



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
08.03.2017 Bulletin 2017/10

(51) Int Cl.:
H05B 6/36 (2006.01) **H01R 4/02 (2006.01)**
H01R 4/62 (2006.01) **H05B 6/12 (2006.01)**

(21) Application number: **16190677.1**

(22) Date of filing: **08.01.2014**

(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 RS SE SI SK SM TR**

(30) Priority: **09.01.2013 JP 2013001488**
09.01.2013 JP 2013001489

(62) Document number(s) of the earlier application(s) in
accordance with Art. 76 EPC:
14737674.3 / 2 945 464

(71) Applicant: **Panasonic Intellectual Property
Management Co., Ltd.**
Osaka-shi, Osaka 540-6207 (JP)

(72) Inventors:
• **KUWAMURA, Hiroshi**
Osaka, 540-6207 (JP)
• **WATANABE, Noriaki**
Osaka, 540-6207 (JP)
• **TAKENAKA, Kazuhiko**
Osaka, 540-6207 (JP)

(74) Representative: **Eisenführ Speiser**
Patentanwälte Rechtsanwälte PartGmbB
Postfach 31 02 60
80102 München (DE)

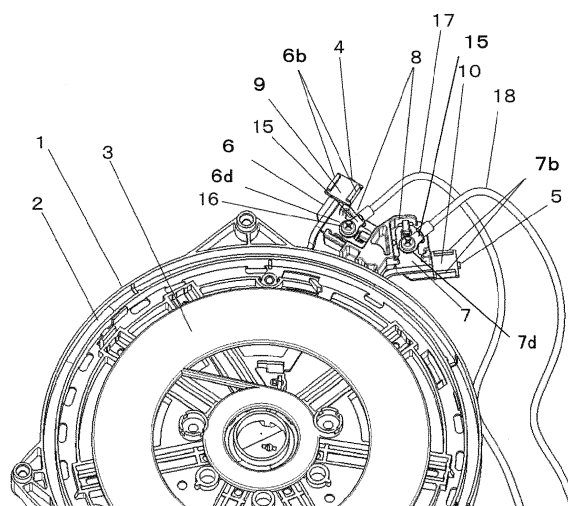
Remarks:

This application was filed on 26-09-2016 as a
divisional application to the application mentioned
under INID code 62.

(54) **INDUCTION-HEATING DEVICE AND INDUCTION-HEATING COOKER**

(57) An induction-heating device 1 has a heating coil 3 with a coil winding of the heating coil 3 including at least one wire. The induction-heating device 1 comprises a coil connection terminal 6 having a groove part 6c capable to accommodate the wire 4a at an end 4 of the coil winding and electrically connecting to a control unit for supplying the heating coil 3 with a current, and a lid body 9 capable to at least partly be disposed in the groove part 6c of the coil connection terminal 6 so as to cover the wire 4a of the coil winding accommodated in the groove part 6c of the coil connection terminal 6. The wire 4a, the coil connection terminal 6, and the lid body 9 are joined together by welding. The welding is performed with the lid body 9 disposed in the groove part 6c of the coil connection terminal 6 pressing the wire 4a accommodated in the groove part 6c.

[Fig. 1]



Description

Technical Field

[0001] The invention relates to an induction-heating device used as a heat source and an induction-heating cooker therewith.

Background Art

[0002] Conventionally, an induction-heating device, which is used as a heat source such as heat source in an induction-heating cooker for home use, has a heating coil for generating a high frequency magnetic field. To an end of a coil winding of the heating coil, a control unit supplying a high frequency current is electrically connected. For example, wires contained within the coil winding of the heating coil are joined to a connection terminal electrically connected to the control unit.

[0003] For example, patent documents 1 and 2 disclose a method for joining wires and a connection terminal.

[0004] Patent document 1 discloses a method for joining wires made from aluminum or aluminum alloy and a connection terminal made from a material such as copper or stainless material by TIG (Tungsten Inert Gas) welding. Specifically, the connection terminal has a tubular part. The wires and an added metal piece such as silver or silicon, which enhances a strength of a joint part by improving brittleness, are inserted in the tubular part of the connection terminal. The TIG welding is performed with the wires and the added metal piece being within the tubular part of the connection terminal, and thereby joins the wires and the connection terminal.

[0005] Patent document 2 discloses a method for ultrasonic-welding a core wire made by twisting aluminum wires to a metal terminal made from a material different from aluminum. Specifically, a portion of the core wire having an insulator coating is fastened to the metal terminal with a swage. Uncoated portions of the wires are placed on a portion of the metal terminal set on an anvil, and then a welding horn continues to presses the wires to the metal terminal and supplies it with a high frequency vibration. Consequently, the core wire and the metal terminal are joined together.

Prior Art Document(s)

[0006]

- Patent Document 1: Japanese Laid-Open Patent Publication No. 2010-251067
- Patent Document 2: Japanese Laid-Open Patent Publication No. 2009-259702

Summary of the Invention

Problems to be solved by the Invention

[0007] However, the joining method disclosed in patent document 1 depends heavily on the added metal. That is, the brittleness improving effect generated by the added metal is insufficient depending on material of the wires or the connection terminal. Depending on a combination of the wires, the connection terminal, and the added metal, there is a possibility that a crack or separation occurs in a joint part (boundary) between the wire and the connection terminal. Also, there is a possibility that a crack or separation occurs in a boundary between melted portions and unmelted portions of the wires.

[0008] In the joining method disclosed in patent document 2, a wire contacting with the metal terminal melts and thus joins to the metal terminal, while a wire away from the metal terminal hardly melt. It causes an increase in contact resistance between the core wire and the metal terminal or an occurrence of a variation in contact resistance. In case that a large current flows between the core wire and the metal terminal, the joint part produces an abnormal heat due to the increase or variation in contact resistance.

[0009] In the light of a reliability, it is not preferable to employ the joining method disclosed in patent documents 1 and 2 on the joining the coil winding of the heating coil and the connection terminal supplying the coil winding with a current.

[0010] Accordingly, it is an object of the invention, in an induction-heating device having a heating coil supplied with a current and used in an induction-heating cooker and like, to secure a high reliability of a joint between a coil winding of the heating coil and a connection terminal supplying the heating coil with a current.

Means to Solve the Problems

[0011] In order to achieve the above object, the present invention has the following constitutions.

[0012] In one aspect of the invention, there is provided an induction-heating device having a heating coil with a coil winding of the heating coil including at least one wire, the induction-heating device comprising:

a coil connection terminal having a groove part capable to accommodate the wire at an end of the coil winding and electrically connecting to a control unit for supplying the heating coil with a current; and a lid body capable to at least partly be disposed in the groove part of the coil connection terminal so as to cover the wire of the coil winding accommodated in the groove part of the coil connection terminal,

wherein the wire, the coil connection terminal, and the lid body are joined together by welding and wherein the welding is performed with the lid body dis-

posed in the groove part of the coil connection terminal pressing the wire accommodated in the groove part.

[0013] In another aspect of the invention, there is provided an induction-heating cooker comprising an induction-heating device and a control unit described above.

Effects of the Invention

[0014] According to the invention, in an induction-heating device having a heating coil supplied with a current, a joint between a coil winding of the heating coil and a coil connection terminal for supplying the heating coil with a current can have a high reliability.

Brief Description of the Drawings

[0015] The above aspects and features of the present invention will become more apparent from the following description of preferred embodiments thereof with reference to the accompanying drawings, and wherein:

Fig. 1 is a perspective view showing a portion of an induction-heating device according to a first embodiment of the invention,

Fig. 2 is a perspective view showing a joint part between an end of a coil winding of a heating coil and a coil connection terminal,

Fig. 3 is a cross-section view showing a state before joining wires at the end of the coil winding of the heating coil and the coil connection terminal,

Fig. 4 is a cross-section view showing, after having joined the wires at the end of the coil winding of the heating coil and the coil connection terminal, the joint part between the end of the coil winding and the coil connection terminal,

Fig. 5 is a cross-section view showing a joint part between an end of a coil winding of a heating coil and a coil connection terminal in an induction-heating device according to a second embodiment of the invention,

Fig. 6 is a cross-section view showing a joint part between an end of a coil winding of a heating coil and a coil connection terminal in an induction-heating device according to a third embodiment of the invention,

Fig. 7 is a view for showing a coil connection terminal of an induction-heating device according to a fourth embodiment of the invention,

Fig. 8 is a perspective view showing a portion of an induction-heating device according to a fifth embodiment of the invention,

Fig. 9 is a perspective view showing a portion of an induction-heating device according to a sixth embodiment of the invention,

Fig. 10 is a perspective view showing a joint part between an end of a coil winding of a heating coil and a coil connection terminal according to the sixth embodiment of the invention, and

Fig. 11 is a further perspective view showing the joint part between the end of the coil winding of the heating coil and the coil connection terminal according to the sixth embodiment of the invention.

Embodiments for Carrying out the Invention

[0016] A aspect of the invention is an induction-heating device having a heating coil with a coil winding of the heating coil including at least one wire, the induction-heating device comprising:

a coil connection terminal having a groove part capable to accommodate the wire at an end of the coil winding and electrically connecting to a control unit for supplying the heating coil with a current; and a lid body capable to at least partly be disposed in the groove part of the coil connection terminal so as to cover the wire of the coil winding accommodated in the groove part of the coil connection terminal,

wherein the wire, the coil connection terminal, and the lid body are joined together by a welding and wherein the welding is performed with the lid body disposed in the groove part of the coil connection terminal pressing the wire accommodated in the groove part.

[0017] According to the aspect of the invention, in the induction-heating device having the heating coil supplied with a current, a joint between a coil winding of the heating coil and the coil connection terminal for supplying the heating coil with a current can have a high reliability.

[0018] In the induction-heating device, preferably, a cross-section of the groove part of the coil connection terminal has a shape in which a groove width is larger than a groove depth. Consequently, a number of the wires contacted with the coil connection terminal and the lid body is increased, and thus the wires easily melt at short times. Therefore, in addition to that the wires are further unified, the melted wires can contact with the coil connection terminal and the lid body through a large contact area. Thereby further secures a high reliability in the joint between the coil winding and the coil connection terminal.

[0019] In the induction-heating device, the coil connection terminal and the lid body may be made from a same material different from a material from which the wire of the coil winding of the heating coil is made. Therefore, the coil connection terminal and the lid body are unified, and thus difference in specific resistance therebetween becomes zero. Thereby suppresses an occurrence of an abnormal heat due to a high current flow and secures a higher reliability in the joint between the coil winding and the coil connection terminal.

