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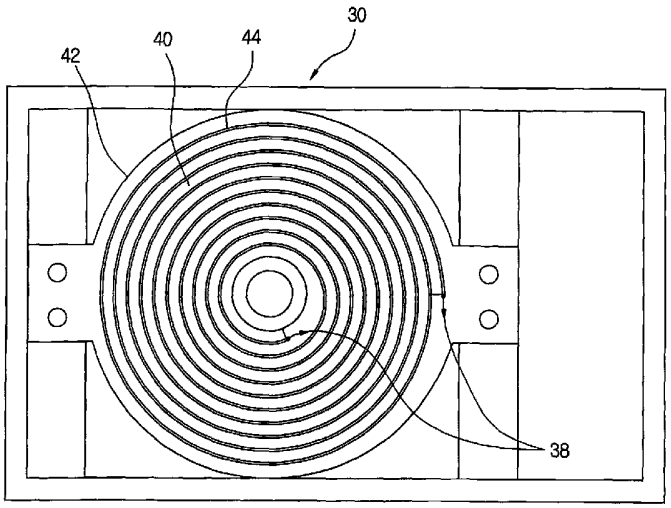
(54) Title: ELECTRONIC INDUCTION HEATER



(57) Abstract: The present invention relates to an electronic induction heater which includes a plate shaped plate installed in an upper portion of a substrate of a heater, a plate shaped insulator installed between the plate shaped conductors, a fixing conductor layer fixed in such a manner that the plate shaped insulator and the plate shaped insulator are integrally formed in multiple numbers and are impregnated in an insulation material such as a varnish or epoxy, and a twisting portion in which the fixing conductor layer is twisted in an intermediate portion of the winding to make the lengths of the inner side winding and the outer side winding same when a bundle conductor wound the fixing conductor layer is engaged on the substrate, and the plate shaped conductor is wound. In the present invention, it is possible to prevent an insulation destroy due to an over heating, to easily increase a cross sectional area in a zone current and to decrease a resistance loss for thereby enhancing an efficiency. In particular, it is possible to decrease an eddy loss and to prevent a temperature increase in an inner end of the bundle conductor and a loss due to a vibration itself, so that there is not an error in the electronic induction heater.

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ELECTRONIC INDUCTION HEATER

Technical Field

The present invention relates to an electronic induction heater, and in particular to an electronic induction heater which is capable of decreasing a resistance and eddy loss using a bundle conductor formed in multiple layers instead of a Litz wire and preventing a loss occurring due to a circulation current by twisting an intermediate portion of a winding bundle conductor and riveting the same at a certain length. Namely, the present invention relates to an electronic induction heater of a cooking container capable of induction-heating a cooking container using a high frequency wave magnetic field. Generally, a cooling utensil represents various vessels such as a steel, aluminum, tungsten, glass, Chinese, etc. The present invention is directed to a patent invention based on a Korean priority of the patent application No. 2002-46979(filing date is August 9, 2002).

Background Art

Figure 1 is a view for describing a principle of an induction heater. A conventional induction heating container is directed to supplying a high frequency wave current from an inverter circuit to a heating coil, and generating

a magnetic field of a high frequency wave above minimum 20kMz in a heating coil for thereby induction-heating a cooling container.

Figure 2 is a view illustrating the construction of a control circuit of an electronic induction heater. As shown therein, a transistor cooling fan motor 3 and a primary coil 4a of a transformer are connected with a power 1 through a switch 2. A direct current power circuit 5 is connected with the power 1 through the switch 2. The DC(Direct Current) power circuit 5 is formed of a choke coil 7 and a smoothing condenser 8. In addition, an inverter circuit 10 is connected with an output terminal of the DC power circuit 8 in series. The inverter circuit 10 is formed of a SEEP circuit and bipolar transistors 11 and 12 which are capable of implementing a switching operation at a frequency of 20kHz. In the inverter circuit 10, a series resonant circuit formed of a heating coil 13 and a condenser 14 is connected between an interconnection point of the transistors 11 and 12 and a terminal N. In addition, in the inverter circuit 10, when a high frequency wave current is supplied to the heating coil 13 by driving the transistors 11 and 12, a high frequency magnetic field is generated, and an eddy current is generated in the cooling container 20. A heating is implemented by the current for thereby heating the food in the interior of the cooking container 20.

Figure 3 is a perspective view illustrating a conventional electronic

induction heater, and Figure 4 is a view illustrating a bottom portion of Figure 3. As shown in Figure 3, the conventional electronic induction heater includes a casing 30, a heating apparatus which is formed in such a manner that an enamel coated copper wire of 0.5ϕ which is a winding conduction wire capable of heating based on a magnetic field in the interior, is twisted in multiple pieces, an electric wire 31 for supplying power, and a ceramic plate 33 for mounting a temperature adjusting unit 32, a power switch 34 and a cooling container 20. When an electronic induction heater is operated, a magnetic flux 48 is formed in a lower portion of the cooling container 20 placed on the ceramic plate 33 which is an upper side of the casing 30, and a high frequency wave magnetic field is formed for thereby implementing a magnetic heating. At this time, it is possible to accurately control a heating temperature using a temperature adjusting unit 32. As shown in Figure 4, a substrate 42 formed of a plastic or nonconductor and a radial shaped iron core 46 are attached to a bottom portion of the casing 30. In the above conventional art, one winding conductor is formed by twisting an enamel coated Litz wire in multiple layers in an upper portion of the substrate, and an electronic induction heater is formed of a steel wire in a bottom portion of the substrate.

A research concerning the electronic induction heater implemented using an electronic induction phenomenon of a high frequency coil has been

conducted. The Korean utility model publication No. 1994-2247(Laid open date: April 11, 1994) discloses a dual side working coil separation type electronic induction heater.

In addition, the Korean patent publication No. 1990-2388(Laid open No. April 13, 1990) discloses an electronic induction heater using a metallic plate. The above heater is directed to an industrial purpose, not for a home heater. Recently, the Korean patent of Dual full bridge type electronic induction heater(filed by LG corporation of Korea and Lain open on February 1, 1999) is directed to implementing a low noise cooking operation by removing an interference noise which occurs between the heating plates based on a time sharing control with respect to a large capacity electronic induction heater having two or four heating plates. However, the above heater is implemented by improving an electronic circuit and must disadvantageously heat multiple heaters.

Generally, since an electronic induction heater is implemented using electricity, there are not any harmful material and any flame, so that there is not any accidents due to a lack of oxygen. In addition, even when a certain food is leaked over a cover of a cooking container, the leaked food is burned, and an energy is effectively saved.

The conventional electronic induction heater uses a Litz wire as a

conductor. In particular, the conductor is constructed in the same construction as an inner surface of a conductor on which a steel wire attached to a lower surface of a substrate is wound. In the case of a zone current of a high frequency, a large cross section area is needed. A this time, the number of pieces of Litz wires is increased, so that it is impossible to implement a desired twist system. In the case that an insulation is not implemented due to a pin hole, the insulation is gradually increased as the time is passed, so that a conductor may be damaged.

In particular, when the number of pieces of Litz wires exceeds 30, it is impossible to implement a twist system. Namely, the above construction may operate as one conductor. In the case that the number of pieces of Litz wires exceeds 50, a desired twist system is not implemented. In addition, since the length of an inner side end of a steel wire is the same as the width of an upper winding bundle conductor, a magnetic region of a magnetic flux flowing into an inner side end of the steel wire is offset with an inner side surface of the conductor, so that a certain heat is generated.

