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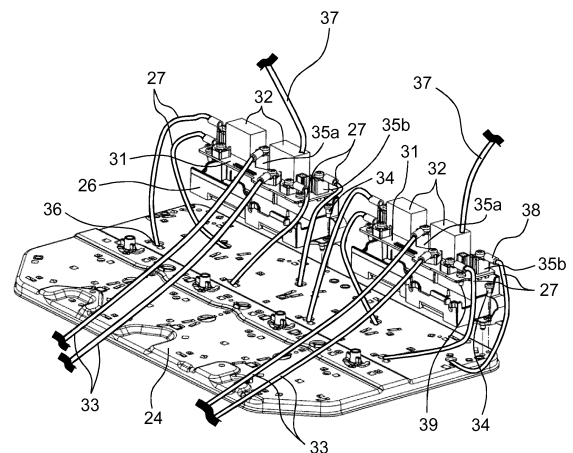
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(54) **INDUCTION HEATING COOKER**

(57) An induction heating cooker includes a drive circuit, multiple heating coils, and relay circuit (31). The drive circuit converts an AC power supply to high-frequency electric power. The multiple heating coils are disposed to metallic shielding plate (24), and generate a high-frequency magnetic field upon receiving the high-frequency electric power. The relay circuit includes multiple relays (32) that switch the connections, in response to a signal supplied from the drive circuit, between the drive circuit and the multiple heating coils, and is coupled to the heating coils via connection wire (27). Relay circuit (31) is mounted to holder (26) provided to shielding plate (24) on a face opposite to a face where the heating coils are provided. The structure discussed above allows a wiring work to be done firstly between relay circuit (31) and the heating coils, and then allows a wiring work to be done between relay circuit (31) and the drive circuit. As a result, noises can be reduced, and this induction heating cooker can be assembled more efficiently. On top of that, the number of components to be commonly used in other models can be increased.

FIG. 4



Description

TECHNICAL FIELD

[0001] The present disclosure relates to induction heating cookers to be used for home cooking and professional cooking.

BACKGROUND ART

[0002] An induction heating cooker includes, in general, at least one heating coil directly under a top plate on which a metallic cooking utensil (e.g. pan) is to be placed. The induction heating cooker allows the heating coil to give off a high-frequency magnetic field, which generates an eddy current to the cooking utensil placed on the top plate. As a result the cooking utensil is heated for carrying out a cooking.

[0003] Patent literature 1 discloses the following induction heating cooker: In order to drive multiple heating coils with a single drive circuit, this induction heating cooker allows controlling the drive circuit such that a current path to the heating coils can be connected or disconnected with relays for avoiding useless supply of high-frequency current to heating coils not in use.

[0004] Patent literature 2 discloses an induction heating cooker in which multiple relays are integrated for improving an assembling efficiency.

[0005] Patent literature 3 discloses an induction heating cooker in which a number of heating coils are arranged in matrix below a cooking utensil, and a single drive circuit supplies a high-frequency current to the heating coils.

Citation List

[0006]

Patent Literature 1: Unexamined Japanese Patent Application Publication No. H09 - 140561
Patent Literature 2: Unexamined Japanese Patent Application Publication No. H05 - 335073
Patent Literature 3: EPO Patent Application Publication No. 2380399

SUMMARY OF DISCLOSURE

[0007] Nevertheless, the prior art discussed above requires that each of the heating coils should be connected to the corresponding relays with wirings.

[0008] The wiring work to the heating coils is regularly done this way: First, the drive circuit is built into a housing of the induction heating cooker, then the wiring work is done with the heating coils being temporarily placed around the housing or special jigs to this wiring work. The wiring work becomes thus complicated in proportion to the number of the heating coils. On top of that, since the wirings are temporarily prepared, lead wires such as con-

nection wires to the heating coils should be longer than necessary.

[0009] The wiring work discussed above not only incurs an increase in the cost, but also possibly invites damages to the lead wires because of stress applied to the lead wires, or due to an unexpected contact of the lead wires to components inside the housing. On top of that, since the lead wires are shaped longer than necessary, it should be noted that noises given off by the heating coils may adversely affect the drive circuit.

[0010] When a distance between the heating coil and the relay cannot be kept constant due to a structural restriction, a length of the connection wire should be changed depending on the locations of the heating coils, or the structure of the housing should be changed in response to the location of the relay. Some of the components thus need to be shaped individually, which is a troublesome work.

[0011] To address the problems discussed above, an induction heating cooker in accordance with one aspect of the present disclosure includes a drive circuit, multiple heating coils, and a relay circuit.

[0012] The drive circuit converts an AC power supply to high-frequency electric power. The multiple heating coils are disposed to a metallic shielding plate, and generate a high-frequency magnetic field upon receiving the high-frequency electric power. The relay circuit includes multiple relays that switch connections between the drive circuit and the multiple heating coils in response to a signal supplied from the drive circuit. This relay circuit is coupled to the heating coils via connection wires, and is disposed to a holder which is mounted to the shielding plate on an opposite face to the face where the heating coils are disposed.

[0013] The aspect discussed above proves that the induction heating cooker, in which the connection between the multiple heating coils and the drive circuit is switched by using the relays, allows achieving the wiring with ease between the heating coils and the relay circuit, as well as between the relay circuit and the drive circuit. On top of that, these wirings can be done free from changes in length of the connection wires to the heating coils. As a result, noises can be reduced, and the assembling efficiency is improved. On top of that, the number of components to be shaped individually, which is a troublesome work, can be reduced.

BRIEF DESCRIPTION OF DRAWINGS

[0014]

FIG. 1A is a perspective view of an induction heating cooker in accordance with an embodiment of the present disclosure.

FIG. 1B is a plan view of the induction heating cooker in accordance with the embodiment of the present disclosure.

FIG. 2 is an exploded perspective view of the induc-

tion heating cooker in accordance with the embodiment of the present disclosure.

FIG. 3 is an exploded perspective view of a heating-coil unit in accordance with the embodiment of the present disclosure.

FIG. 4 is an exploded perspective view of the heating-coil unit, viewed from the back side thereof, in accordance with an embodiment of the present disclosure.

FIG. 5 is a perspective view of a holder, viewed from the back side thereof, in accordance with an embodiment of the present invention.