[0020] In the induction-heating device, the coil connection terminal, the lid body, and the wire of the coil winding of the heating coil may be made from a same material. Differences in specific resistance between the coil connection terminal, the wire of the coil winding, and the lid

body become zero. Thereby further suppresses the occurrence of the abnormal heat due to the high current flow and further secures a high reliability in the joint between the coil winding and the coil connection terminal.

[0021] The induction-heating device may have a substrate having the coil connection terminal and a unit connection terminal mounted thereon and having a wiring pattern electrically connecting the coil connection terminal and the unit connection terminal. In this case, the unit connection terminal is electrically connected to the control unit.

[0022] The induction-heating device may have a substrate holder on which the substrate is placed. In addition to this, the coil connection terminal may be mounted on the substrate with the groove part not overlapping with the substrate in a vertical direction, the substrate may be placed on the substrate holder with groove part not overlapping with the substrate holder in the vertical direction. Consequently, an anvil can contact with the groove part of the coil connection terminal from below when an ultrasonic-welding is performed. That is, with the substrate, on which the coil connection terminal is mounted, being placed on the substrate holder part, the ultrasonic-welding for joining the groove part of the coil connection terminal, the wires of the coil winding, and the lid body can be performed.

[0023] In the induction-heating device, the coil connection terminal may include a first coil connection terminal joined to one end of the coil winding of the heating coil and a second coil connection terminal joined to the other end of the coil winding of the heating coil, and the substrate may include a first substrate on which the first coil connection terminal is mounted and a second substrate on which the second coil connection terminal is mounted. Thereby improves an ease of assembly in comparison to the case that the first and second coil connection terminals are mounted on a single substrate.

[0024] In the induction-heating device, the lid body and the wire of the coil winding of the heating coil may be made from a same material, the control unit may have a current supply terminal contacting with the coil connection terminal and supplying the coil connection terminal with a current, and the coil connection terminal is made from a cladding material made by joining at least two materials including a first material identical to the material of the wire of the coil winding of the heating coil and a second material identical to a material of the current supply terminal. In this case, the wire of the coil winding of the heating coil is joined to the groove part of the coil connection terminal made from the first material and the current supply terminal is connected to a portion of the coil connection terminal made from the second material. Consequently, the joint between the coil connection terminal and the coil winding can have a high reliability, and the connection between the coil connection terminal and the current supply terminal can have a high reliability.

[0025] In the induction-heating device, the coil connection terminal and the lid body may have engagement

parts engaging with each other, and the engagement part of the coil connection terminal and the engagement parts of the lid body may be configured such that the lid body is located with respect to the groove part of the coil connection terminal. Consequently, the groove part of the coil connection terminal, the wires of the coil winding accommodated in the groove part thereof, and the lid body can be stably joined.

[0026] Another aspect of the invention is an induction-heating cooker having the induction-heating device and the control unit described above.

[0027] According to the another aspect of the invention, the induction-heating cooker can have a high reliability.

[0028] Hereinbelow, embodiments of the present invention will be described with reference to the accompanying drawings. It is noted that the invention is not limited by the following embodiments.

(First Embodiment)

[0029] Fig. 1 is a perspective view showing a portion of an induction-heating device according to a first embodiment of the invention.

[0030] The induction-heating device shown in Fig. 1 is used as a heat source such as heat source of heat in an induction-heating cooker for home use. The induction-heating device 1 has a coil base 2 made from a plastic material, a heating coil 3 placed and fixed on the coil base 2 and generating a magnetic field, and coil connection terminals 6, 7 joined to ends 4, 5 of a coil winding of the heating coil 3.

[0031] The heating coil 3 is made of, for example, a coil winding made by twisting a plurality of wires made from aluminum or aluminum alloy and coating the twisted wires with an insulating material (for instance, electrical insulating enamel). The wires of the heating coil 3 may be made from a material other than aluminum or aluminum alloy, for example, copper.

[0032] One end 4 of the coil winding of the heating coil 3 is joined to one coil connection terminal 6. The other end 5 of the coil winding is joined to the other coil connection terminal 7. In this embodiment, the coil connection terminals 6, 7 are fixed to a terminal holder part 8 integrally formed and laterally placed on the coil base 2. When viewed from above, the coil connection terminals 6, 7 fixed to the terminal holder part 8 are positioned the outside of the heating coil 3 placed on the coil base 2. The coil winding passes through the coil base 2 in a downward direction and then extends toward the terminal holder part 8 in order to join one end 4 and the other end 5 of the coil winding of the heating coil 3 and the coil connection terminals 6, 7.

[0033] Next, joints of the ends 4, 5 of the coil winding of the heating coil 3 and the coil connection terminals 6, 7 are explained.

[0034] Fig. 2 is a perspective view showing a portion of the induction-heating device according to the first em-

bodiment. Fig. 2 also shows a joint between one end 4 of the coil winding of the heating coil 3 and one coil connection terminal 6. One coil connection terminal 6 and the other coil connection terminal 7 are about the same in configuration, and thus are the same in joint to the coil winding. Therefore, the joint between one coil connection terminal 6 and one end 4 of the coil winding is only explained.

[0035] As show in Fig. 2, the coil connection terminal 6 is made by press-cutting a thin plate in a desired configuration and then folding the press-cut plate partly. Specifically, the coil connection terminal 6 has a body part 6a and two wall parts 6b erecting from the body part 6a in parallel to each other. That is, the coil connection terminal 6 has a groove part 6c defined by the body part 6b and two wall parts 6b. A groove part of a coil connection terminal according to an embodiment of the invention however is not limited to the groove part defined by the body part and two wall parts thereof.

[0036] Fig. 3 shows the wires 4a(5a) at the end 4(5) of the coil winding of the heating coil 3 and the groove part 6c(7c) of the coil connection terminal 6(7) when viewed in an extending direction of the groove part 6c(7c) of the coil connection terminal 6(7). Fig. 3 also shows a state right before joining the wires 4a(5a) and the coil connection terminal 6(7).

[0037] The wires 4a (5a) at the end 4(5) of the coil winding of the heating coil 3 are accommodated in the groove part 6c(7c) of the coil connection terminal 6(7). Specifically, the insulating material is removed from the end 4(5) of the coil winding (that is, the end is uncoated), and thereby exposes the wires 4a(5a) to outside. The exposed wires 4a(5a) are accommodated in the groove part 6c(7c) of the connection terminal 6(7).

[0038] As shown in Fig. 3, a lid body 9(10) covers the wires 4a(5a) at end 4(5) of the coil winding of the heating coil 3 accommodated in the groove part 6c(7c) of the coil connection terminal 6(7). Specifically, the lid body 9(10) is a plate-like member as show in Figs. 1 and 2, and has a configuration capable to at least partly be disposed in the groove 6c(7c) of the coil connection terminal 6(7) as shown in Fig. 3. That is, the lid body 9(10) has a configuration capable to contact with the coil connection terminal 6(7) and the wires 4a(5a) accommodated in the groove part 6c(7c).

[0039] The lid body 9(10), the wires 4a(5a) at the end 4(5) of the coil winding of the heating coil, and the coil connection terminal 6(7) are joined together.

[0040] The lid body 9(10), the wires 4a(5a), and the coil connection terminal 6(7) are joined together, by welding, for example, ultrasonic welding. In the ultrasonic welding, the welding is performed according to the following procedure.

[0041] Firstly, the wires 4a(5a) at the end 4(5) of the coil winding of the heating coil 3 are accommodated in the groove part 6c(7C) of the coil connection terminal 6(7), and then the lid body 9(10) is partly disposed in the groove part 6c(7c) so as to cover the wires 4a(5a) ac-

commodated therein.

[0042] Secondly, as shown in Fig. 3, an anvil 11 is contacted with the coil connection terminal 6(7) from below while a ultrasonic-welding horn is contacted with the lid body 9(10) from above. The lid body 9(10), the wires 4a(5a) of the coil winding of the heating coil 3, and the groove part 6c(7c) are sandwiched between the anvil 11 and the ultrasonic-welding horn 12, and thereby compresses the wires 4a(5a) into the back of the groove part 6c(7c) through the lid body 9(10). Consequently, the wires 4a(5a) possibly close up in the groove part 6c(7c) of the coil connection terminal 6(7) and thus the coil connection terminal 6(7a) and the lid body 9(10) are contacted with as much as possible of the wires.

[0043] Subsequently, the ultrasonic-welding horn 12 keeps moving so as to press the wires 4a(5a) of the coil winding of the heating coil 3 through the lid body 9(10) and vibrating at ultrasonic frequency. Therefore, the wires 4a(5a) surrounded by the coil connection terminal 6(7) and the lid body 9(10) melt and thus the lid body 9(10) moves in the back of the groove part 6c(7c) of the coil connection terminal 6(7). Eventually, as shown in Fig. 4, the wires 4a(5a) accommodated in the groove part 6c(7c) of the coil connection terminal 6(7) are unified by melting itself and joined to the coil connection terminal 6(7) and the lid body 9(10). Also, the coil connection terminal 6(7) and the lid body 9(10) are joined together. Consequently, a joint part 13 formed by mutually and integrally joining the wires 4a(5a), the groove part 6c(7c) of the coil connection terminal 6(7), and lid body 9(10).

[0044] The joining of the ends 4, 5 of the coil winding of the heating coil 3 and the coil connection terminals 6, 7 may be performed after the heating coil 3 has been placed on the coil base 2 and the coil connection terminals 6, 7 have been mounted on the terminal holder part 8 or before placing and mounting thereof. Alternatively, the joining of the ends 4, 5 of the coil winding and the coil connection terminals 6, 7 may be performed with the heating coil 3 having been placed on the coil base 2 and the coil connection terminals 6, 7 not mounted on the terminal holder part 8.

[0045] The joining of the ends 4, 5 of the coil winding of the heating coil 3 and the coil connection terminals 6, 7 is not limited to ultrasonic welding. For example, it is possible to use welding such as resistance welding or TIG welding. That is, the welding can at least achieve a mutual joint of the wires 4a, 5a at the ends 4, 5 of the coil winding, the coil connection terminals 6, 7 (the groove parts 6c(7c) thereof), and the lid body 9, 10.

[0046] Even if the coil winding of the heating coil 3 has a single wire, the single wire can be joined to the groove part of the coil connection terminal, as well as a plurality of wires. That is, a coil winding according to an embodiment of the invention has at least one wire.