Therefore, in the conventional art, the instruction may be destroyed by an eddy loss of a Litz wire, a current and a vibration of a conductor itself.

Disclosure of Invention

Accordingly, it is an object of the present invention to overcome the above conventional problems. It is another object of the present invention to provide an electronic induction heater which is capable of maximum decreasing a loss of a circulation current which may be a cause of an eddy loss and preventing an insulation destruction, so that it is possible to implement an electronic induction heater which does not have an error.

It is another object of the present invention to provide an electronic induction heater which is well adapted to a cooling container of a large capacity of above 1.9kW of a minimum rating power.

It is further another object of the present invention to provide an electronic induction heater which has a good resistance with respect to a temperature increase and vibration itself and implements a low price.

To achieve the above objects, in the present invention, an electronic induction heater is implemented in such a manner that an enamel coated copper wire is twisted on an upper portion of a substrate in multiple layers for thereby forming one winding conductor, and a radial shaped steel wire is installed in a bottom portion of a substrate.

To achieve the above objects, as shown in Figure 5, there is provided an electronic induction heater which includes a plate shaped plate installed in an upper portion of a substrate of a heater, a plate shaped insulator installed

between the plate shaped conductors, a fixing conductor layer fixed in such a manner that the plate shaped insulator and the plate shaped insulator are integrally formed in multiple numbers and are impregnated in an insulation material such as a varnish or epoxy, and a twisting portion in which the fixing conductor layer is twisted in an intermediate portion of the winding to make the lengths of the inner side winding and the outer side winding same when a bundle conductor wound the fixing conductor layer is engaged on the substrate, and the plate shaped conductor is wound.

The length of the iron core is a length Lb obtained by adding the length La from an outer diameter portion of the bundle conductor to an inner diameter portion in a normal direction and the length L_2 that the iron core is extended from an inner diameter portion of the bundle conductor.

The length of the inner side end from the inner diameter portion to the center of the circle is smaller than the height l_2 of the bundle conductor.

When winding the upper portion of the substrate of the heater according to the present invention, there is a method of a bundle conductor in which an enamel coating layer is coated on a surface of the plate shaped conductor, and the resultant structure is wound in multiple layers or a method in which the plate shaped insulator is inserted between the plate shaped conductors.

The bundle conductor is formed by integrating the plate shaped

conductor and the plate shaped insulator in the bundle conductor, a fixing conductor layer is impregnated in an insulation material such as a varnish or epoxy, so that is fixed.

The lengths of the inner circle side winding and the outer circle side winding are made same when the plate shaped conductor is wound in a circle shape in the bundle conductor. For implementing the above construction, a twisting portion is formed in an intermediate portion of the winding in such a manner that the plate shaped conductor is twisted.

In the present invention, in order to make the lengths of the plate shaped conductors same, an intermediate portion of the fixing conductor layer is twisted. The fixing conductor layer is implemented in such a manner that the plate shaped conductor and the insulator are integrated and are bound in one bundle using a certain number of the same(preferably, 5) for thereby forming a conductor. Here, the bundle conductor represents a heating member formed by winding the fixing conductor layer. Namely, as shown in Figure 5, the bundle conductor represents a circular heating member in which the fixing conductor layer is wound on the substrate. The plate shaped conductor may be enamel-coated for insulating the portions between the plate shaped conductors or the insulator maybe inserted. In the preset invention, an insulation paper called as NOMAX(brand name)is used as the insulator .

In addition, as the iron core installed in the bottom portion of the substrate, a circular iron core or a protrusion type circular iron core is preferably used for extending the magnetic path.

The twisting portion is implemented by riveting the plate shaped conductor using rivets at a certain length interval for decreasing the loss of the circulation current in maximum which may be a cause of eddy loss and insulation destroy.

Brief Description of Drawings

The present invention will become better understood with reference to the accompanying drawings which are given only by way of illustration and thus are not limitative of the present invention, wherein;

Figure 1 is a view for describing a principle with respect to an induction heater;

Figure 2 is a view illustrating the construction of a control circuit of an electronic induction heater;

Figure 3 is a perspective view illustrating a conventional electronic induction heater;

Figure 4 is a view illustrating a bottom portion of a heater of Figure 3;

Figure 5 is a plane view illustrating a major portion of the present

invention;

Figure 6 is a cross sectional view of Figure 5;

Figure 7 is a view illustrating the construction of a bundle conductor according to the present invention;

Figure 8 is a view illustrating a twist system of a plate shaped conductor according to the present invention;

Figure 9 is a view illustrating the construction that a plate shaped conductor is riveted according to the present invention;

Figure 10A is a bottom view illustrating an iron core according to the present invention;

Figure 10B is a cross sectional view illustrating an iron core according to the present invention;

Figure 11A is a bottom view illustrating a circular iron core according to another embodiment of the present invention;

Figure 11B is a cross sectional view illustrating a circular iron core according to another embodiment of the present invention;

Figure 12A is a cross sectional view illustrating a circular iron core having a protrusion structure according to another embodiment of a circular iron core according to the present invention;

Figure 12B is a perspective view illustrating the construction that a

circular iron core of Figure 12A is engaged to a heater according to the present invention;

Figure 13A is a cross sectional view illustrating a circular core according to another embodiment of the present invention;

Figure 13B is a perspective view illustrating the construction that a circular core of Figure 13A is engaged to a heater according to the present invention;

Figure 14A is a cross sectional view illustrating a circular core according to another embodiment of the present invention; and

Figure 14B is a perspective view illustrating the construction that a circular core of Figure 14A is engaged to a heater according to the present invention.

Best Mode for Carrying Out the Invention

The embodiments of the present invention will be described with reference to the accompanying drawings.

Figure 5 is a plane view illustrating a major portion of the present invention, Figure 6 is a cross sectional view of Figure 5, and Figure 7 is a view illustrating the construction of a bundle conductor according to the present invention.

As shown in Figure 5, in the present invention, a surface of a plate shaped conductor is coated with an enamel coating layer 48 based on a copper plate of a thickness 0.3mm and a height 5~10mm or a plane type insulation material 44 is inserted between the plate shaped conductors 41 as an insulation material. A bundle conductor 40 formed by winding a fixing conductor layer 49 in a circular shape in which a multiple number of plate shaped conductors 41 is bound is engaged to an upper portion of the substrate 42. In the drawing, reference numeral 38 represents a construction that the fixing conductor layer 49 is connected with an electric circuit. The above construction may be easily understood by the constructions of both ends of the heating coil 13 provided in a lower portion of the cooking container 20.

In order to obtain an inductance L which determines a characteristic of an electronic induction heating apparatus, it is needed to K_1 and K_2 are constant.

[Equation 1]

$$L = K_1 \frac{N^2 \times A}{\ell}$$

[Equation 2]

$$B_m = K_2 \frac{V}{f \times N \times A}$$

Namely, according to the above Equations 1 and 2, when increasing the homocentric cross sectional area A of the center of the bundle conductor 40, the magnetic flux density Bm is decreased, and the inductance L is increased.

According to the Equation 2, in order to decrease the magnetic flux density Bm, it is needed to increase the frequency or to increase the homocentric cross section area A of the center of the bundle conductor.

Figure 8 is a view illustrating the construction that the plate shaped conductor of the present invention is twisted, and Figure 9 is a view illustrating the construction which is riveted by the plate shaped conductor rivet of the present invention.