FIG. 6 is a sectional view cut along line 6 - 6 in FIG. 1B.

FIG. 7 is a perspective view illustrating how to provide a wiring between the heating coil unit and the drive circuit.

DESCRIPTION OF EMBODIMENT

[0015] An induction heating cooker in accordance with a first aspect of the present disclosure includes a drive circuit, multiple heating coils, and a relay circuit.

[0016] The drive circuit converts an AC power supply to high-frequency electric power. The multiple heating coils are mounted to a metallic shielding plate, and generate a high-frequency magnetic field upon receiving the high-frequency electric power. The relay circuit includes multiple relays that switch connections between the drive circuit and the multiple heating coils in response to a signal supplied from the drive circuit. This relay circuit is coupled to the heating coils via a connection wire, and is disposed to a holder which is mounted to the shielding plate on a face opposite to the face where the heating coils are mounted.

[0017] This first aspect proves that a wiring work is firstly done between the relay circuit and the heating coils, and then a wiring work can be done between the relay circuit and the drive circuit. As a result, the induction heating cooker can be assembled with more ease.

[0018] The first aspect proves that the heating coils can be brought closer to the relay circuit when the heating coils are connected to the relay circuit. The connection wires thus need not to be shaped uselessly long, so that the noises given off by the heating coils can be reduced.

[0019] The first aspect proves that if the shielding plate becomes hot due to the heat from the heating coils, the holder protects the relay circuit from the heat given off by the shielding plate.

[0020] The first aspect proves that if the location of the heating-coil unit in the housing is changed, no change is needed in a distance between the heating coils and the relay circuit within the heating-coil unit. In other words, the length of the connection wire does not depend on the location of the heating-coil unit. This structure allows the connection wires of the same length can be commonly used for other models in which the heating coil units are placed in different places from each other.

[0021] An induction heating cooker in accordance with a second aspect of the present disclosure includes a connection wire that is wired via an opening formed on the shielding plate for connecting the heating coils and the relay circuit together. This is a different point from the first aspect.

[0022] The structure of the second aspect allows using a connection wire shorter than the connection wire taking a long way around the shielding plate.

[0023] An induction heating cooker in accordance with a third aspect of the present disclosure includes a holder that has a stationary section to be joined mechanically to the housing, and this holder is disposed around an edge of the shielding plate. This is a different point from the first aspect.

[0024] The holder according to the third aspect can be used not only for holding the relay circuit, but also for joining the shielding plate and the housing together. Since the housing is made of rather inexpensive sheet steel, this holder made of resin is disposed between the heating coils and the shielding plate for achieving an electric insulation inexpensively between the housing and the heating coils

[0025] An induction heating cooker in accordance with a fourth aspect of the present disclosure includes a relay circuit that has a connecting section to receive the connection wire, and the holder includes an outer wall taller than the relays and the connecting section. This outer wall is disposed close to the housing. This is a different point from the third aspect.

[0026] This outer wall of the holder allows prolonging a creeping distance of insulation between the housing and the connecting section, so that the electric insulation can be more stable. If water entered around the shielding plate, the outer wall is able to protect the relay circuit from the water.

[0027] A preferred embodiment of the induction heating cooker of the present disclosure is demonstrated hereinafter with reference to the accompanying drawings. In the drawings, elements similar to each other have the same reference marks, and the descriptions to be duplicated are sometimes omitted.

[0028] FIG. 1A is a perspective view of induction heating cooker 1 in accordance with the embodiment of the present disclosure. FIG. 1B is a plan view of induction heating cooker 1 in accordance with the embodiment. FIG. 2 is an exploded perspective view of induction heating cooker 1 in accordance with the embodiment.

[0029] As FIGS. 1A, 1B, and FIG. 2 show, induction heating cooker 1 is disposed in kitchen cabinet 3, and includes top plate 4, heating-coil units 5a, 5b and 6, fan motor 8, drive circuit 9, housing 10, and operating board 12.

[0030] Top plate 4 is formed of heat-resistant tempered glass, and includes multiple heating regions 4b thereon.

[0031] Heating-coil units 5a, 5b, and 6 are disposed respectively beneath each of the heating regions with each one side of the heating-coil units being supported

by supporting plate 7. Fan motor 8 is disposed under supporting plate 7 for cooling drive circuit 9, which is disposed below supporting plate 7 for feeding high-frequency electric power to heating-coil units 5a, 5b, and 6.

[0032] Housing 10 accommodating the foregoing structural elements is formed of plated sheet steel having a thickness of approx. 0.6 mm and includes mica-sheet 11 disposed inside housing 10 for electrically insulating drive circuit 9. Operating board 12 is disposed in front of supporting plate 7 and yet under operating region 4a.

[0033] Induction heating cooker 1 heats pan 2 placed on heating region 4b in response to the heating power set through operating region 4a disposed this side of top plate 4.

[0034] FIG. 3 is an exploded perspective view of heating-coil unit 6 of induction heating cooker 1 in accordance with the embodiment. FIG. 4 is an exploded perspective view of heating-coil unit 6 viewed from the rear side.

[0035] As FIGS. 3 and 4 show, heating-coil unit 6 includes four heating coils 22, mica sheets 21, 23, shielding plate 24, and coil ferrites 25.

[0036] Shielding plate 24 is formed of aluminum sheet having a thickness of approx. 1.0 mm. Heating coils 22 are disposed on a top face of shielding plate 24. Coil ferrites 25 are disposed on the top face of shielding plate 24 such that coil ferrites 25 surround each of heating coils 22.

[0037] Mica sheets 21 are disposed between top plate 4 and heating coils 22 for insulation purpose. Mica sheets 23 are disposed between heating coils 22 and coil ferrites 25 for insulation purpose. Mica sheets 21 and 23 are bonded respectively to top plate 4 and coil ferrites 25 with silicone (not shown).

[0038] In this embodiment, heating coils 22 are formed of stranded copper-wires that are bundled together and coated with, for instance, polyethylene, and the stranded copper-wires are wound into an oval shape. Connection wire 27 is coupled to both the ends of each of heating coils 22 via round terminal 38 that is attached to the tip of wire 27 by heat-crimping. The resin coating has been removed from the tip of wire 27.