[0047] As shown in Fig. 1, the coil connection terminal s 6, 7 joined to the ends 4, 5 of the coil winding of the heating coil 3 are connected to crimp-type terminals 15 as current supply terminals. For example, screws 16 in-

serted in through-holes of the crimp-type terminals 15 engage with threaded parts 6d, 7d formed on the connection terminals 6, 7 (See Fig. 2) and thereby connects the crimp-type terminals 15 and the coil connection terminals 6, 7.

[0048] Leads 17, 18 extend from a control unit (not shown) of the induction-heating cooker are attached to the crimp-type terminals 15 connected with the coil connection terminals 7, 8. The leads 17, 18, for example, are swaged to the crimp-type terminals 15.

[0049] The leads 17, 18 of the control unit are leads for supplying the heating coil 3 with a high frequency current. The control unit supplies the heating coil 3 with the high frequency current through the leads 17, 18, the crimp-type terminals 15, the coil connection terminals 6, 7, and the wires 4a, 5a in the groove part 6c(7c) of the coil connection terminals 6, 7.

[0050] According to the first embodiment, the induction-heating device 1, which has the heating coil 3 supplied with a current and is used in the induction-heating cooker and like, can have a high reliability of the joint between the coil winding of the heating coil 3 and the coil connection terminals 6, 7 for supplying the heating coil 3 with a current.

[0051] Specifically, as shown in Fig. 3, the wires 4a(5a) of the coil winding of the heating coil 3 accommodated in the groove part 6c(7c) of the coil connection terminals 6(7) are, during welding, in a state that peripheries thereof are covered and contacted with the coil connection terminal 6(7) and the lid body 9(10). It therefore is easy for the wires to melt uniformly. Thereby avoids a presence of unmelted portions of the wires after the wires 4a(5a) has unified. Consequently, it is suppressed that a crack or separation occurs in a boundary between melted portions and unmelted portions of the wires. Thus, the joint between the coil winding of the heating coil and the coil connection terminal for supplying the heating coil with a current can secure a high reliability.

[0052] Since the wires 4a(5a) melt with it pressed by the lid body 9(10) during welding, the wires 4a(5a), which are unified by melting, can stably contact with the coil connection terminal 6(7) and the lid body 9(10) through a relatively large contact area. Therefore, contact resistances between the wires 4a(5a) (that is, the coil winding) and the coil connection terminal 6(7) and between the wires 4a(5a) and the lid body 9(10) approach zero, and a variation in contact resistance is suppressed. Consequently, an occurrence of an abnormal heat due to a high current flow is suppressed. Thereby secures a high reliability in the joint between the coil winding of the heating coil and the coil connection terminal for supplying the heating coil with a current.

[0053] A cross-section of the groove part 6c(7c) of the coil connection terminal 6(7) (a cross-section perpendicular to an extending direction thereof) preferably has a shape in which a groove width is larger than a groove depth, in order to join the coil connection terminal 6(7) and the wires 4a(5a) of the heating coil 3 accommodated

in groove part 6c(7c) of the coil connection terminal 6(7) at short time with high reliability. Consequently, a number of the wires 4a(5a) contacted with the coil connection terminal 6(7) and the lid body 9(10) is increased, and thus the wires 4a(5a) easily melt. Therefore, in addition to that the wires 4a(5a) are easily unified, the melted wires 4a(5a) can contact with the coil connection terminal 6(7) and the lid body 9(10) through a large contact area. The cross-section shape of the groove part 6c(7c) of the coil connection terminal 6(7) is not limited to a rectangular shape elongated in a groove width direction and may be any shape as long as the groove part 6c(7c) accommodates the wires 4a(5a) of the coil winding and a great number of wires contact with the coil connection terminal 6(7) and the lid body 9(10).

(Second Embodiment)

[0054] Fig. 5 is a cross-section view showing a joint part between an end of a coil winding and a coil connection terminal in an induction-heating cooker according to the second embodiment. Elements identical to the elements of the first embodiment have same reference numbers.

[0055] Configurations of a coil connection terminal 26(27) and a lid body 29(30) of the second embodiment are the same as the configurations of the coil connection terminal 6(7) and the lid body 9(10) of the first embodiment. However, as shown in Fig. 4, in the first embodiment, the coil connection terminal 6(7) and the lid body 9(10) are made from different materials. Also, the materials of the coil connection terminal 6(7) and the lid body 9(10) are different from a material of the wires 4a(5a) of the coil winding of the heating coil 3. On the other hand, in the second embodiment, the coil connection terminal 26(27) and the lid body 29(30) are made from a same material different from a material from which the wires 4a(5a) of the coil winding are made. For example, the coil connection terminal 26(27) and the lid body 29(30) are made from a stainless material or copper phosphate, in contrast to the wires 4a(5a) of the coil winding made from aluminum or aluminum alloy.

[0056] By welding similar to the first embodiment, the coil connection terminal 26(27) and the lid body 29(30) made from a same material are unified as shown in Fig. 5. Difference in specific resistance of the coil connection terminal 26(27) and the lid body 29(30) becomes zero. Consequently, an occurrence of an abnormal heat due to a high current flow is further suppressed. Thereby secures a high reliability in the joint between the coil winding of the heating coil and the coil connection terminal for supplying the heating coil with a current.

(Third Embodiment)

[0057] Fig. 6 is a cross-section view showing a joint between an end of a coil winding of a heating coil and a coil connection terminal in an induction-heating cooker according to the third embodiment. Elements identical to

the elements of the first embodiment have same reference numbers.

[0058] Configurations of a coil connection terminal 36(37) and a lid body 39(40) of the third embodiment are the same as the configurations of the coil connection terminal 6(7) and the lid body 9(10) of the first embodiment. However, as shown in Fig. 4, in the first embodiment, the coil connection terminal 6(7) and the lid body 9(10) are made from different materials. Also, the materials of the coil connection terminal 6(7) and the lid body 9(10) are different from a material of the wires 4a(5a) of the coil winding of the heating coil 3. On the other hand, in the third embodiment, the coil connection terminal 36(37), the lid body 39(40), and the wires 4a(5a) of the coil winding are made from a same material. For example, the coil connection terminal 36(37) and the lid body 39(40) are made from aluminum or aluminum alloy as well as the wires 4a(5a) of the coil winding.

[0059] By welding similar to the first embodiment, the wires 4a(5a) of the coil winding of the heating coil 3, the coil connection terminal 36(37), and the lid body 39(40) made from a same material are unified. Tripartite differences in specific resistance become zero. Consequently, an occurrence of an abnormal heat due to a high current flow is further suppressed. Thereby secures a high reliability in the join between the coil winding of the heating coil and the coil connection terminal for supplying the heating coil with a current.

(Fourth Embodiment)

[0060] Fig. 7 schematically shows a coil connection terminal 46 of an induction-heating device according to the fourth embodiment. In drawings, elements identical to the elements of the first embodiment have same reference numbers.

[0061] As shown in Fig. 2, in the first embodiment, the coil connection terminals 6, 7 are made by press-cutting a thin plate in desired configuration and then folding the press-cut plate partly, that is, made from a single material. On the other hand, in the fourth embodiment, the coil connection terminal 46 is made from a cladding material made by joining at least two materials, as shown in Fig. 7.

[0062] Specifically, the coil connection terminal 46 is made from the cladding material made by joining a material (a first material) identical to a material of the wires 4a of the coil winding of the heating coil 3 and a material (a second material) identical to a material of the crimp-type terminal 15 connected to the control unit (not shown).

[0063] For example, the coil connection terminal 46 is made from the cladding material made by joining a first member 46a made from aluminum which is the material of the wires 4a of the coil winding of the heating coil 3 and a second member 46b made from a stainless material or copper phosphate which is the material of the crimp-type terminal 15.

[0064] A groove part 46c joined to the wires 4a of the

coil winding of the heating coil 3 is formed on the first member 46. The lid body 9 disposed in the groove part 46c is made from the material identical to the materials of the wires 4a and the first member 46a, for example, aluminum. A joining of the wires 4a, the groove part 46c, and the lid body 9 is performed in the same manner as the first embodiment.

[0065] On the other hand, a threaded part 46d engaged with the screw 16 passing through the through-hole of the crimp-type terminal 15 is formed on the second member 46b. A washer 50 is disposed between the crimp-type terminal 15 and the second member 46b.

[0066] The material of the second member 46b is not required to be identical to the materials of the crimp-type terminal 15, the screw 16, and the washer 50 and may be any material having a small ionization tendency difference and a small potential difference with respect to the crimp-type terminal 15, the screw 16, and the washer 50 and having a small specific resistance.

[0067] According to such coil connection terminal 46, the joint between the wires 4a of the coil winding of the heating coil 3 and the coil connection terminal 46 can have a high reliability and can suppress an occurrence of an abnormal heat, as well as the third embodiment.

[0068] Moreover, according to such coil connection terminal 46, differences in specific resistance between the second member 46b of the coil connection terminal 46, the crimp-type terminal 15, screw 16, and washer 50 become zero. Thereby suppresses an occurrence of an abnormal heat due to a high current flow and an occurrence of an electrical corrosion in a contact region between the crimp-type terminal 15 and the coil connection terminal 46. Consequently, a connection between the coil connection terminal 46 and the crimp-type terminal 15 can have a high reliability.

(Fifth Embodiment)

[0069] Fig. 8 is a perspective view showing a portion of an induction-heating device according to the fifth embodiment. Elements identical to the elements of the first embodiment have same reference numbers.

[0070] The induction-heating device 51 has a substrate 52. The substrate 52 is placed and fixed on a substrate holder part 53 integrally formed on the coil base 2.

[0071] A coil connection terminal 54 joined to one end 4 of the coil winding of the heating coil 3 (specifically, to wires at the end 4) and a coil connection terminal 55 joined to the other end 5 (specifically, to wires at the end 5) are mounted on the substrate 52. Unit connection terminals 56, 57 are mounted on the substrate 52 and electrically connected to the crimp-type terminals 15 attached to the leads 17, 18 of the control unit (not shown) for supplying the heating coil 3 with a current. The substrate 52 has a wiring pattern (not shown) for electrically connecting one coil connection terminal 54 and one unit connection terminal 56 and a wiring pattern (not shown) for electrically connecting the other coil connection terminal

55 and the other unit connection terminal 57. The wiring patterns are, for example, patterns made from copper.

[0072] The coil connection terminals 54, 55 mounted on the substrate 52 have groove parts 54c, 55c accommodating wires at the ends 4, 5 of the coil winding of the heating coil 3, as well as the coil connection terminals 6, 7. In the groove parts 54c, 55c, lid bodies 58, 59 as well as the lid bodies 9, 10 of the first embodiment are disposed.