When winding the bundle conductor 40, as shown in Figure 8, the intermediate portion of the bundle conductor 40 is twisted in such a manner that the inner and outer sides of the bundle conductor 40 are substituted for thereby forming the twisted portion 47. Therefore, the lengths of the inner and outer sides of the plate shaped conductor 42 are same, so that a circulation current does not occur. The above feature is the major point of the present invention. Namely, when the length of the electric wire is increased, the resistance is increased. When the length of the electric wire is decreased, the resistance is decreased. As seen in the Equation "V=IR"(V is an electric potential difference, I is a circulation power, and R is a conductor resistance), when the resistance R

is decreased, the electric potential difference V is decreased, and the eddy loss is minimized.

In another embodiment of the present invention, the bundle conductor 40 is connected at its certain length using the rivets 50 for thereby decreasing the size of the circulation current. As shown in the Equation of loss power $P=I^2R$, the loss power P occurs in proportion to the square of the circulation current I. In the electronic induction heater, the loss power P occurs as a heat loss. Therefore, it is possible to increase the efficiency by minimizing the heat loss.

Figures 10A and 10B are views illustrating the iron core of the present invention, and Figure 10A is a bottom view, and Figure 10B is a perspective view illustrating that a steel wire is engaged to a heater.

As shown in Figure 10A, an iron core 46 of a ferrite core is attached to a lower portion of the substrate 42 in a radial shape. The length of the iron core 46 is determined by summing the length La from an outer diameter of a circle of the bundle conductor to an inner diameter in a normal direction and the length(hereinafter referred to as a height l_2 of the bundle conductor 40) of the inner side end from the inner diameter of the circle to the center of the circle, namely, Lb=La+1. When the magnetic flux is perpendicular with respect to the bundle conductor 40, an eddy current is generated, so that an eddy loss occurs. Therefore, the eddy loss may become a certain heat loss for thereby heating

the bundle conductor 40.

The length of the iron core of the present invention is directed to preventing the magnetic flux from being offset with the bundle conductor 40. As shown in Figure 10B, the height l_1 of the plate shaped conductor 41 is smaller than the extended length l_2 or equal thereto to or is larger than 0, namely, $0<l_1 \leq l_2$.

Figures 11A and 11B are views illustrating the arrangements of the circular iron core 52 according to another embodiment of the present invention. Figure 11A is a bottom view, and Figure 11B is a perspective view illustrating the construction that a circular iron core is engaged to the heater according to the present invention. Here, the circular iron core 52 is adapted for the reason that the inner diameter may be decreased compared to the homocentric portion when the homocentric cross sectional area of the inner side circular of the winding is exchanged with the cross sectional area of the iron core. In order to insert into the center portion of the inner side circular of the winding, the shape must be same as the shape of the inner side circular of the winding.

Figures 12A and 12B are views illustrating the circular iron core according to another embodiment of the present invention. Figure 12A is a cross sectional view illustrating a circular iron core 54 having a protrusion structure, and Figure 12B is a perspective view illustrating the construction that

the circular iron core 54 of the protrusion structure is engaged to the heater. Figures 13A and 13B are views illustrating a circular iron core according to another embodiment of the present invention. Figure 13A is a cross sectional view, and Figure 13B is a perspective view illustrating the construction that a circular iron core is engaged to the heater according to the present invention. In the circular iron core 54, the above iron core is implemented by integrally attaching a plate shaped iron core to the lower portion of the circular iron core. Therefore, when one circular iron core 54 of the protrusion structure is used, the performance of the magnetic path is improved, and an easier assembling is implemented. In addition, the lower portion is made flat so that it is possible to advantageously maintain a desired plane during the arrangement of the bindle conductor. Figures 14A and 14B are views illustrating a circular iron core according to another embodiment of the present invention. Figure 14A is a cross sectional view illustrating the construction that a circular iron core is arranged for extending the magnetic path without arranging the circular iron core in a radial direction, and Figure 14B is a perspective view illustrating that the circular iron core is engaged to the heater. In this case, the length of the iron core is Lc.

In the case that when a current flows in the winding conductor, a magnetic flux is formed based on the Lenz's law, and a force is applied to the

conductor based on the Flemings left hand rule. The conductor is vibrated by the above force. When the vibrations are continuously transferred to the winding conductor, an insulation material provided between the conductors becomes fatigue, and the above fatigue phenomenon of the insulation material may cause an insulation destroy. Therefore, in the present invention for implementing a dual effect for a fixing method capable of preventing the vibrations of the conductor and an enhancement of the insulation, the bundle conductor is impregnated with varnish or epoxy, so that the conductor is mechanically fixed, and the insulation is improved. In the present invention, it is possible to prevent an insulation destroy due to the vibrations of the bundle conductor 40 by fixing using the fixing conductor layer 49 formed by impregnating the bundle conductor 40, the substrate 35 and the iron core 46 in a varnish or epoxy.

Therefore, in the present invention, it is possible to obtain a desired safety during the operation of the electronic induction heating, so that a reliable electronic induction heater is implemented.

The present invention is basically directed to forming a bundle conductor using multiple pieces of a plate shaped conductor which does not have a circular cross section, and an intermediate insulation material is inserted into between the bundle conductors. An intermediate portion of each conductor

is twisted, and the conductor is riveted using rivets at its regular length for thereby twisting the intermediate portions of the conductor. Namely, in the present invention, since the plane type conductor is used instead of the Litz wire comparing to the conventional art, so that it is possible to generate a uniform electric potential difference, whereby it is possible to decrease the eddy loss and the loss of the circulation current which may be a cause of the insulation destroy. In addition, it is possible to prevent an insulation destroy due to a vibration of a bundle which may occur when the substrate, winding bundle conductor, etc. are impregnated into an insulation material such as a varnish, epoxy, etc.

In addition, in the present invention, since the length of the inner side end of the iron core of the bottom portion of the substrate is extended within a length range below the height of the bundle conductor, so that it is possible to prevent a thermal loss which occurs when the magnetic flux is offset with the inner side end of the bindle conductor in such a manner that the magnetic flux passes through at a certain distance from the inner side surface of the bundle conductor when the magnetic flux moves upwardly.

In the conventional art, since there is provided a capacity of a minimum rating power of 1.9kW, in the case of a larger capacity, it is impossible to adapt the electronic induction heater to an electronic oven or electric cooking

appliance. However, in the present invention, the electronic induction heater is well adapted to an electric oven, electric cooking appliance or heating instrument when a minimum rating power is above 1.9kW.

In particular, the electronic induction heater according to the present invention may be well adapted as a heating source for a heating appliance which needs an accurate time and temperature control such as an electric water heating device, an electric boiler, an electric iron, a coffee port, a vapor heater, etc. In the case that a gas is used as a heating source, there may be a problem in safety. Therefore, the present invention may be well adapted to all kinds of products which use the gas as a heating source. The electronic induction heater according to the present invention is capable of saving an energy and is well adapted to play a role as a stable heat source.

Industrial Applicability

As described above, in the present invention, since the bundle conductor 40 is used, so that the surface is uniform. A relative electric potential difference occurring between the conductors is uniform, so that a circulation current does not occur for thereby fully preventing a cause of a heating of a bundle conductor and easily extending a cross sectional area during a zone current. In addition, it is possible to decrease a resistance loss and to increase

an efficiency. The eddy loss is decreased, and it is possible to prevent a certain damage due to a temperature increase in an inner side end of the bundle conductor and due to a vibration. In the present invention, it is possible to provide an induction heating cooking apparatus which has a low error ratio, low fabrication cost, and accurate operation in such a manner that a stable magnetic field is formed in a heating apparatus during a heating operation of an electronic induction based on the above described multiple advantages.