[0039] Heating coils 22 can be formed of materials other than copper, such as a wire formed of layers of copper and aluminum. The shape of heating coil 22 is not limited to the oval shape, but it can be a round shape, a triangular shape, or a rectangular shape. Heating-coil unit 6 can include three or less than three heating coils 22, or five or more than five heating coils 22.

[0040] As FIG. 4 shows, two holders 26 are rigidly mounted with screws 34 to the rear side (underside) of shielding plate 24 around the edge thereof. The rear side is opposite to the front side (top face) on which heating coils 22 are mounted. Each one of holders 26 shapes like a box made of heat-resistant resin and having no lid (refer to FIG. 5). One relay circuit 31 is rigidly mounted with screw 39 inside of each holder 26.

[0041] In this embodiment, one relay circuit 31 works for two heating coils 22, so that induction heating cooker

1 includes two relay circuits 31, and two relays 32 are disposed in each of two relay circuits 31.

[0042] Relay circuit 31 includes one terminal pedestal 35a to be used for receiving power line 33 extended from drive circuit 9, and four terminal pedestals 35b to be used for receiving connection wires 27. Terminal pedestals 35a and 35b work as connecting sections for connecting power line 33 and connection wires 27 to relay circuit 31 respectively.

[0043] Connection wire 27 is routed through opening 36 formed on shielding plate 24 and connects heating coil 22 disposed on the top face of shielding plate 24 to relay 32 disposed on the underside of shielding plate 24.

[0044] Relay 32 switches the connection in response to a signal supplied from drive circuit 9 via signal line 37. In response to this switching done by relay 32, the high-frequency electric power is fed to either one of two heating coils 22.

[0045] FIG. 5 is a perspective view of holder 26 viewed from the rear side. FIG. 6 is a sectional view cut along line 6 - 6 in FIG. 1B.

[0046] As FIGS. 2, 5, and 6 show, heating-coil unit 6 is mounted to a step section provided to housing 10. Heating-coil unit 6 is positioned with pin 42 provided to holder 26, then screw-slot 41 (i.e. a stationary section) formed horizontally and housing 10 are screwed together, whereby heating-coil unit 6 is rigidly mounted to housing 10.

[0047] Holder 26 includes outer wall 40 taller than relay 32, terminal pedestals 35a, 35b with relay circuit 31 being disposed inside the holder 26. Rigid mounting of holder 26 to housing 10 causes outer wall 40 to approach housing 10.

[0048] The ways of placing and wiring the heating coils 22, relay circuit 31, and other elements in accordance with the embodiment are demonstrated hereinafter.

[0049] First, heating coils 22 are placed on the top face of shielding plate 24, then relay circuit 31 is placed on the underside of shielding plate 24 via holder 26. Connection wires 27 are connected to corresponding terminal pedestals 35b respectively. The connection between heating coils 22 and relay circuit 31 is thus completed.

[0050] Next, a wiring between heating-coil unit 6 and drive circuit 9 is done. FIG. 7 is a perspective view illustrating this wiring; however, connection wire 27 is omitted in FIG. 7.

[0051] Heating-coil unit 6 is temporarily placed laterally near drive circuit 9 with holder 26 facing downward as shown in FIG. 7. While heating-coil unit 6 is kept this status, power line 33 and signal line 37 are connected to heating-coil unit 6, whereby the connection between heating-coil unit 6 and drive circuit 9 is completed.

[0052] To be more specific, in this embodiment, the wiring between relay circuit 31 and heating coils 22 is firstly done, and then the wiring between relay circuit 31 and drive circuit 9 is done, so that induction heating cooker 1 can be assembled more efficiently.

[0053] In this embodiment, when heating coils 22 are

coupled to relay circuit 31, heating coils 22 can approach relay 32. This structure allows connection wires 27 not to be shaped uselessly long, so that noises given off by heating coils 22 can be reduced.

[0054] In this embodiment, the heat generated by heating coils 22 will cause shielding plate 24 to be hot; however, holder 26 made of heat-resistant insulating material allows protecting relay circuit 31 from the heat given off by shielding plate 24.

[0055] In this embodiment, a change in the position of heating-coil unit 6 within housing 10 does not affect the distance between heating coils 22 of heating-coil unit 6 and relay circuit 31. In other words, the length of connection wire 27 is independent of the position of heating-coil unit 6. This structure allows connection wires 27 of the same length to be commonly used among the models in which heating-coil units 6 are positioned at different places.

[0056] In this embodiment, connection wire 27 routed through the opening formed on shielding plate 24 is coupled to relay 32. This structure allows using connection wire 27 shorter than that taking a long way around shielding plate 24.

[0057] In this embodiment, holder 26 is used not only for holding relay circuit 31, but also for coupling shielding plate 24 and housing 10 together. Since housing 10 is made of rather inexpensive sheet steel, housing 10 can be electrically insulated inexpensively from heating coils 22 with holder 26 made of resin and disposed between them.

[0058] In this embodiment, the presence of outer wall 40 provided to holder 26 allows prolonging the creeping distance for insulation between housing 10 and terminal pedestals 35a, 35b working as the connecting section, so that a steady electrical insulation can be achieved. If water entered around shielding plate 24, outer wall 40 allows protecting relay circuit 31 from the water.

INDUSTRIAL APPLICABILITY

[0059] As discussed above, the induction heating cooker in accordance with the present disclosure reduces noises, improves the assembling efficiency, and allows a greater number of components to be used commonly. This induction heating cooker is applicable to not only a built-in type cooking device, but also other types of cooking devices.