[0073] The joining of the coil connection terminals 54, 55 mounted on the substrate 52, the wires of the coil winding of the heating coil 3 accommodated in the groove parts 54c, 55c thereof, and the lid bodies 58, 59 are mutually joined by welding, as well as the coil connection terminals 6, 7, the wires 4a, 5a accommodated in the groove parts 6c, 7c thereof, and the lid bodies 9, 10 of the first embodiment.

[0074] The ends 4, 5 of the coil winding of the heating coil 3 and the coil connection terminals 54, 55 may be performed after the heating coil 3 has been placed on the coil base 2 and the substrate 52 has been placed on the substrate holder part 53 or before placing thereof. Alternatively, the joining of the ends 4, 5 of the coil winding and the coil connection terminals 54, 55 may be performed with the heating coil 3 having been placed on the coil base 2 and the substrate 52 not placed on the substrate holder part 53.

[0075] The crimp-type terminals 15 attached to the leads 17, 18 of the control unit (not shown) are connected to the unit connection terminals 56, 57 mounted on the substrate 52 by, for example, screws.

[0076] The control unit supplies the heating coil 3 with a high frequency current through the leads 17, 18, the crimp-type terminals 15, the unit connection terminals 56, 57, the wiring patterns on the substrate 52, the coil connection terminals 54, 55, and the wires in the groove parts 54c, 55c of the coil connection terminals 54, 55.

[0077] The joint between the coil winding of the heating coil 3 and the coil connection terminals 54, 55 in the fifth embodiment can have a high reliability, as well as the joint between the coil winding of the heating coil 3 and the coil connection terminals 6, 7.

(Sixth Embodiment)

[0078] Fig. 9 is a perspective view showing a portion of an induction-heating device according to the sixth embodiment. Elements identical to the elements of the fifth embodiment have same reference numbers.

[0079] In the fifth embodiment, as shown in Fig. 8, the coil connection terminals 54, 55 and the unit connection terminals 56, 57 are mounted on the single substrate 52. On the other hand, in the induction-heating device 61 of the sixth embodiment, the coil connection terminals 54, 55 are mounted on separate substrates 52A, 52B different from each other.

[0080] The two substrates 52A, 52B are fixed on the substrate holder part 53 with a gap 62 therebetween.

[0081] The coil connection terminal 54 and the unit connection terminal 56 are mounted on the substrate 52A. The substrate 52A has a wiring pattern (not shown), such as pattern made from copper, electrically connecting the coil connection terminal 54 and the unit connection terminal 56.

[0082] The coil connection terminal 55 and the unit connection terminal 57 are mounted on the substrate 52B. The substrate 52B has a wiring pattern (not shown), such as pattern made from copper, electrically connecting the coil connection terminal 55 and the unit connection terminal 57.

[0083] According to the sixth embodiment, as well as the fifth embodiment, the joint between the coil winding of the heating coil 3 and the coil connection terminals 54, 55 for supplying the heating coil 3 with a current can have a high reliability.

[0084] The substrates 52A, 52B respectively are more compact than the substrate 52 of the fifth embodiment. Also, the coil connection terminals 54, 55 are mounted on separate substrates 52A, 52B different from each other. Therefore, the induction-heating device of the sixth embodiment is easier in assembly than that of the fifth embodiment.

[0085] For example, firstly, one end 4 of the coil winding of the heating coil 3 is joined to the coil connection terminal 54 mounted on the substrate 52A and then the substrate 52A is fixed on the substrate holder part 53. Next, the other end 5 of the coil winding is joined to the coil connection terminal 55 mounted on the substrate 52B and then the substrate 52B is fixed on the substrate holder part 53. Such method is easier in assembly than the case that the substrate 52 joined to both ends 4, 5 of the coil winding is fixed on the substrate holder part 53.

[0086] The invention has described with reference to the embodiments described above, however, the invention is not limited to the embodiments.

[0087] For example, Figs. 10 and 11 are perspective views showing the joint part between one end 4 of the coil winding of the heating coil 3 and the groove part 54c of the one coil connection terminal 54 in the induction-heating device according to the sixth embodiment.

[0088] Preferably, a coil connection terminal and a lid body respectively have engagement parts engaging with each other, and the engagement parts are configured such that the lid body is located with respect to a groove part of the coil connection terminal, as well as the groove part 54c of the coil connection terminal 54 and the lid body 58 of the sixth embodiment shown in Figs. 10 and 11.

[0089] As shown in Fig. 11, in the sixth embodiment, the lid body 58 forms a shape having two protrusions 58a projecting in a width direction of the groove part 54c of the coil connection terminal 54, more specifically, is formed in the shape of "T". On the other hand, slots 54d capable to engage with the protrusions 58a of the lid body 58 are formed on wall parts 54b defining the groove part 54c.

[0090] A relative position of the lid body 58 with respect to the groove part 54c of the coil connection terminal 54 (a position in an extending direction of the groove part 54c) is unambiguously defined by engaging the protrusions 58a of the lid body 58 with the slots 54d of the wall parts 54b. Thereby suppresses a movement of the lid body 58 in the groove part 54c when the groove part 54c of the coil connection terminal 54, the wires of the coil winding accommodated in the groove part 54c thereof, and the lid body 58 are joined. Consequently, the groove part 54c, the wires, and the lid body 58 can be stably joined.

[0091] Engagement parts of a coil connection terminal and a lid body are not limited to the slots 54 and the protrusions 58a. For example, in the second embodiment shown in Fig. 2, the lid body 9 has recesses 9a opposite each other (that is, is formed in the shape of "H"). The wall parts 6b of the coil connection terminal 6 engage with the recesses 9a thereof.

[0092] For example, in the case that a coil connection terminal is mounted on a substrate (in the fifth and sixth embodiments), preferably, the coil connection terminal is mounted on the substrate with a groove part thereof not overlapping with the substrate in a vertical direction, and the substrate is placed on a substrate holder part with the groove part of the coil connection terminal not overlapping with the substrate holder part in the vertical direction.

[0093] For example, in the sixth embodiment shown in Fig. 10, the coil connection terminal 54 is mounted on the substrate 52A such that the groove part 54c of the coil connection terminal 54 is not overlapping with the substrate 52A in the vertical direction. That is, in the sixth embodiment, the substrate 52A has a shape in which a portion thereof positioned under the groove part 54c of the coil connection terminal 54 is eliminated.

[0094] Also, the substrate 52A is placed on the substrate holder part 53 such that the groove part 54c of the coil connection terminal 54 is not overlapping with the substrate holder part 53 in the vertical direction. That is, in the sixth embodiment, the substrate holder part 53 has a shape in which a portion thereof positioned under the groove part 54c of the coil connection terminal 54 is eliminated.

[0095] As shown in Fig. 10, there are no portions of the substrate 52A and the substrate holder part 53 under the groove part 54c of the coil connection terminal 54. Therefore, the anvil 11 can contact with the groove part 54c of the coil connection terminal 54 from below when an ultrasonic-welding is performed. That is, with the substrate 52, on which the coil connection terminal 54 is mounted, being placed on the substrate holder part 53, the ultrasonic-welding for joining the groove part 54c of the coil connection terminal 54, the wires of the coil winding, and the lid body 58 can be performed.

[0096] Although the present invention has been fully described in connection with the preferred embodiments thereof with reference to the accompanying drawings, it

is to be noted that various changes and modifications are apparent to those skilled in the art. Such changes and modifications are to be understood as included within the scope of the present invention as defined by the appended claims unless they depart therefrom.

[0097] The entire disclosure of Japanese Patent Applications No. 2013-001488 filed on January 9, 2013 and No. 2013-001489 filed on same day, 2010, including specification, claims, and drawings are incorporated herein by reference in its entirety.

Industrial Applicability

[0098] An induction-heating device according to the invention having a high reliability can be used in, for example, an induction-heating cooker using an induction-heating device as a high heat source by supplying a heating coil of the induction-heating device with a high current.

Embodiments

[0099] The present invention relates to the following embodiments:

[0100] According to a first embodiment, there is provided an induction-heating device having a heating coil with a coil winding of the heating coil including at least one wire, the induction-heating device comprising: a coil connection terminal having a groove part capable to accommodate the wire at an end of the coil winding and electrically connecting to a control unit for supplying the heating coil with a current; and a lid body capable to at least partly be disposed in the groove part of the coil connection terminal so as to cover the wire of the coil winding accommodated in the groove part of the coil connection terminal, wherein the wire, the coil connection terminal, and the lid body are joined together by welding, wherein the welding is performed with the lid body disposed in the groove part of the coil connection terminal pressing the wire accommodated in the groove part, wherein the coil connection terminal and the lid body have engagement parts engaging with each other, and wherein the engagement part of the coil connection terminal and the engagement part of the lid body are configured such that the lid body is located with respect to the groove part of the coil connection terminal.

[0101] According to a second embodiment, the induction-heating device according to the first embodiment is provided, wherein a cross-section of the groove part of the coil connection terminal perpendicular to an extending direction of the groove part has a shape in which a groove width is larger than a groove depth.

[0102] According to a third embodiment, the induction-heating device according to the first or second embodiment is provided, wherein the coil connection terminal and the lid body are made from a same material different from a material from which the wire of the coil winding of the heating coil is made.

[0103] According to a fourth embodiment, the induc-

tion-heating device according to the first or second embodiment is provided, wherein the coil connection terminal, the lid body, and the wire of the coil winding of the heating coil are made from a same material.

[0104] According to a fifth embodiment, the induction-heating device according to anyone of the first to fourth embodiments is provided, further comprising a substrate having the coil connection terminal and a unit connection terminal mounted thereon and having a wiring pattern electrically connecting the coil connection terminal and the unit connection terminal, wherein the unit connection terminal is electrically connected to the control unit.

[0105] According to a sixth embodiment, the induction-heating device according to the fifth embodiment is provided, further comprising a substrate holder on which the substrate is placed, wherein the coil connection terminal is mounted on the substrate with the groove part not overlapping with the substrate in a vertical direction, and wherein the substrate is placed on the substrate holder with the groove part of the coil connection terminal not overlapping with the substrate holder in the vertical direction.

[0106] According to a seventh embodiment, the induction-heating device according to the fifth or sixth embodiment is provided, wherein the coil connection terminal includes a first coil connection terminal joined to one end of the coil winding of the heating coil and a second coil connection terminal joined to the other end of the coil winding of the heating coil, and wherein the substrate includes a first substrate on which the first coil connection terminal is mounted and a second substrate on which the second coil connection terminal is mounted.