As described above, the above description is one embodiment for implementing a hair cutting scissors according to the present invention. The present invention is not limited to the above embodiment. As the present invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, it should also be understood that the above-described examples are not limited by any of the details of the foregoing description, unless otherwise specified, but rather should be construed broadly within its spirit and scope as defined in the appended claims, and therefore all changes and modifications that fall within the meets and bounds of the claims, or equivalences of such meets and bounds are therefore intended to be embraced by the appended claims.

Claims:

1. In an electronic induction heater in which one winding conductor is formed in such a manner that an enamel coated copper wire is twisted in multiple pieces on an upper portion of a substrate, and a radial shaped iron core is installed in a bottom portion of the substrate, an electronic induction heater, comprising:

a plate shaped plate installed in an upper portion of a substrate of a heater;

a plate shaped insulator installed between the plate shaped conductors;

a fixing conductor layer fixed in such a manner that the plate shaped insulator and the plate shaped insulator are integrally formed in multiple numbers and are impregnated in an insulation material such as a varnish or epoxy; and

a twisting portion in which the fixing conductor layer is twisted in an intermediate portion of the winding to make the lengths of the inner side winding and the outer side winding same when a bundle conductor wound the fixing conductor layer is engaged on the substrate, and the plate shaped conductor is wound.

2. The heater of claim 1, wherein the length of the iron core is a length Lb

obtained by adding the length La from an outer diameter portion of the bundle conductor to an inner diameter portion in a normal direction and the length L_2 that the iron core is extended from an inner diameter portion of the bundle conductor.

3. The heater of claim 2, wherein the height l_2 of the plate shaped conductor is smaller than the extended length L_2 of the iron core or equal thereto or is larger than 0.

4. The heater of claim 1, wherein said iron core is a circular iron core inserted into an inner diameter of the bundle conductor.

5. The heater of claim 4, wherein said circular iron core is arranged in a circular plate shape for extending a magnetic path without inserting into an inner diameter portion "d" of the bundle conductor, and the length of the iron core is Lc.

6. The heater of claim 1, wherein said iron core is formed by integrally attaching the plate shaped iron core to a lower portion of the circular iron core.

7. The heater of claim 6, wherein said iron core is a circular iron core having protrusions formed in a circumferential surface at a certain interval therebetween.

8. The heater of claim 1, wherein said insulator is formed in such a manner that the surface of the plate shaped conductor is coated with an enamel coating layer.

9. The heater of claim 1, wherein a twisting portion is implemented in such a manner that the fixing conductor layer or the bundle conductor is riveted in a normal direction at an interval of a certain length for thereby decreasing a resistance loss which may occur due to a circulation current.

FIG. 1

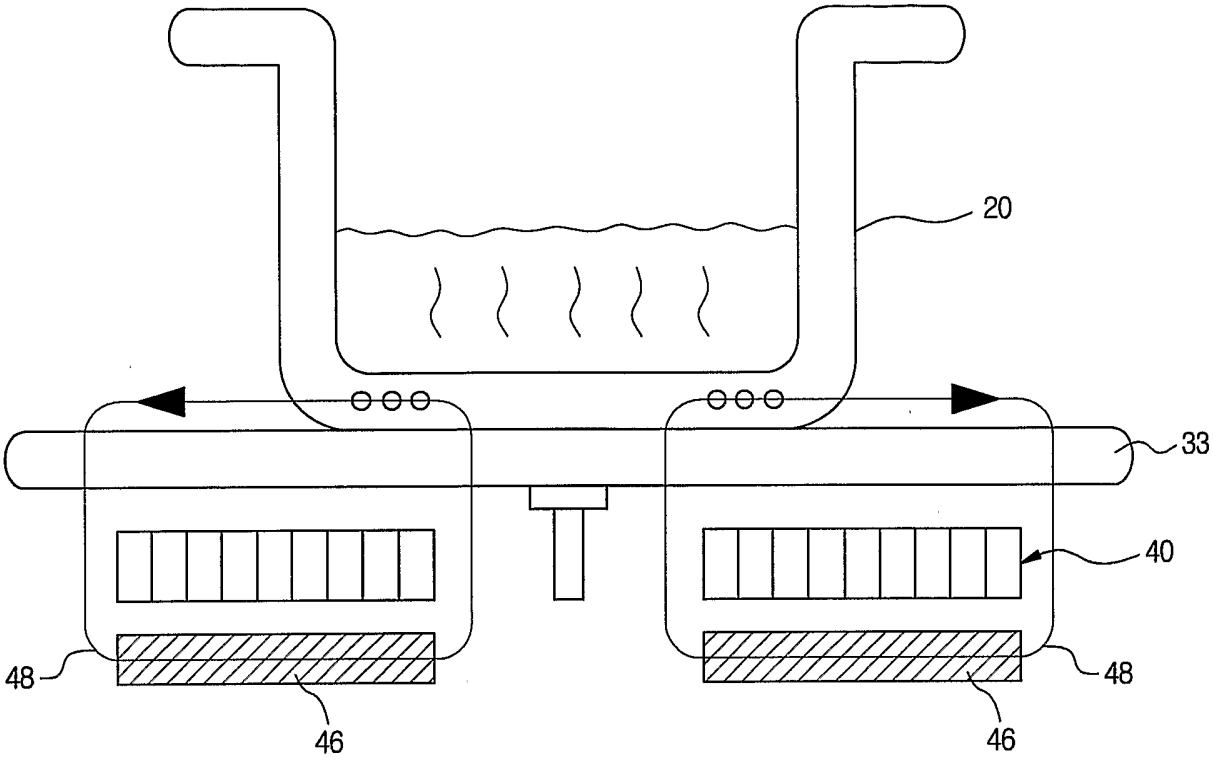
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FIG. 2

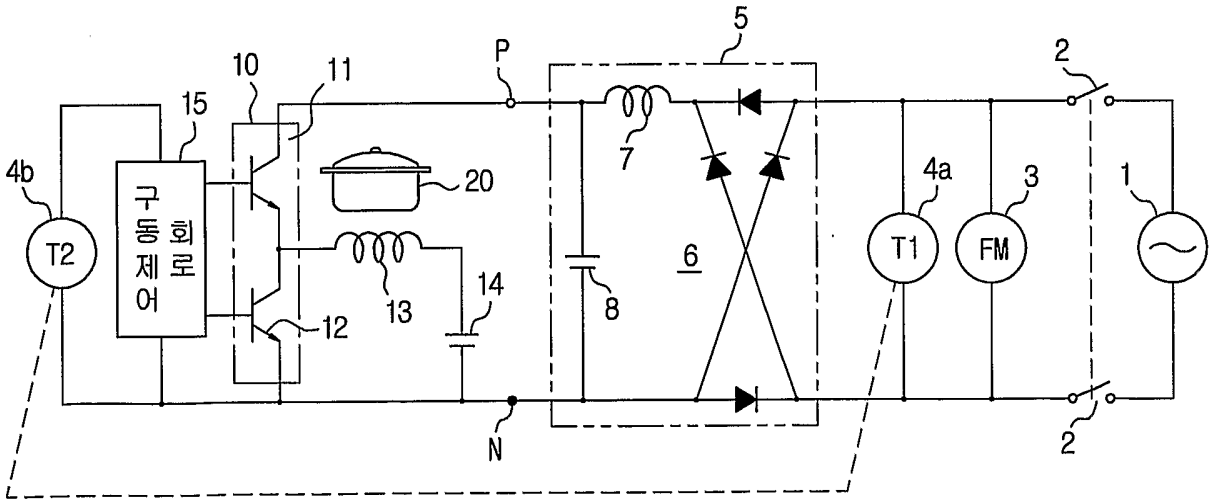
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FIG. 3

