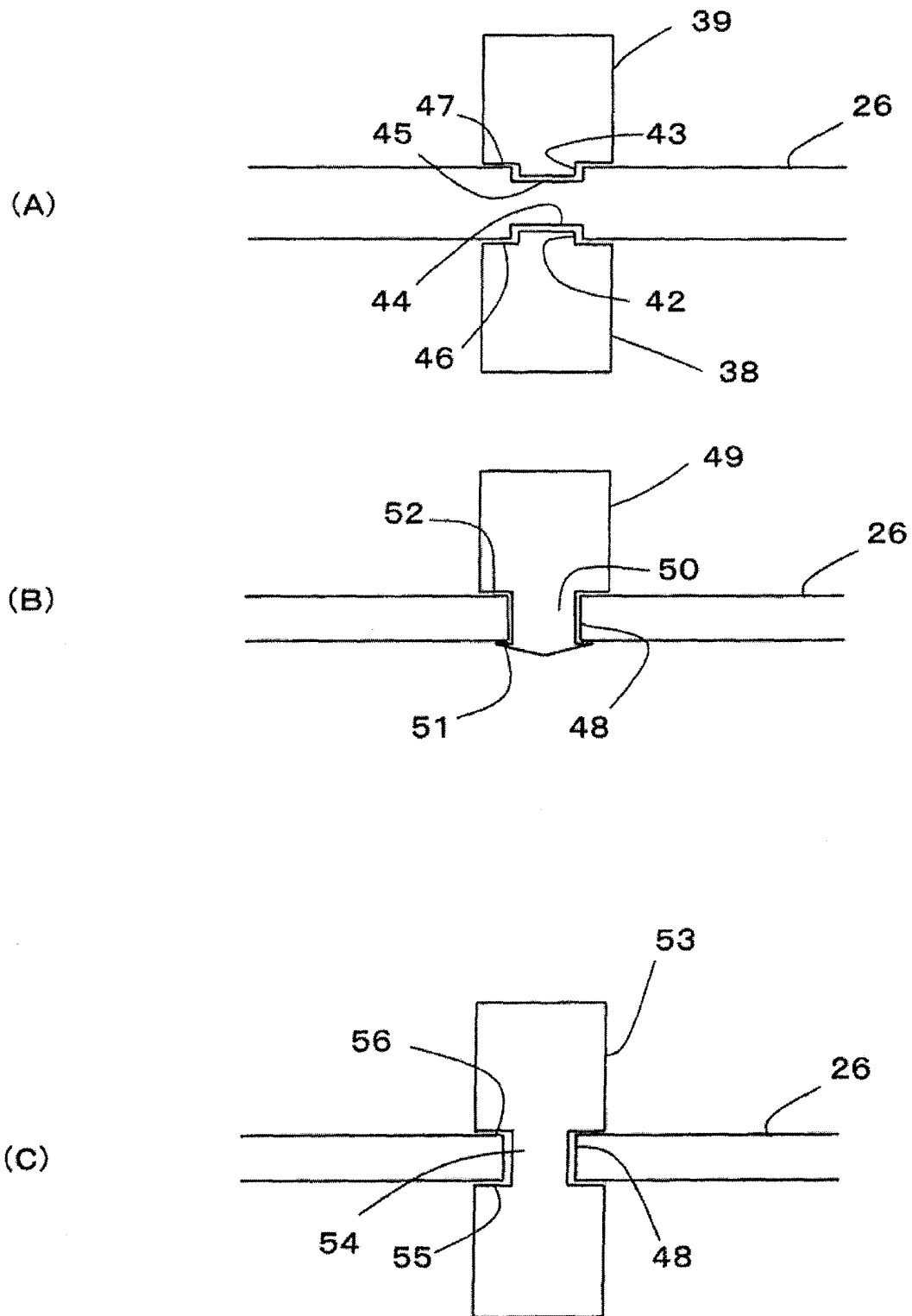


FIG. 6