[0107] According to a eighth embodiment, the induction-heating device according to the first or second embodiment is provided, wherein the lid body and the wire of the coil winding of the heating coil is made from a same material, wherein the control unit has a current supply terminal contacting with the coil connection terminal and supplying the coil connection terminal with a current, wherein the coil connection terminal is made from a cladding material made by joining at least two materials including a first material identical to the material of the wire of the coil winding of the heating coil and a second material identical to a material of the current supply terminal, wherein the wire of the coil winding of the heating coil is joined to the groove part of the coil connection terminal made from the first material, and wherein the current supply terminal is connected to a portion of the coil connection terminal made from the second material.

Explanation of reference numerals

[0108]

- 1 induction-heating device
- 3 heating coil
- 4 end of coil winding
- 4a wire

- 5 end of coil winding
- 5a wire
- 6 coil connection terminal
- 6c groove part
- 5 7 coil connection terminal
- 7c groove part
- 9 lid body
- 10 lid body

10

Claims

1. An induction-heating device (1, 51, 61) having a heating coil (3) with a coil winding (4, 5) of the heating coil (3) including at least one wire (4a, 5a), the induction-heating device (1, 51, 61) comprising:

15

a coil connection terminal (6, 7, 8, 26, 27, 36, 37, 46, 54, 55) having a groove part (6c, 7c, 46c, 54c, 55c) capable to accommodate the wire (4a, 5a) at an end of the coil winding (4, 5) and electrically connecting to a control unit for supplying the heating coil (3) with a current;

20

a lid body (9, 10, 29, 30, 39, 40, 58) capable to at least partly be disposed in the groove part (6c, 7c, 46c, 54c, 55c) of the coil connection terminal (6, 7, 8, 26, 27, 36, 37, 46, 54, 55) so as to cover the wire (4a, 5a) of the coil winding (4, 5) accommodated in the groove part (6c, 7c, 46c, 54c, 55c) of the coil connection terminal (6, 7, 8, 26, 27, 36, 37, 46, 54, 55); and

25

a substrate (52) having the coil connection terminal (6, 7, 8, 26, 27, 36, 37, 46, 54, 55) and a unit connection terminal (56, 57) mounted thereon and having a wiring pattern electrically connecting the coil connection terminal (6, 7, 8, 26, 27, 36, 37, 46, 54, 55) and the unit connection terminal (56, 57),

30

35

40

wherein the wire (4a, 5a), the coil connection terminal (6, 7, 8, 26, 27, 36, 37, 46, 54, 55), and the lid body (9, 10, 29, 30, 39, 40, 58) are joined together by welding,

45

wherein the welding is performed with the lid body (9, 10, 29, 30, 39, 40, 58) disposed in the groove part (6c, 7c, 46c, 54c, 55c) of the coil connection terminal (6, 7, 8, 26, 27, 36, 37, 46, 54, 55) pressing the wire (4a, 5a) accommodated in the groove part (6c, 7c, 46c, 54c, 55c), and

50

wherein the unit connection terminal (56, 57) is electrically connected to the control unit.

2. The induction-heating device (1, 51, 61) according to claim 1, wherein a cross-section of the groove part (6c, 7c, 46c, 54c, 55c) of the coil connection terminal (6, 7, 8, 26, 27, 36, 37, 46, 54, 55) perpendicular to an extending direction of the groove part (6c, 7c, 46c, 54c, 55c) has a shape in which a groove width is

55

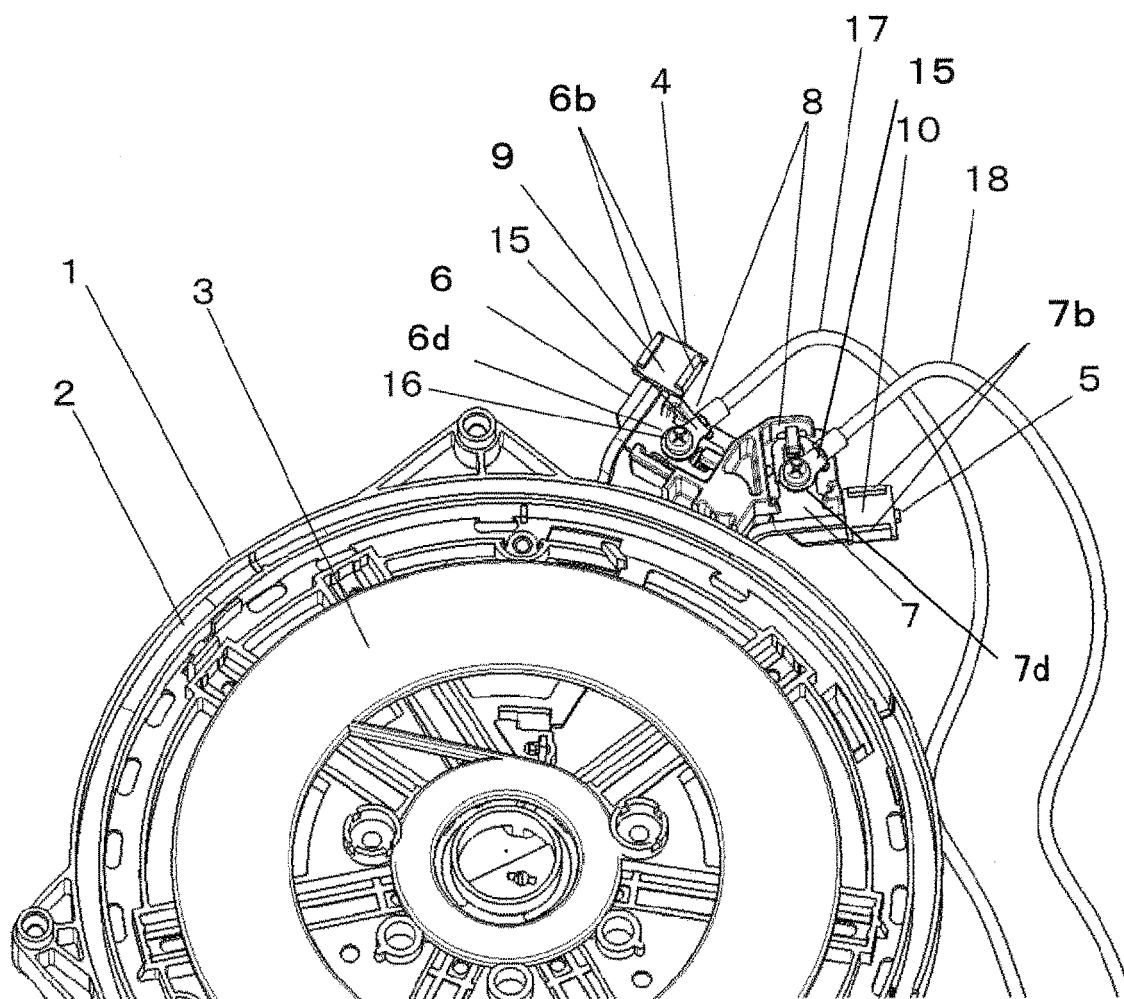
larger than a groove depth.

3. The induction-heating device (1, 51, 61) according to claim 1 or 2, wherein the coil connection terminal (6, 7, 8, 26, 27, 36, 37, 46, 54, 55) and the lid body (9, 10, 29, 30, 39, 40, 58) are made from a same material different from a material from which the wire (4a, 5a) of the coil winding (4, 5) of the heating coil (3) is made. 5
4. The induction-heating device (1, 51, 61) according to claim 1 or 2, wherein the coil connection terminal (6, 7, 8, 26, 27, 36, 37, 46, 54, 55), the lid body (9, 10, 29, 30, 39, 40, 58), and the wire (4a, 5a) of the coil winding (4, 5) of the heating coil (3) are made from a same material. 10 15
5. The induction-heating device (1, 51, 61) according to anyone of claims 1 to 4, further comprising a substrate holder (53) on which the substrate (52) is placed, 20
 wherein the coil connection terminal (6, 7, 8, 26, 27, 36, 37, 46, 54, 55) is mounted on the substrate (52) with the groove part (6c, 7c, 46c, 54c, 55c) not overlapping with the substrate (52) in a vertical direction, 25
 and
 wherein the substrate (52) is placed on the substrate holder (53) with the groove part (6c, 7c, 46c, 54c, 55c) of the coil connection terminal (6, 7, 8, 26, 27, 36, 37, 46, 54, 55) not overlapping with the substrate holder (53) in the vertical direction. 30
6. The induction-heating device (1, 51, 61) according to anyone of claims 1 to 5, wherein the coil connection terminal (6, 7, 8, 26, 27, 36, 37, 46, 54, 55) includes a first coil connection terminal (6, 7, 8, 26, 27, 36, 37, 46, 54, 55) joined to one end of the coil winding (4, 5) of the heating coil (3) and a second coil connection terminal (6, 7, 8, 26, 27, 36, 37, 46, 54, 55) joined to the other end of the coil winding (4, 5) of the heating coil (3), and 35 40
 wherein the substrate (52) includes a first substrate (52A) on which the first coil connection terminal (6, 7, 8, 26, 27, 36, 37, 46, 54, 55) is mounted and a second substrate (52B) on which the second coil connection terminal (6, 7, 8, 26, 27, 36, 37, 46, 54, 55) is mounted. 45
7. The induction-heating device (1, 51, 61) according to anyone of claims 1 to 6, wherein the coil connection terminal (6, 7, 8, 26, 27, 36, 37, 46, 54, 55) and the lid body (9, 10, 29, 30, 39, 40, 58) have engagement parts engaging with each other, and 50
 wherein the engagement part of the coil connection terminal (6, 7, 8, 26, 27, 36, 37, 46, 54, 55) and the engagement part of the lid body (9, 10, 29, 30, 39, 40, 58) are configured such that the lid body (9, 10, 29, 30, 39, 40, 58) is located with respect to the 55