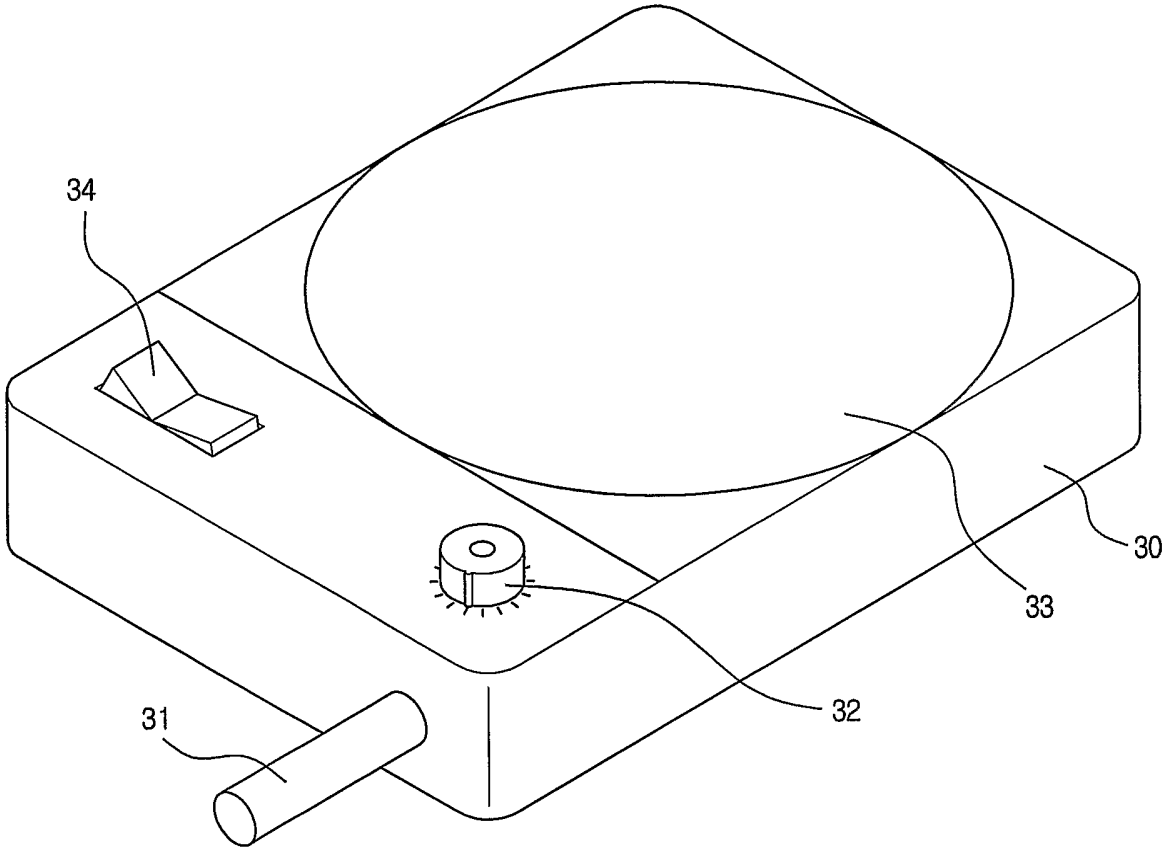


FIG. 4

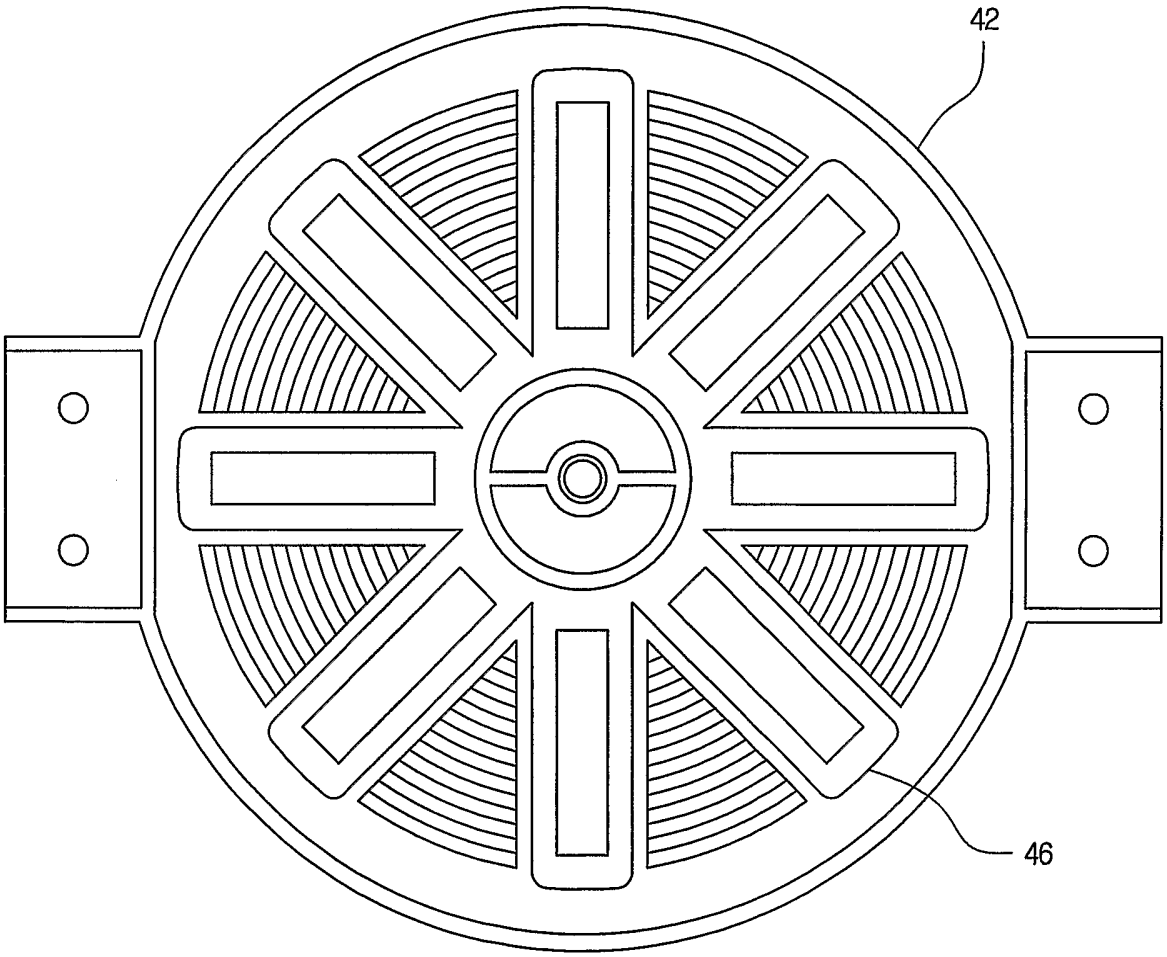


FIG. 5

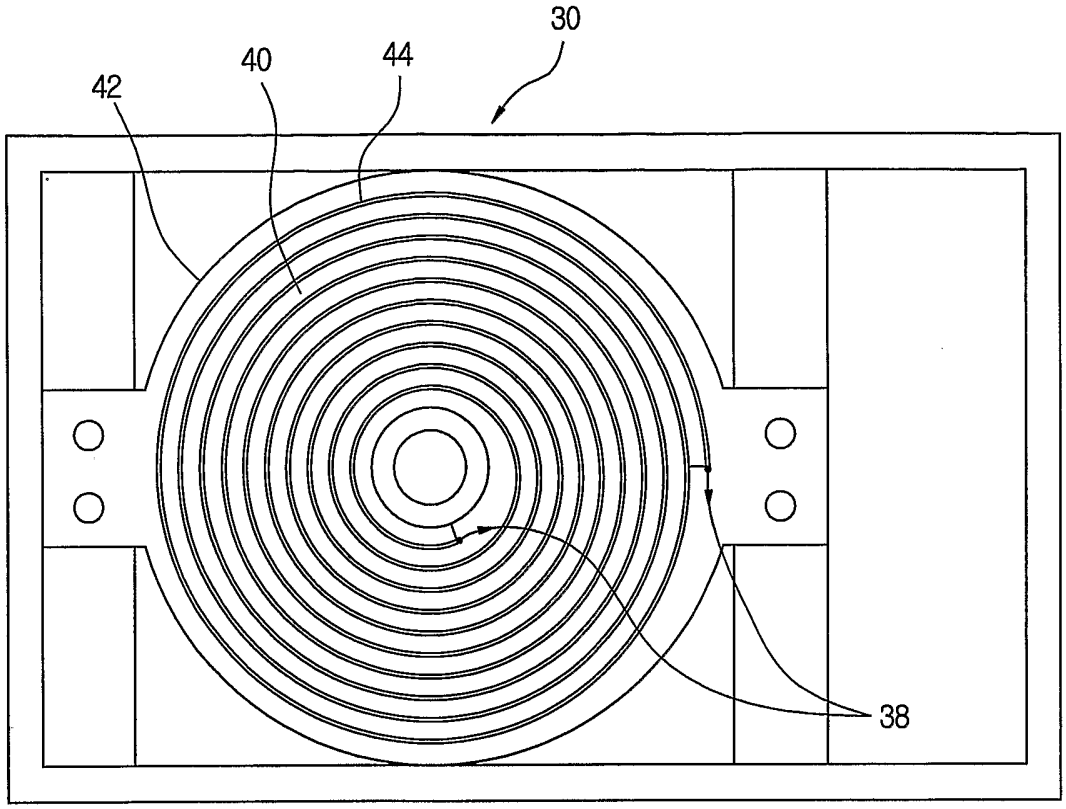


FIG. 6