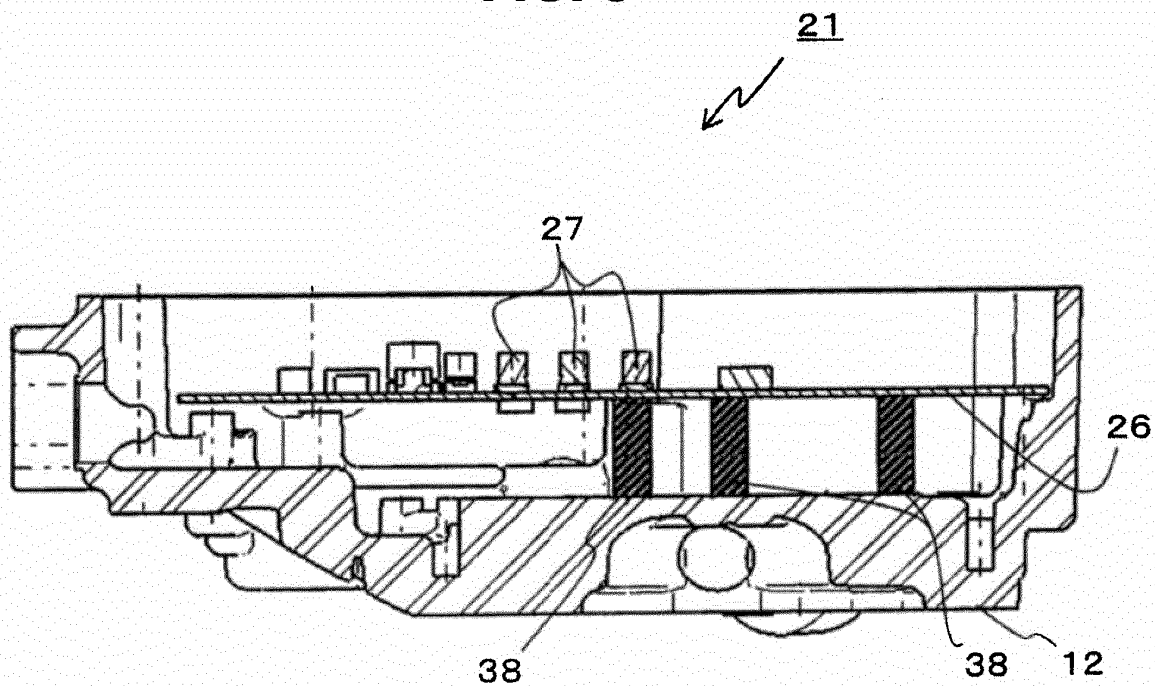
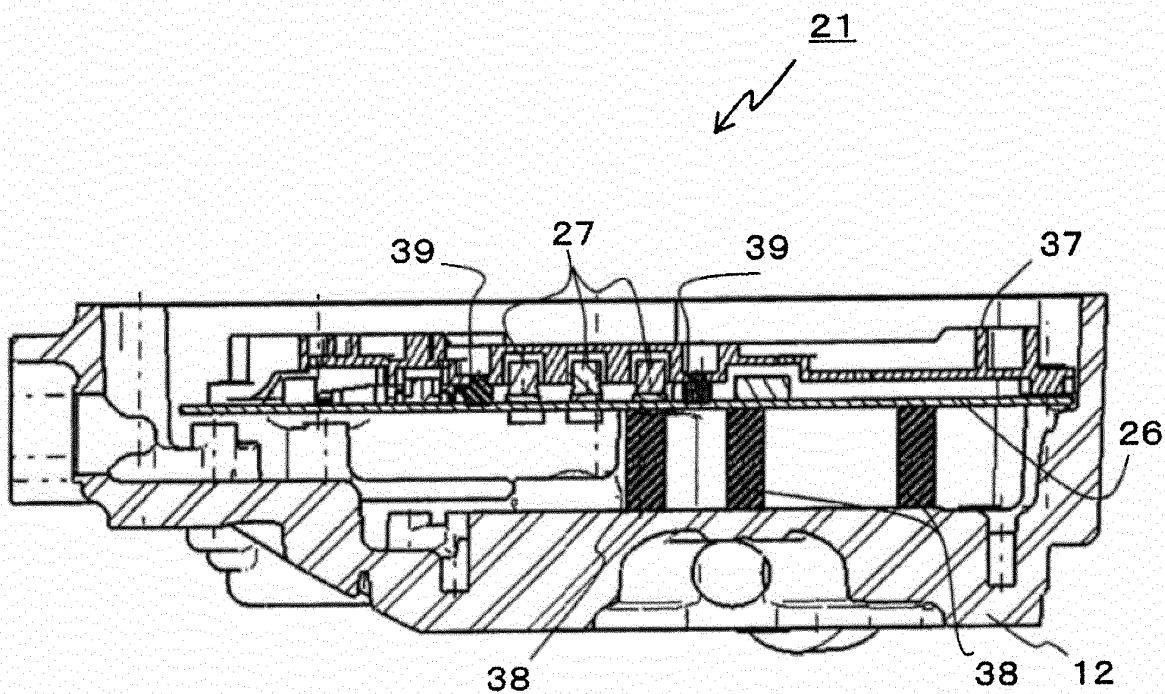


FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2010/058021

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	1996-2010
Kokai Jitsuyo Shinan Koho	1971-2010	Toroku Jitsuyo Shinan Koho	1994-2010

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 2007-315269 A (Mitsubishi Heavy Industries, Ltd.), 06 December 2007 (06.12.2007), paragraphs [0036] to [0040]; fig. 1, 4, 5 (Family: none)	1-3, 9 2-8
X Y	JP 2007-315374 A (Matsushita Electric Industrial Co., Ltd.), 06 December 2007 (06.12.2007), paragraph [0063]; fig. 1, 2 (Family: none)	1, 9 2, 3
Y	JP 5-315772 A (Matsushita Electric Industrial Co., Ltd.), 26 November 1993 (26.11.1993), paragraph [0015]; fig. 1 (Family: none)	4, 6, 7

☒ 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

"I" 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
27 July, 2010 (27.07.10)Date of mailing of the international search report
10 August, 2010 (10.08.10)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2010/058021

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 6-203624 A (Matsushita Electric Works, Ltd.), 22 July 1994 (22.07.1994), paragraph [0014]; fig. 8 (Family: none)	5-8
Y	JP 7-335014 A (Matsushita Electric Works, Ltd.), 22 December 1995 (22.12.1995), paragraph [0012]; fig. 1 (Family: none)	5-8
P,X	JP 2009-114961 A (Mitsubishi Heavy Industries, Ltd.), 28 May 2009 (28.05.2009), paragraph [0041]; fig. 1 to 3 & WO 2009/060796 A1	1,9

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2010/058021

Box No. II	Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)
This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons: 1. ☐ Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely: 2. ☐ Claims Nos.: because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically: 3. ☐ Claims Nos.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).	
Box No. III	Observations where unity of invention is lacking (Continuation of item 3 of first sheet)
This International Searching Authority found multiple inventions in this international application, as follows: See extra sheet 1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims. 2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees. 3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.: 4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.: Remark on Protest ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee. ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation. ☒ No protest accompanied the payment of additional search fees.	

Form PCT/ISA/210 (continuation of first sheet (2)) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2010/058021

Continuation of Box No.III of continuation of first sheet (2)

Document 1 (JP 2007-315269 A) substantially discloses a configuration in which a vibration isolating member (133) for a circuit board, said vibration isolating member consisting of an electrically insulative elastic body, is disposed between the control board (25A) and board affixing sections (131A-C). Since the document 1 discloses that the vibration isolating member (133) for the board is "rubber," unless there is a specific statement, it is appropriate to understand that a rubber material is electrically insulative, and using rubber as an electrically insulative material is an addition of well-known commonly used art. Document 1 also discloses that the configuration has an electrically insulative filling material (33).

Accordingly, the inventions in claims 1, 2, and 9 have no novelty in relation to the inventions disclosed in document 1 and therefore have no special technical feature. As a consequence, the claims include three inventions (groups) having the below-described special technical features.

Notethattheinventionsinclaims1, 2, and9havingnospecialtechnical features are categorized in invention 1.

(Invention 1) The inventions in claims 1-3, and 9

The inventions having all the configurations stated in claims 1-3.

(Invention 2) The invention in claim 4

The invention having all the configurations stated in claim 1 and claim 4.

(Invention 3) The inventions in claims 5-8

The inventions having all the configurations stated in claim 1 and claim 5.

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 2006177214 A [0004]
- JP 2006316754 A [0004]
- JP 2008133729 A [0004]