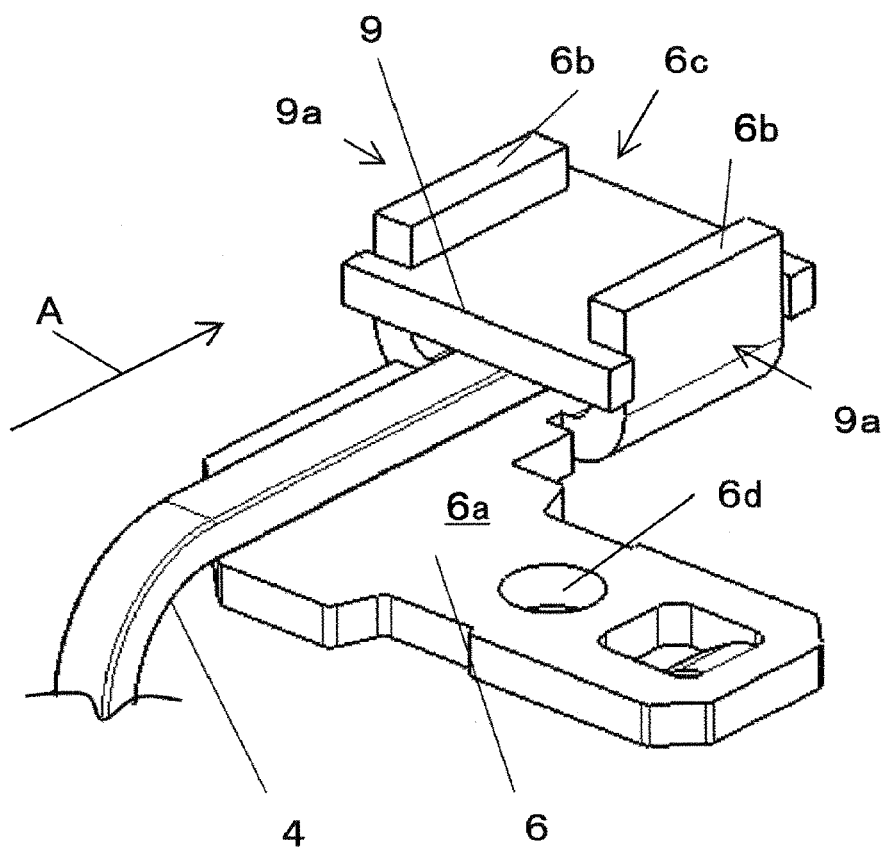
groove part (6c, 7c, 46c, 54c, 55c) of the coil connection terminal (6, 7, 8, 26, 27, 36, 37, 46, 54, 55).

8. An induction-heating cooker comprising an induction-heating device (1, 51, 61) and a control unit of anyone of claims 1 to 7.

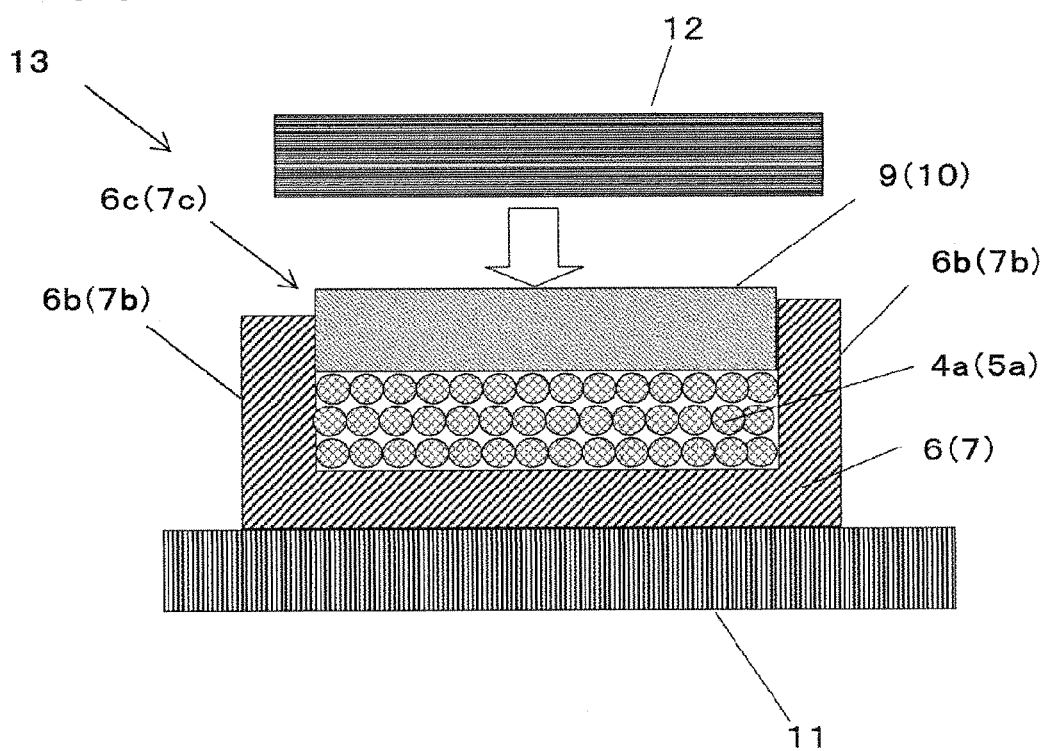
[Fig. 1]



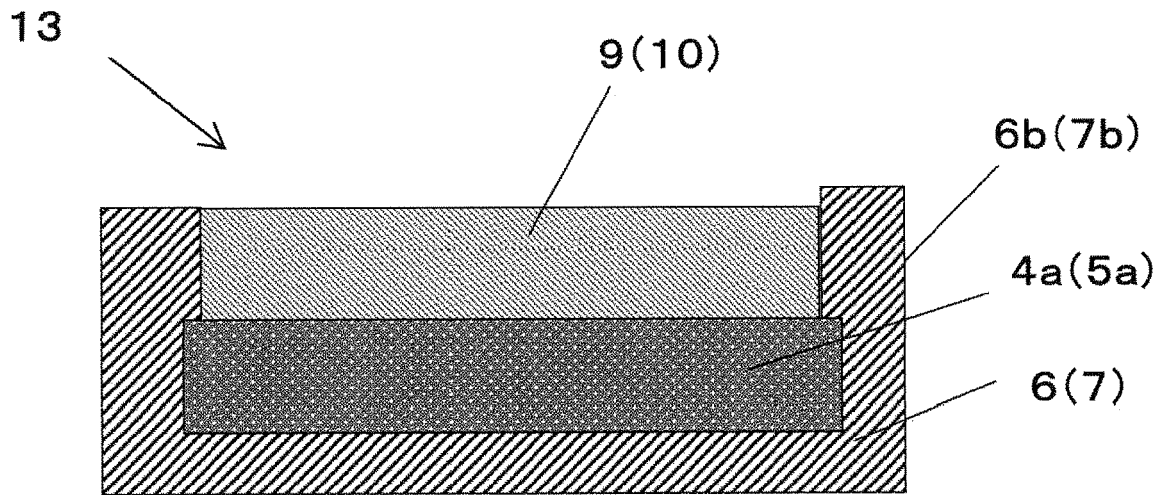
[Fig. 2]



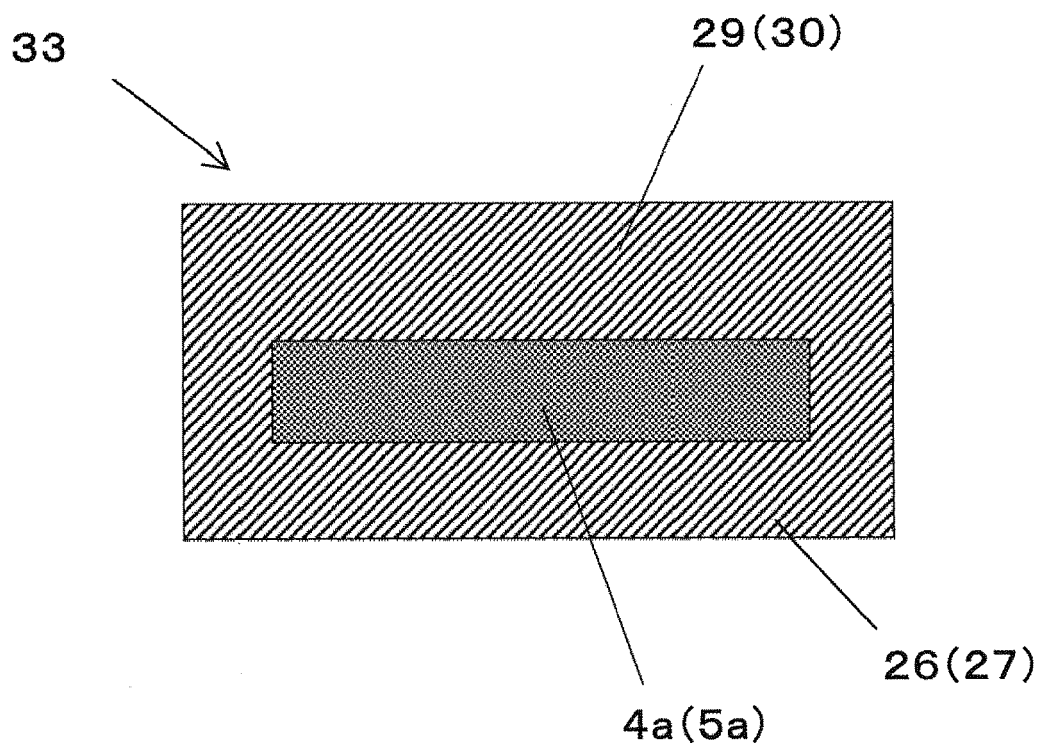
[Fig. 3]



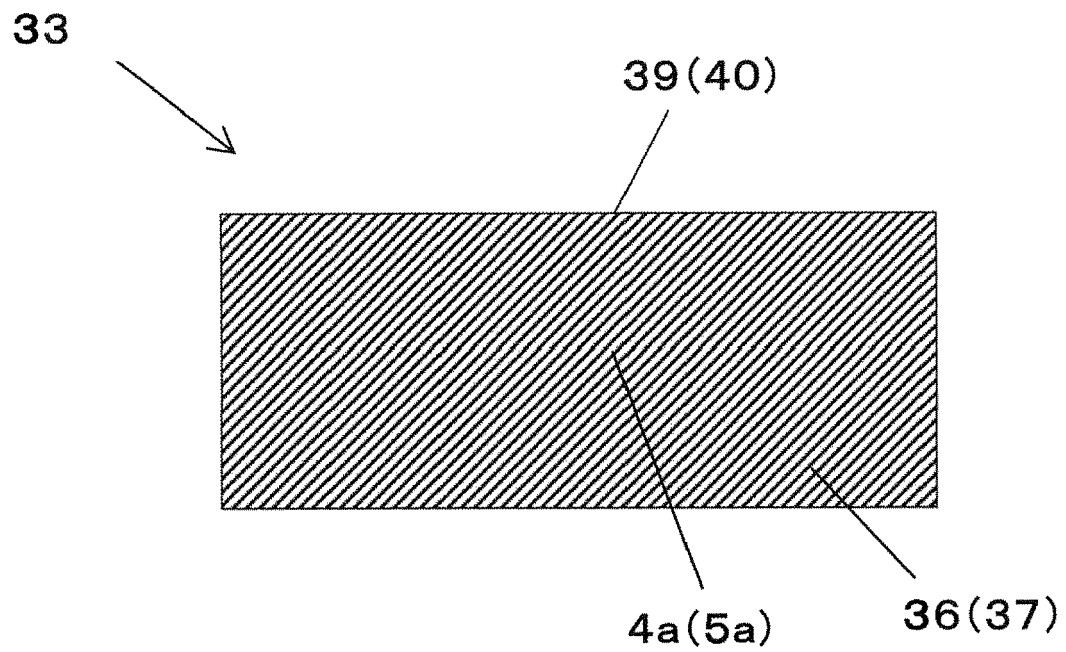
[Fig. 4]