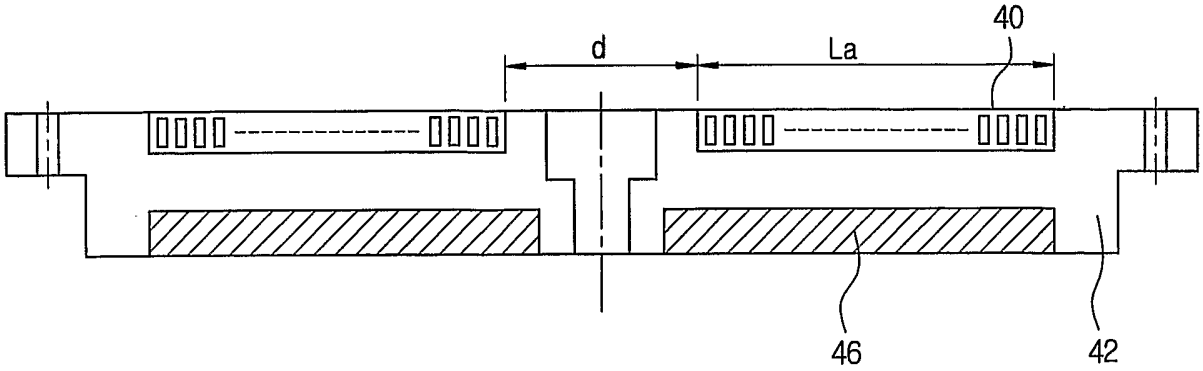


FIG. 7

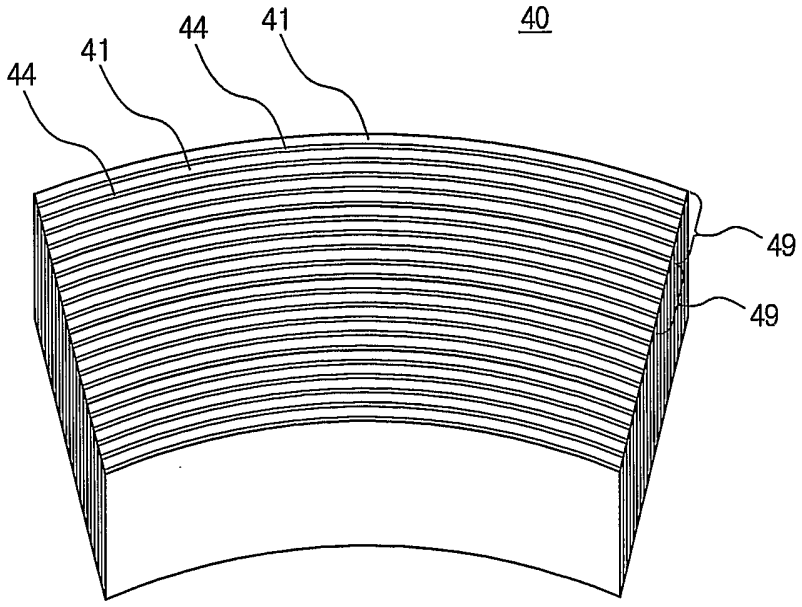


FIG. 8

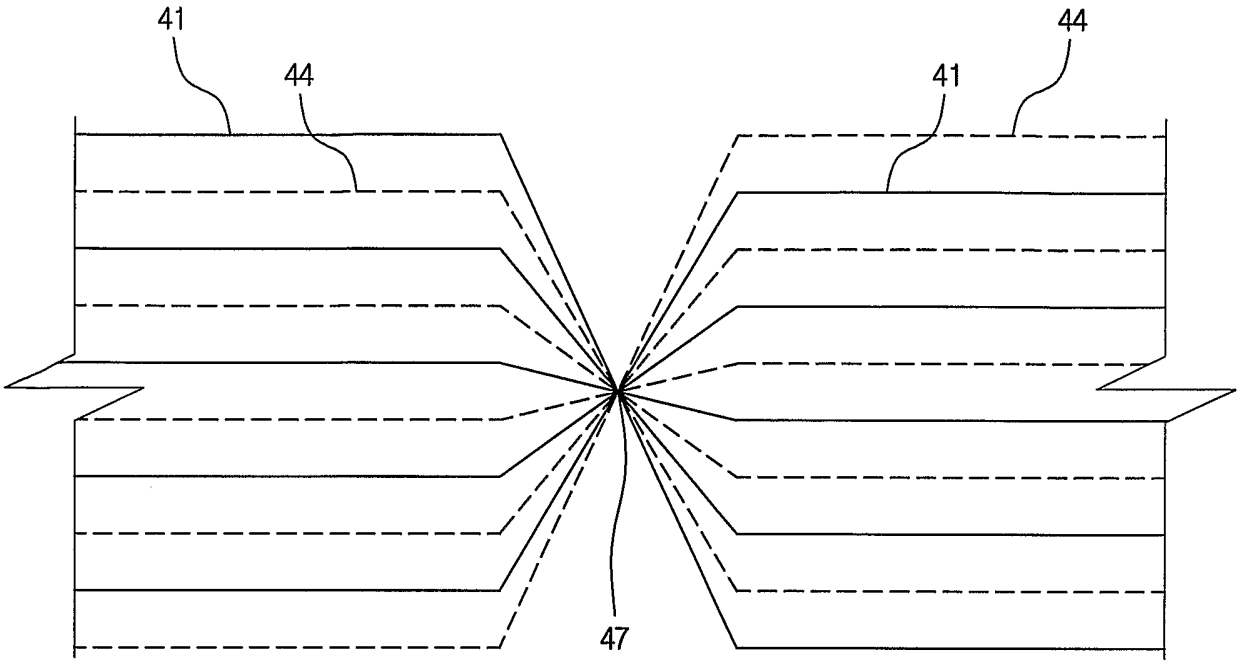


FIG. 9