REFERENCE MARKS IN THE DRAWINGS

[0060]

- | | |
|----|--------------------------|
| 1 | induction heating cooker |
| 2 | pan (cooking utensil) |
| 3 | kitchen cabinet |
| 4 | top plate |
| 4a | operating region |
| 4b | heating region |

- | | |
|------------|---------------------------------|
| 5a, | 5b, 6 heating-coil unit |
| 7 | supporting plate |
| 8 | fan motor |
| 9 | drive circuit |
| 5 10 | housing |
| 11, 21, 23 | mica sheet |
| 12 | operating board |
| 22 | heating coil |
| 24 | shielding plate |
| 10 25 | coil ferrite |
| 26 | holder |
| 27 | connection wire |
| 31 | relay circuit |
| 32 | relay |
| 15 33 | power line |
| 34, 39 | screw |
| 35a, 35b | terminal pedestal |
| 36 | opening |
| 37 | signal line |
| 20 40 | outer wall |
| 41 | screw-slot (stationary section) |
| 42 | pin |

Claims

1. An induction heating cooker comprising:

30 a drive circuit for converting an AC power supply to high-frequency electric power;
 a plurality of heating coils provided to a metallic shielding plate and generating a high-frequency magnetic field upon receiving the high-frequency electric power; and
 35 a relay circuit including a plurality of relays that switches connections between the drive circuit and the plurality of heating coils in response to a signal supplied from the drive circuit, and coupled to the heating coils via a connection wire, wherein the relay circuit is disposed to an electrically insulated holder disposed to the shielding plate on a face opposite to a face where the heating coils are provided.

- 45 2. The induction heating cooker according to claim 1, wherein the connection wire is routed through an opening formed on the shielding plate, and couples the heating coils and the relay circuit together.

- 50 3. The induction heating cooker according to claim 1, wherein the holder includes a stationary section which is to be mechanically coupled to a housing, and the holder is disposed around an edge of the shielding plate.

- 55 4. The induction heating cooker according to claim 3, wherein the relay circuit includes a connecting section for receiving the connection wire, and the holder

includes an outer wall taller than the relays and the connecting section, and the outer wall is disposed close to the housing.