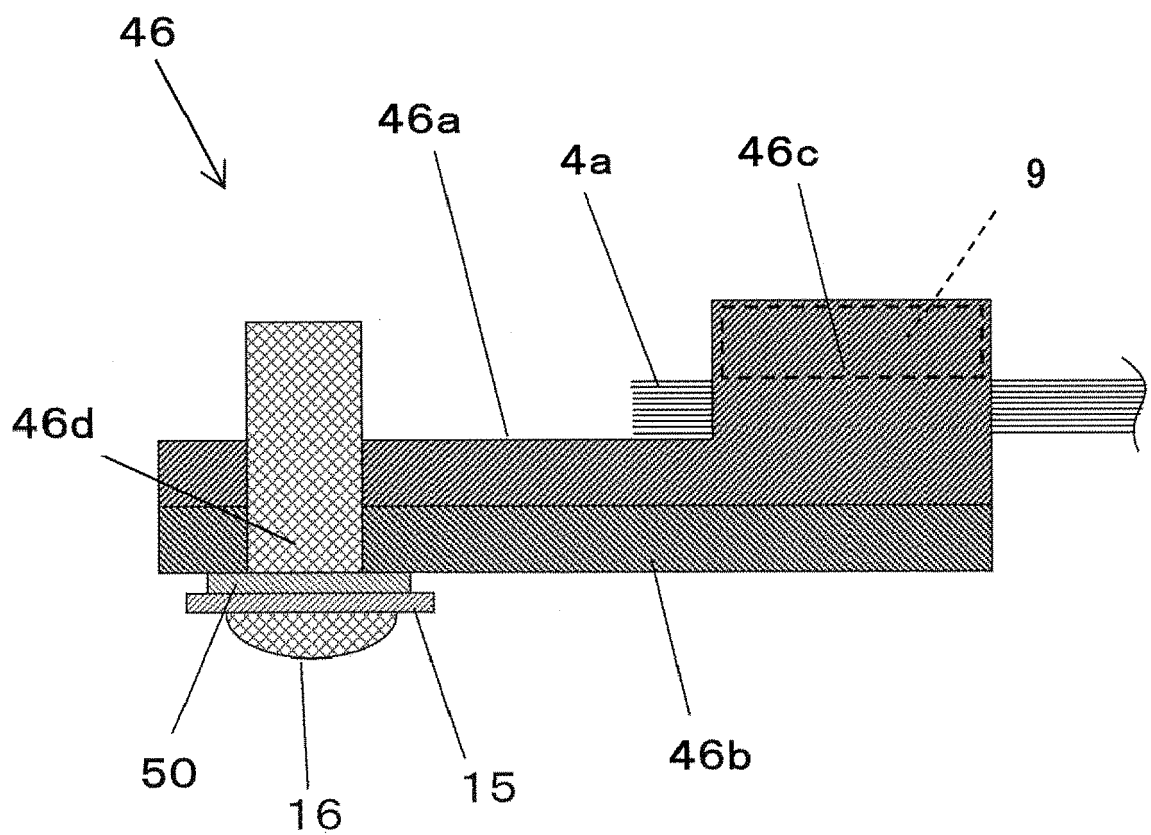
[Fig. 5]



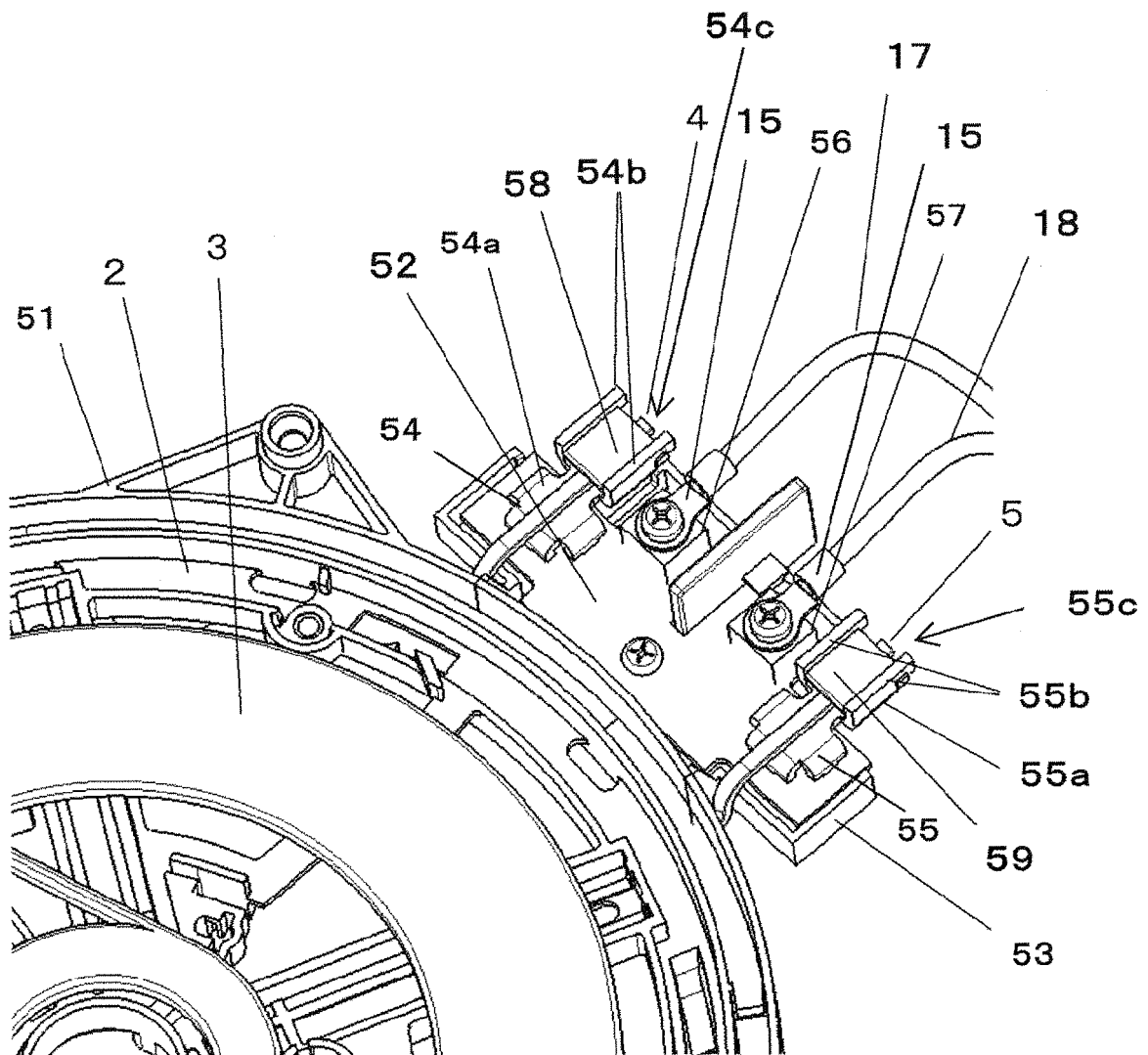
[Fig. 6]



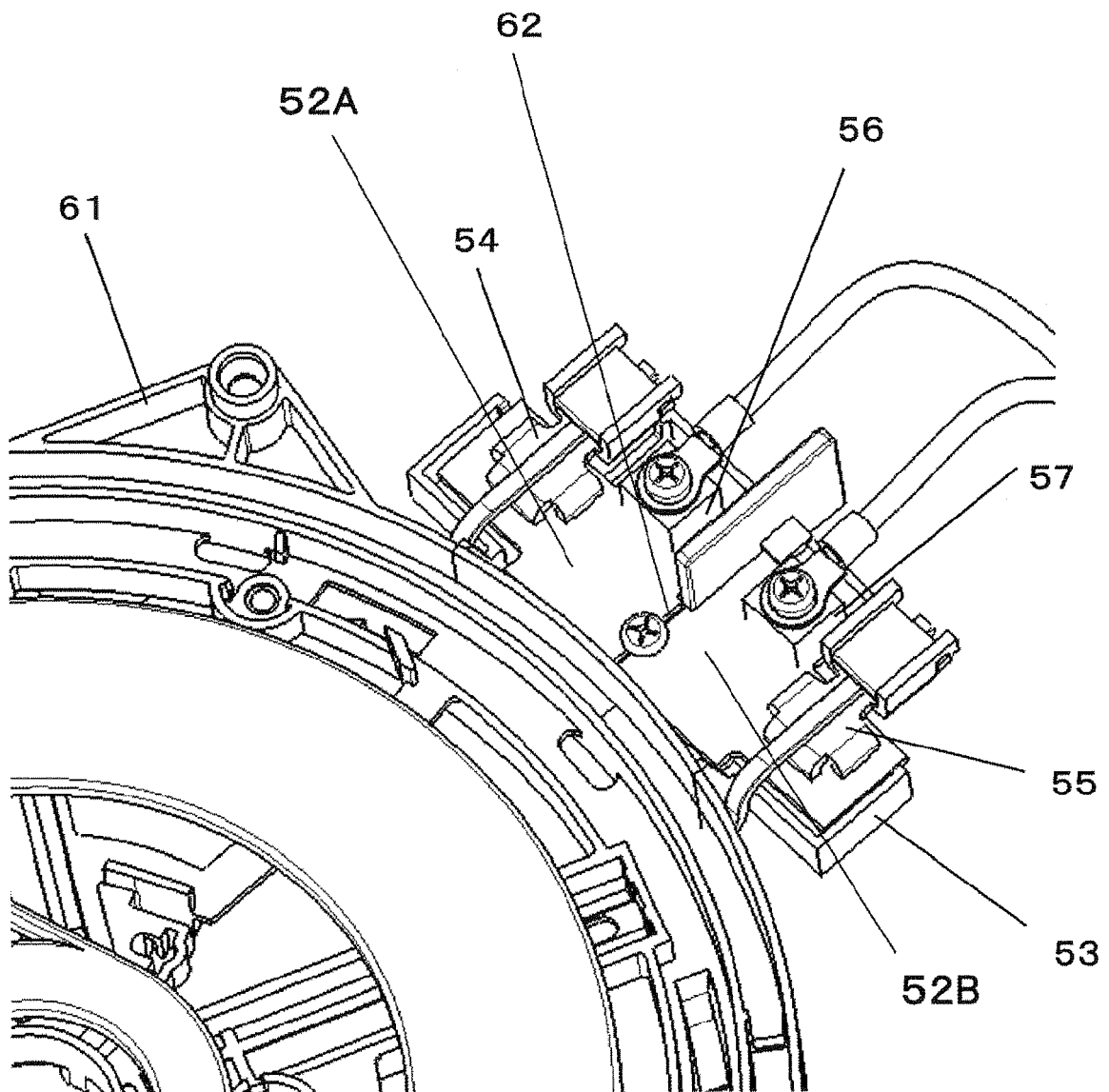
[Fig. 7]