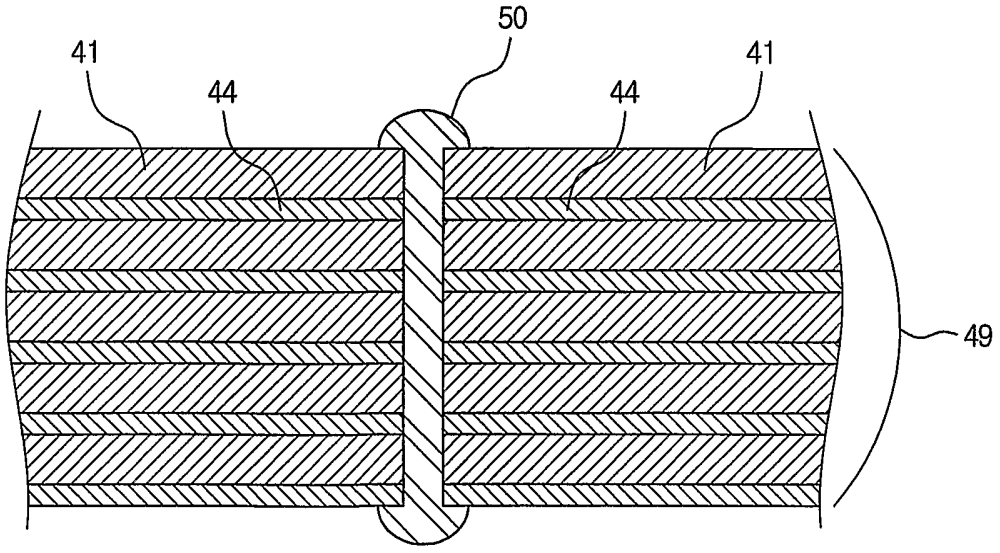


FIG. 10A

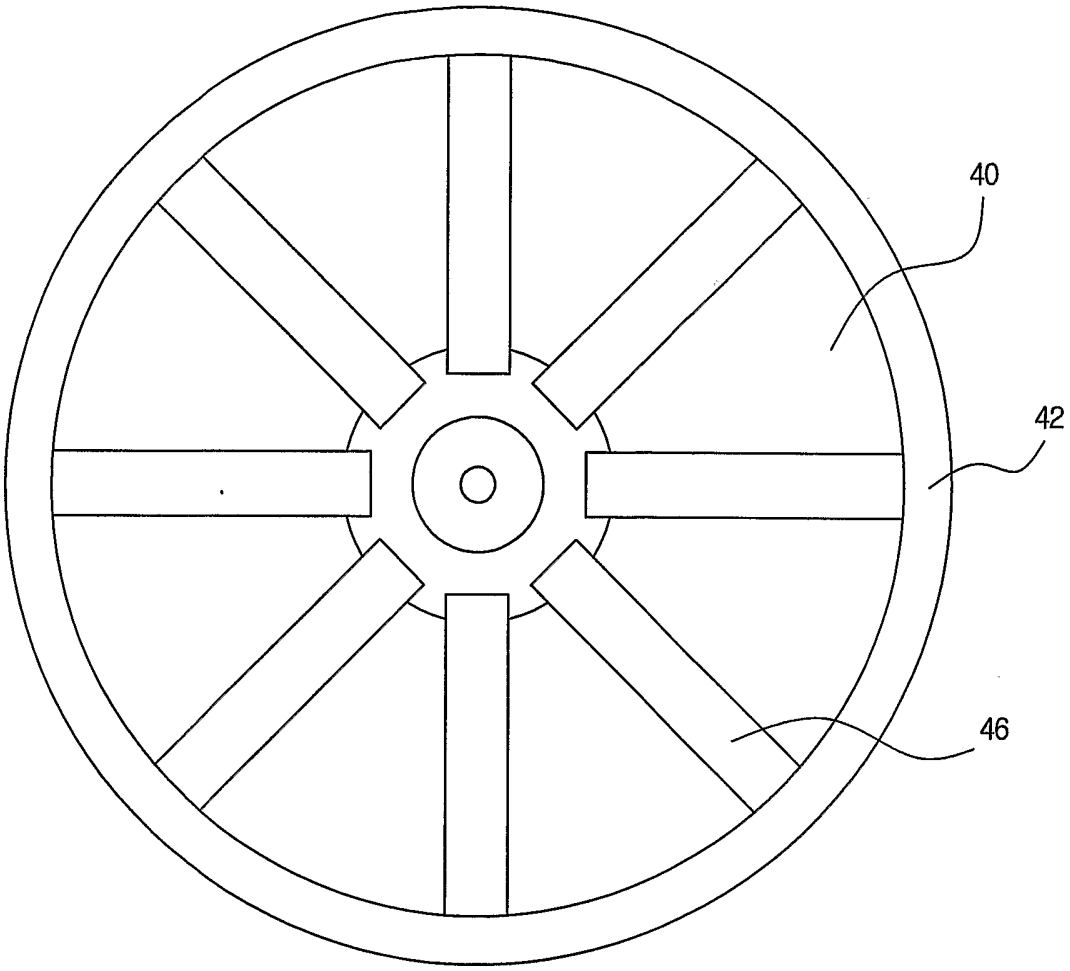


FIG. 10B

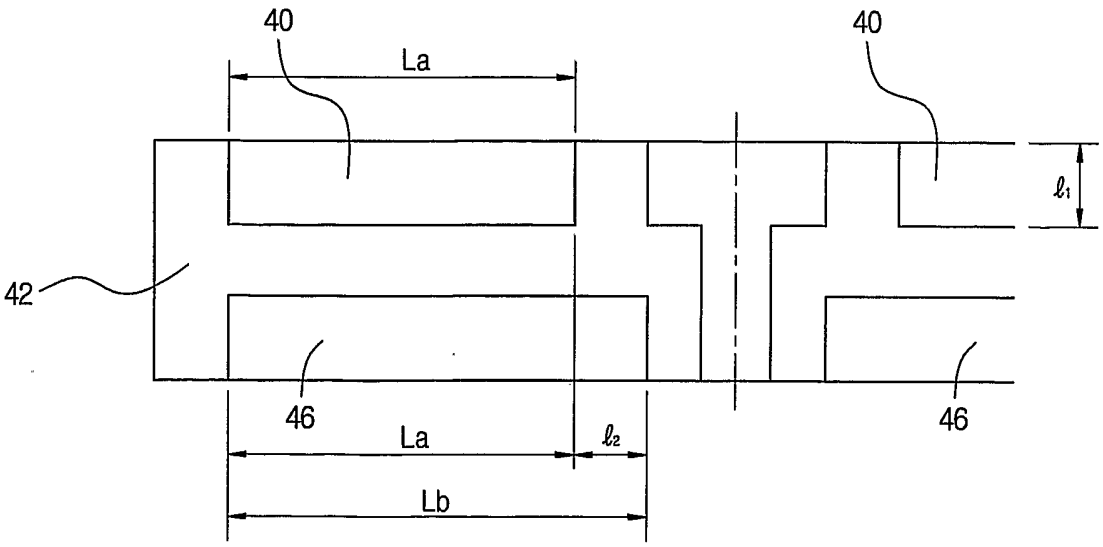


FIG. 11A