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FIG. 1A

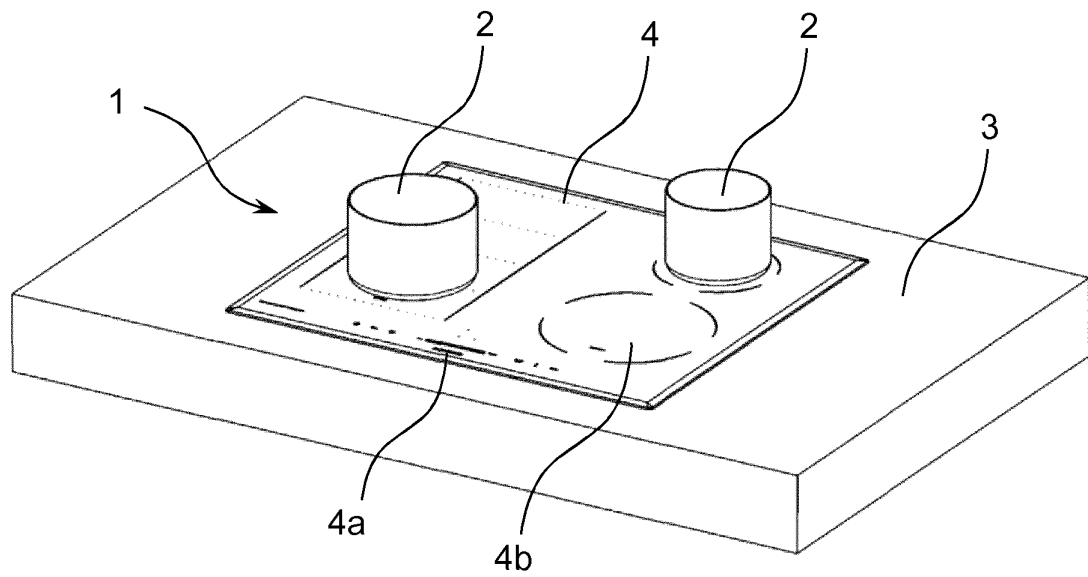


FIG. 1B

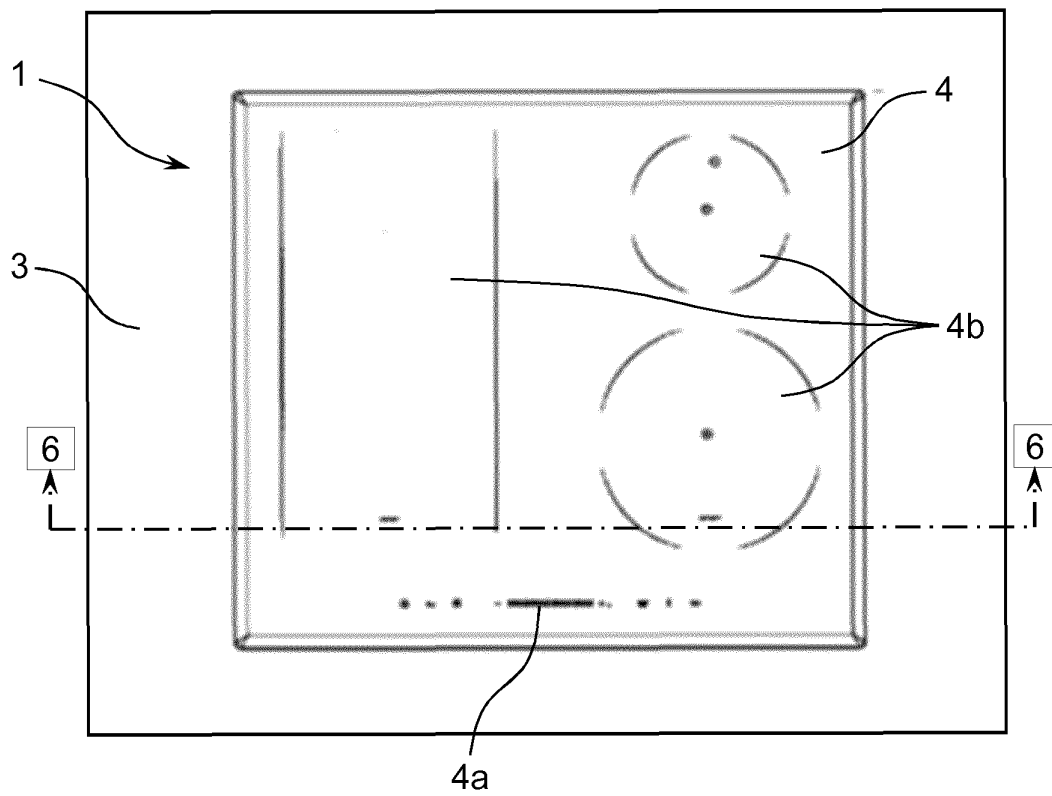


FIG. 2

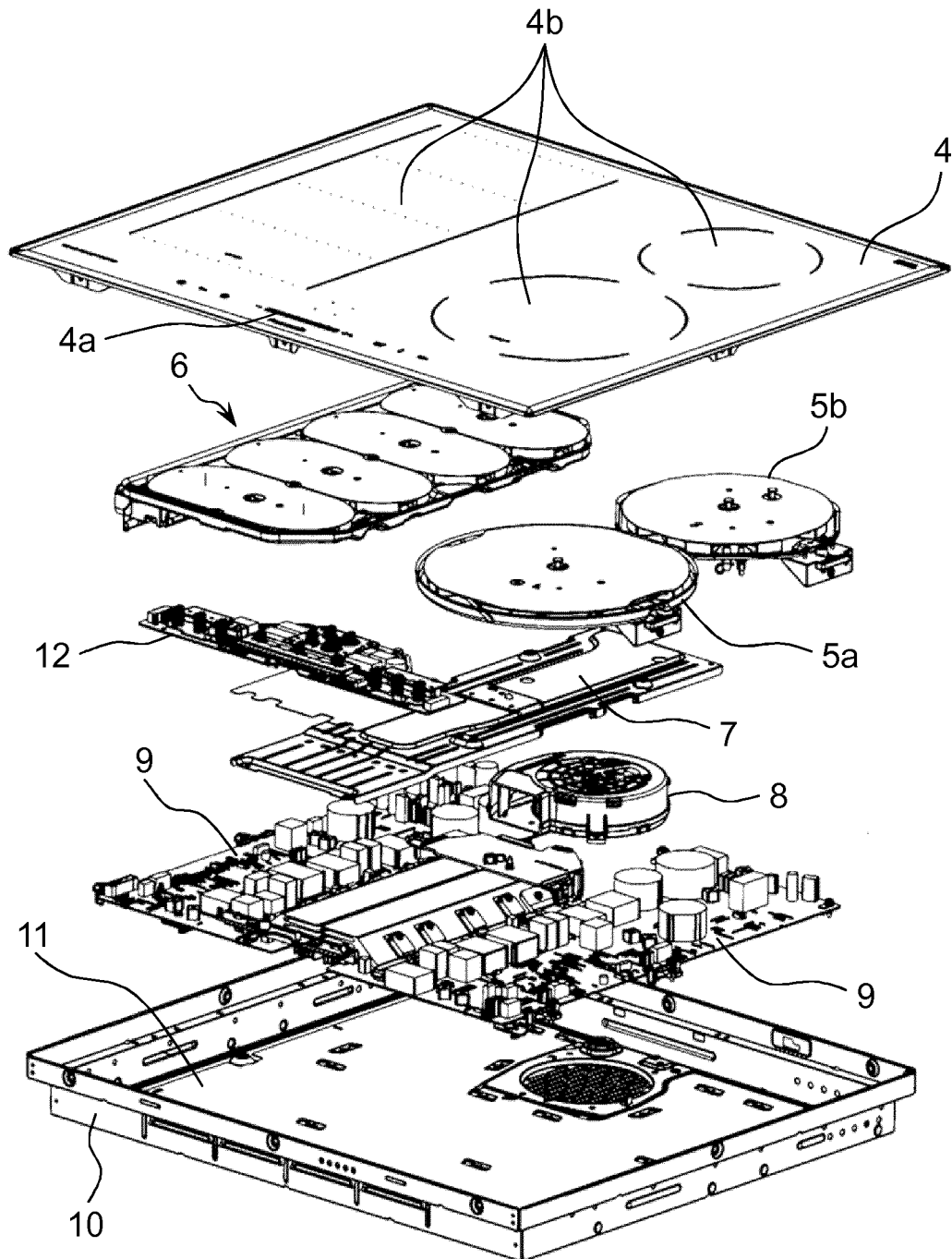


FIG. 3

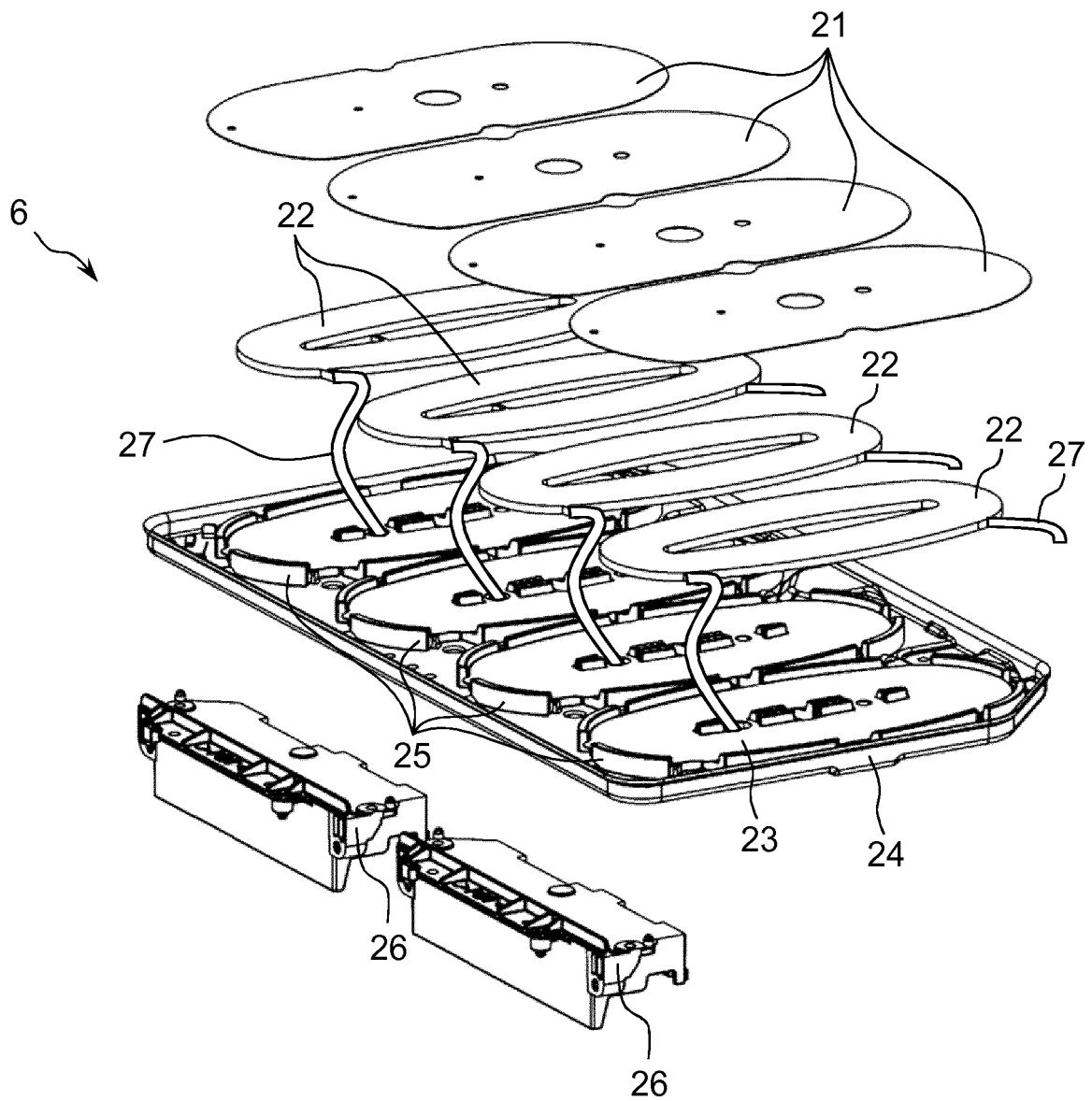


FIG. 4

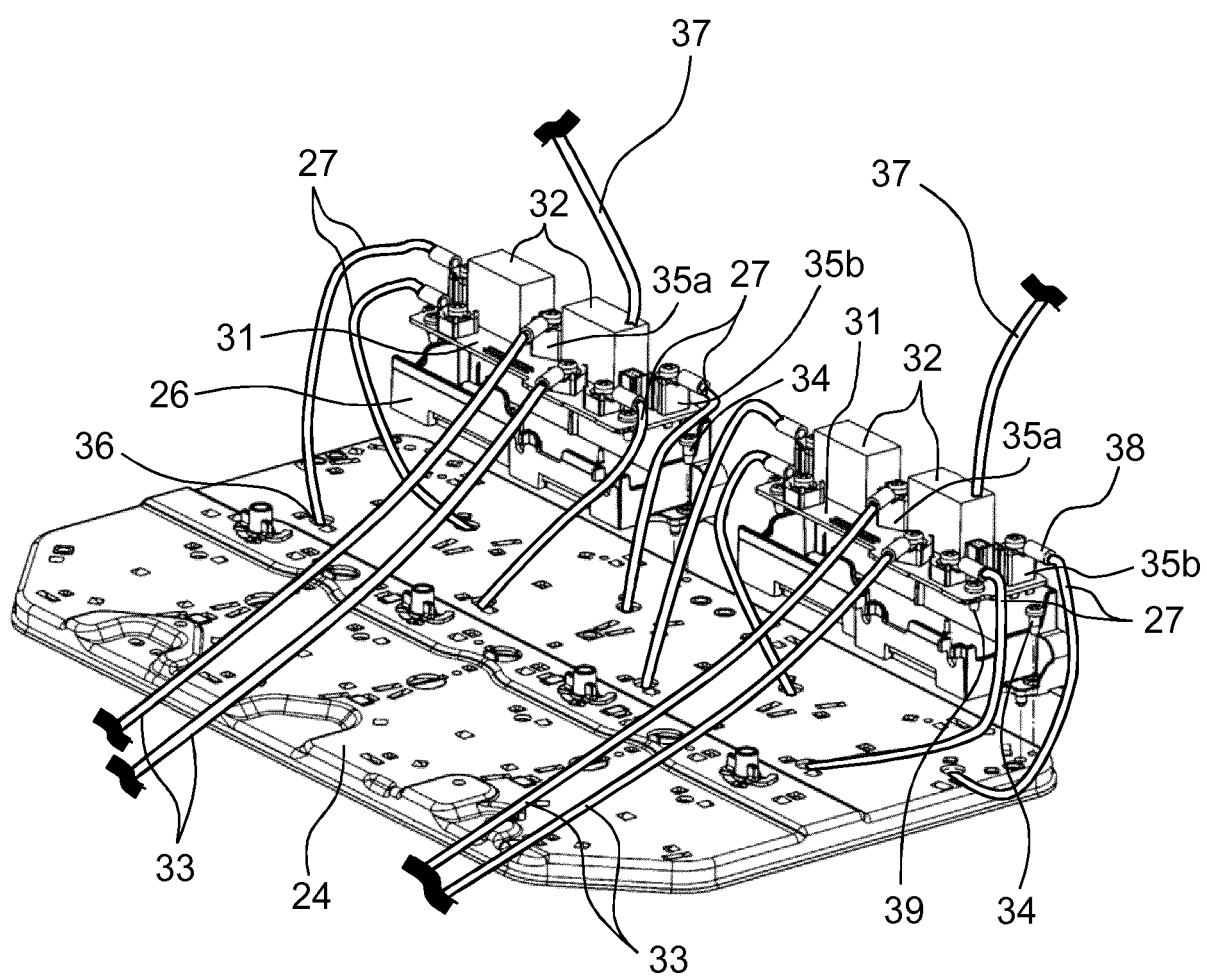


FIG. 5

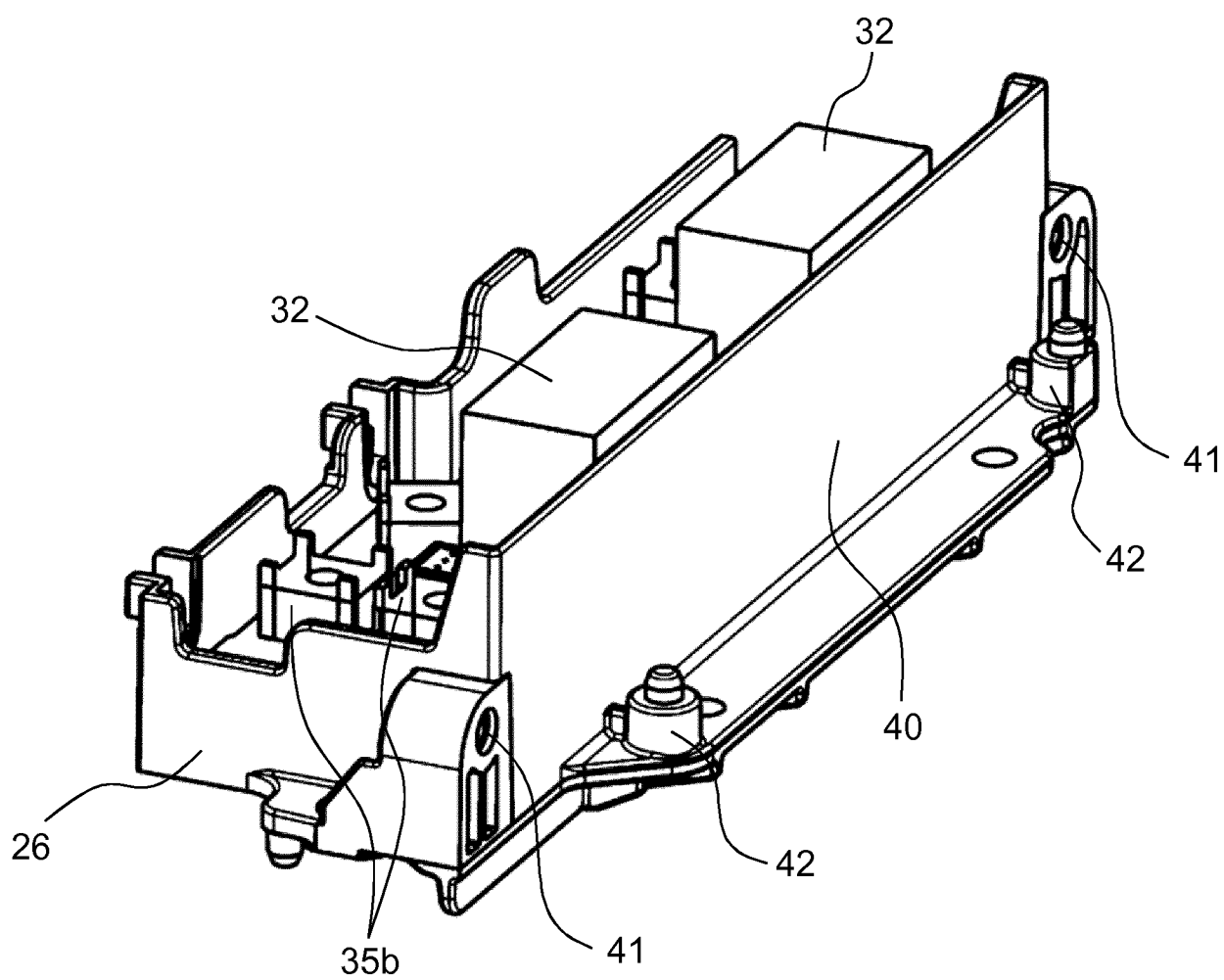


FIG. 6

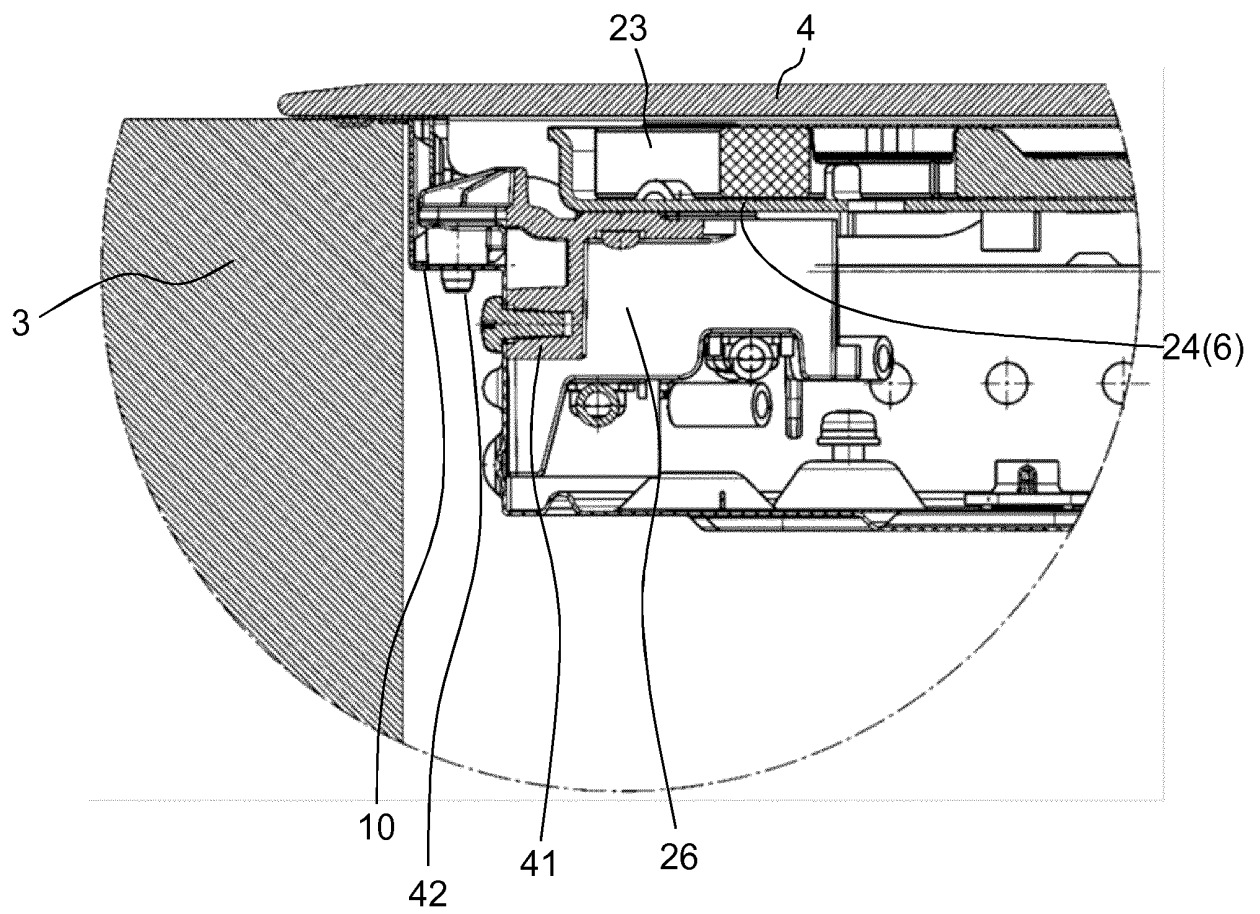
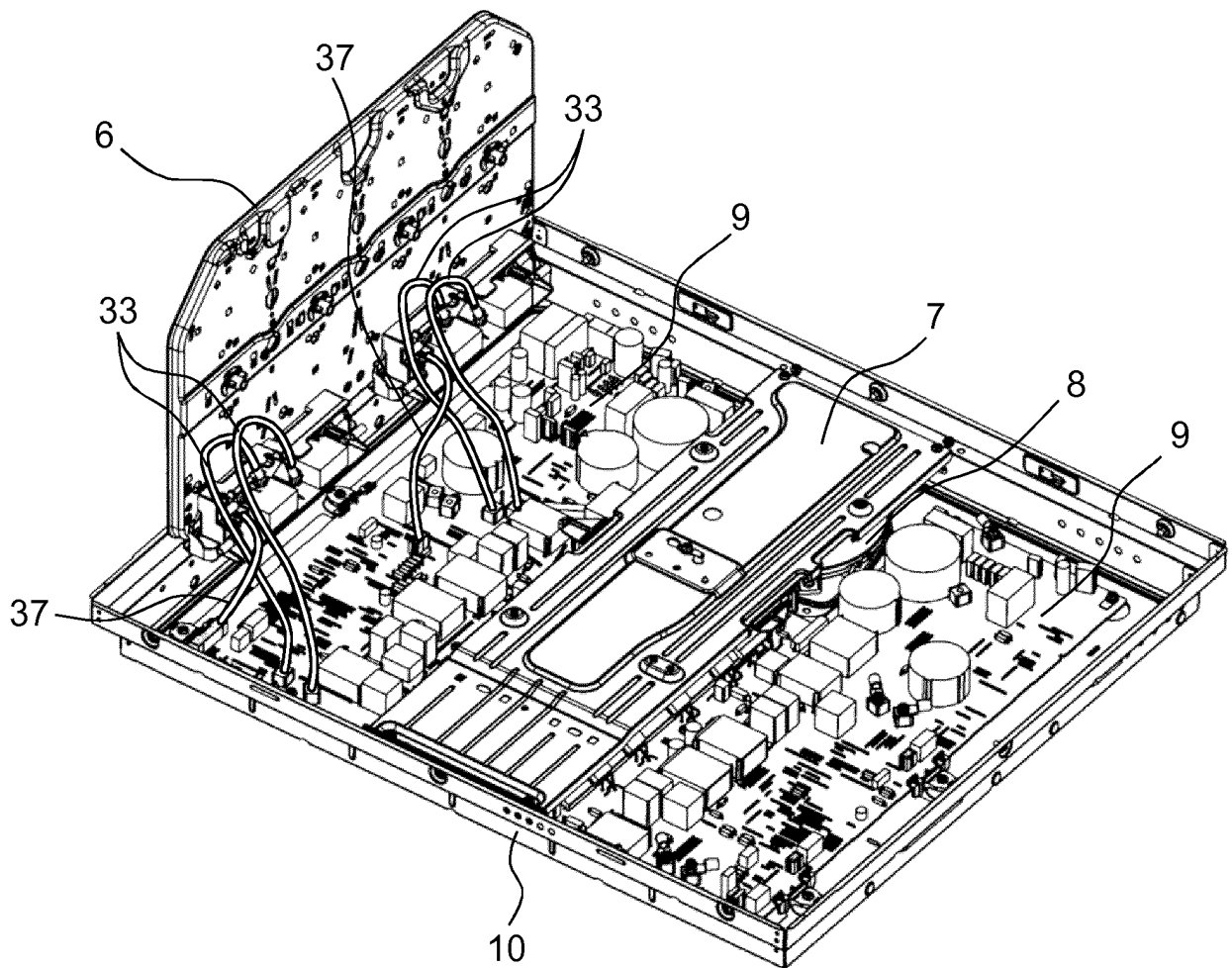


FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/001127

A. CLASSIFICATION OF SUBJECT MATTER