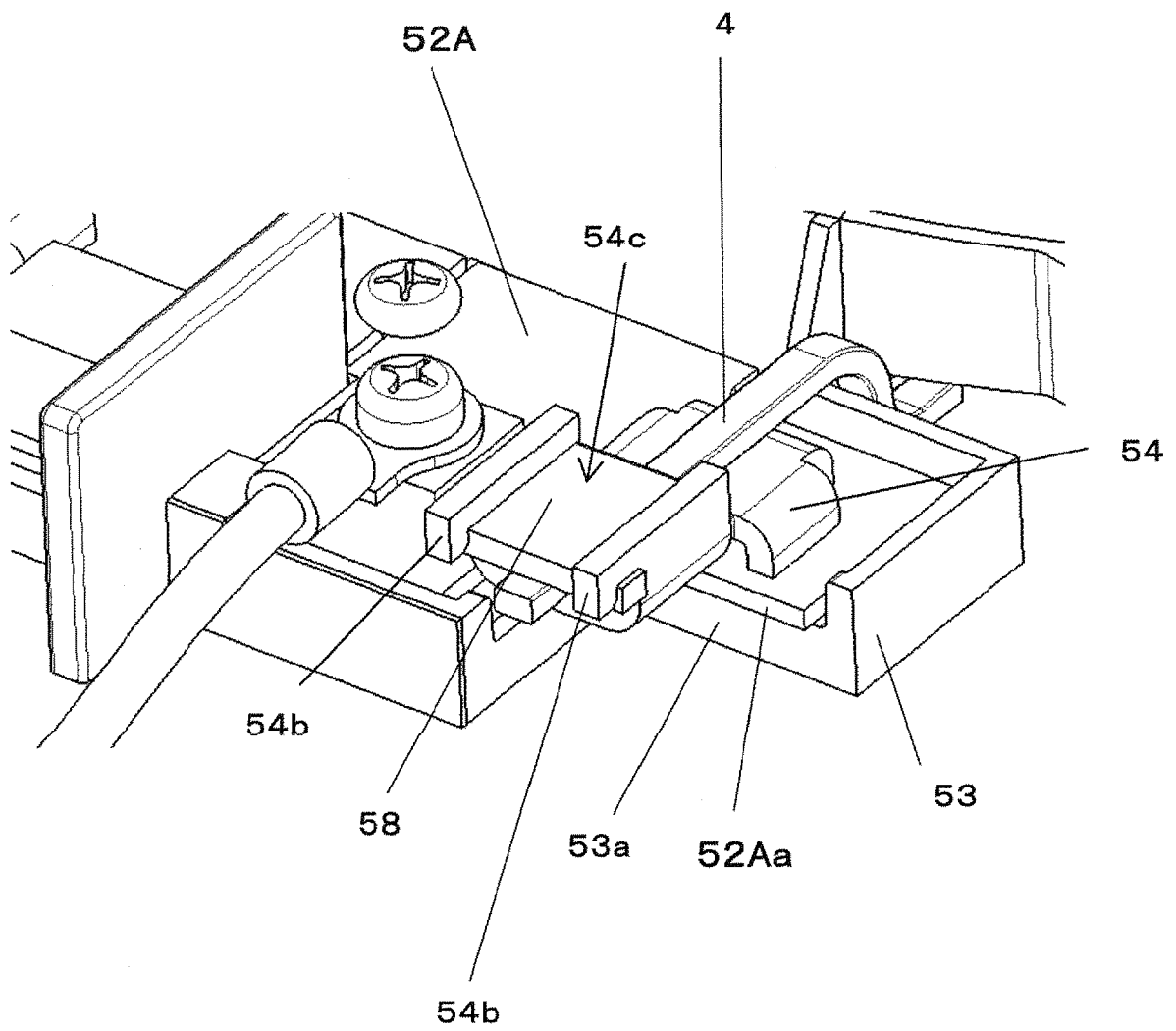
[Fig. 8]



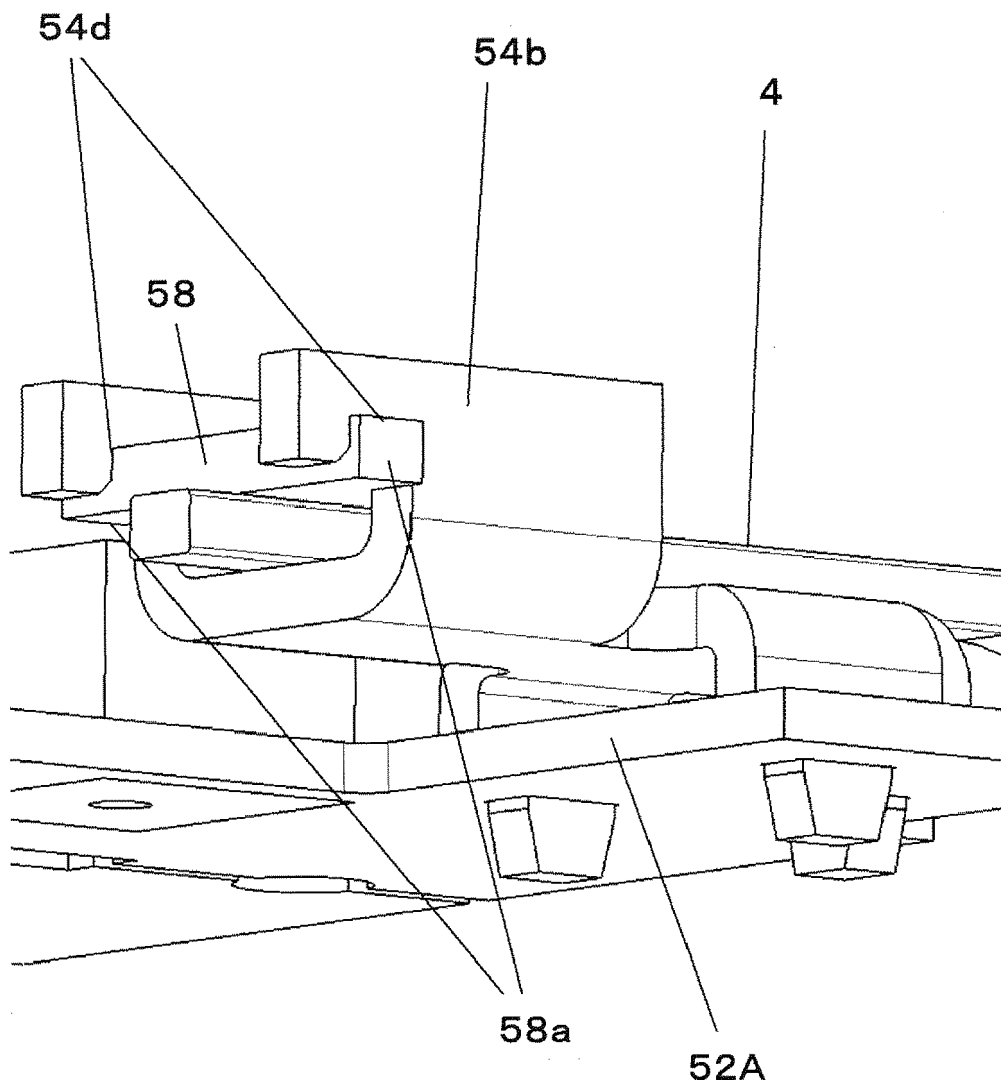
[Fig. 9]



[Fig. 10]



[Fig. 11]





EUROPEAN SEARCH REPORT

 Application Number
 EP 16 19 0677

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 1 545 159 A1 (MATSUSHITA ELECTRIC IND CO LTD [JP]) 22 June 2005 (2005-06-22) * paragraph [0136]; figure 24 *	1-8	INV. H05B6/36 H01R4/02 H01R4/62 H05B6/12
A	EP 1 811 812 A1 (MATSUSHITA ELECTRIC IND CO LTD [JP]) 25 July 2007 (2007-07-25) * paragraph [0024]; figures 6b,6C *	1-8	
A	JP 2010 287533 A (MITSUBISHI ELECTRIC CORP; MITSUBISHI ELECTRIC HOME APPL) 24 December 2010 (2010-12-24) * abstract; figure 6 *	1-8	
A	JP 2011 014343 A (PANASONIC CORP) 20 January 2011 (2011-01-20) * abstract; figures 11,12 *	1-8	
			TECHNICAL FIELDS SEARCHED (IPC)
			H05B H01R
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 25 January 2017	Examiner Gea Haupt, Martin
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

 1
 EPO FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 16 19 0677

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

25-01-2017

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1545159 A1	22-06-2005	CN 1675962 A	28-09-2005
		EP 1545159 A1	22-06-2005
		ES 2342377 T3	06-07-2010
		HK 1081792 A1	14-05-2010
		JP 3823076 B2	20-09-2006
		JP 2004079318 A	11-03-2004
		KR 20050043910 A	11-05-2005
		US 2005284862 A1	29-12-2005
		WO 2004017681 A1	26-02-2004
EP 1811812 A1	25-07-2007	EP 1811812 A1	25-07-2007
		ES 2341882 T3	29-06-2010
		HK 1107161 A1	20-11-2009
		US 2009212043 A1	27-08-2009
		WO 2006082753 A1	10-08-2006
JP 2010287533 A	24-12-2010	JP 5183576 B2	17-04-2013
		JP 2010287533 A	24-12-2010
JP 2011014343 A	20-01-2011	JP 5240105 B2	17-07-2013
		JP 2011014343 A	20-01-2011

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 2010251067 A [0006]
- JP 2009259702 A [0006]
- JP 2013001488 A [0097]
- JP 2013001489 A [0097]