H05B6/12(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)
H05B6/12

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	1996-2016
Kokai Jitsuyo Shinan Koho	1971-2016	Toroku Jitsuyo Shinan Koho	1994-2016

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.
A	WO 2014/167814 A1 (Panasonic Corp.), 16 October 2014 (16.10.2014), paragraphs [0053] to [0103]; fig. 1 to 2 & US 2016/0029439 A paragraphs [0068] to [0120]; fig. 1 to 2 & CN 105191494 A	1-4

☒ 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

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"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

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"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
29 March 2016 (29.03.16)Date of mailing of the international search report
05 April 2016 (05.04.16)Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/001127

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 51-122726 A (Environment One Corp.), 27 October 1976 (27.10.1976), page 14, lower right column, line 1 to page 15, upper right column, line 11; page 29, lower left column, line 5 to lower right column, line 8; fig. 3 & US 3710062 A column 18, lines 6 to 64; column 36, line 61 to column 37, line 20; fig. 3 & GB 1392221 A & DE 2216255 A & IT 957496 B	1-4
A	JP 2013-201073 A (Mitsubishi Electric Corp.), 03 October 2013 (03.10.2013), paragraphs [0016] to [0022]; fig. 2 (Family: none)	1-4
A	JP 5-335073 A (Matsushita Electric Industrial Co., Ltd.), 17 December 1993 (17.12.1993), paragraphs [0020] to [0021]; fig. 1 to 2 (Family: none)	1-4

Form PCT/ISA/210 (continuation of second sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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- EP 2380399 A [0006]