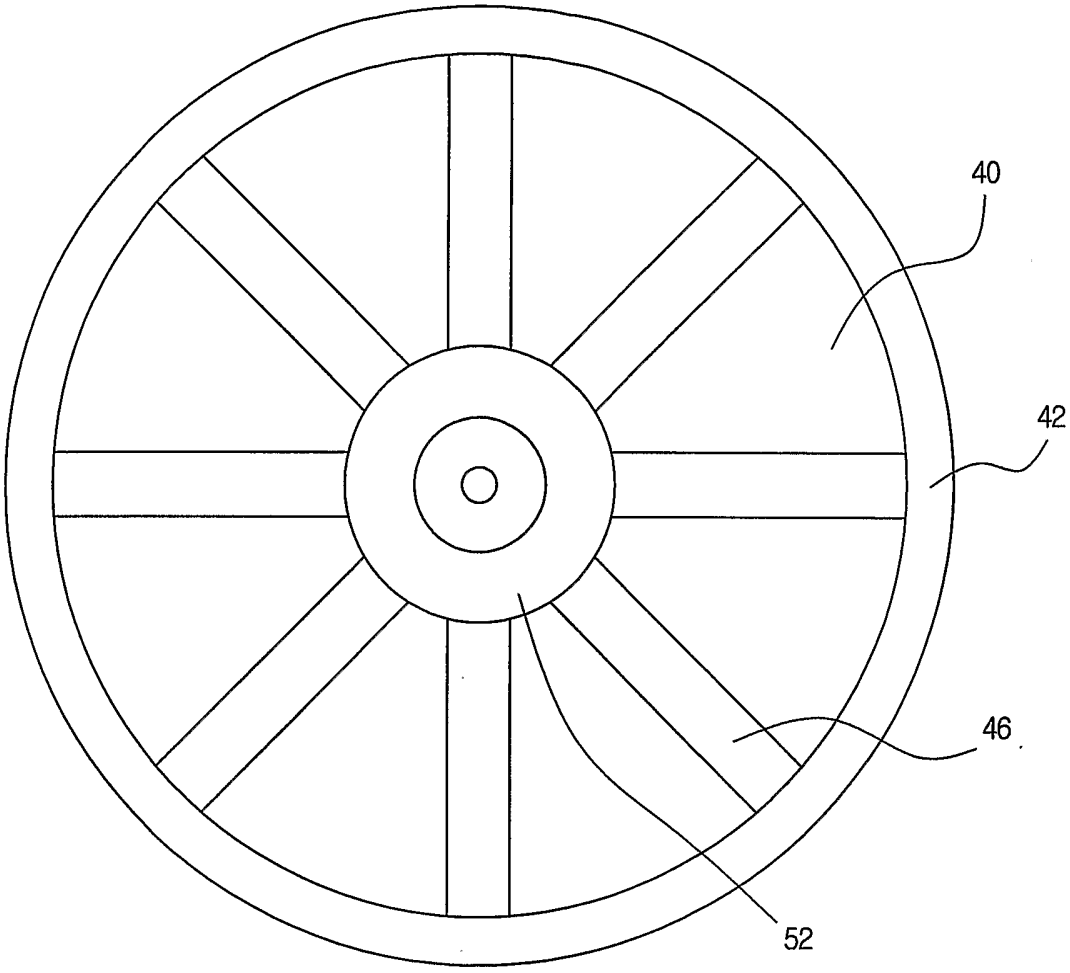


FIG. 11B

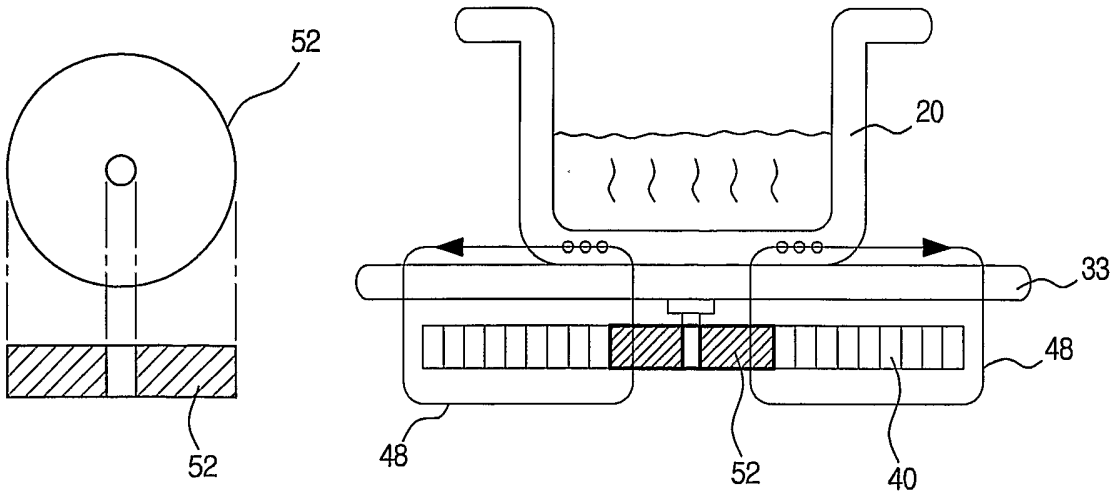


FIG. 12A

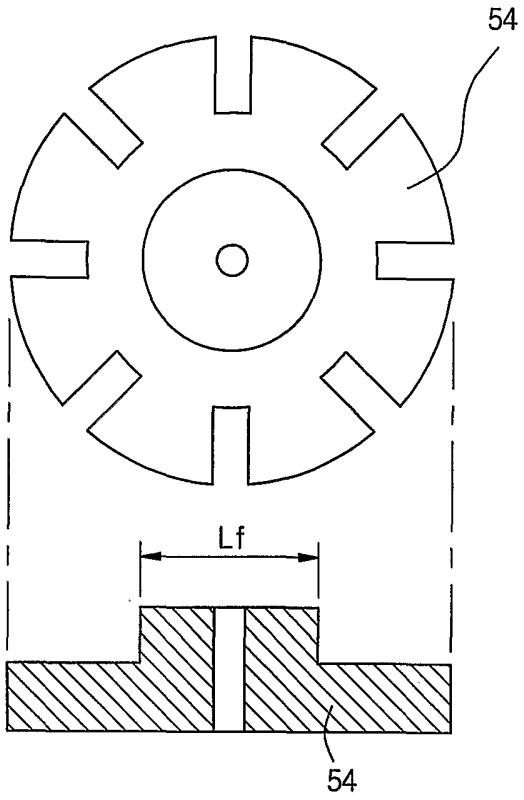


FIG. 12B

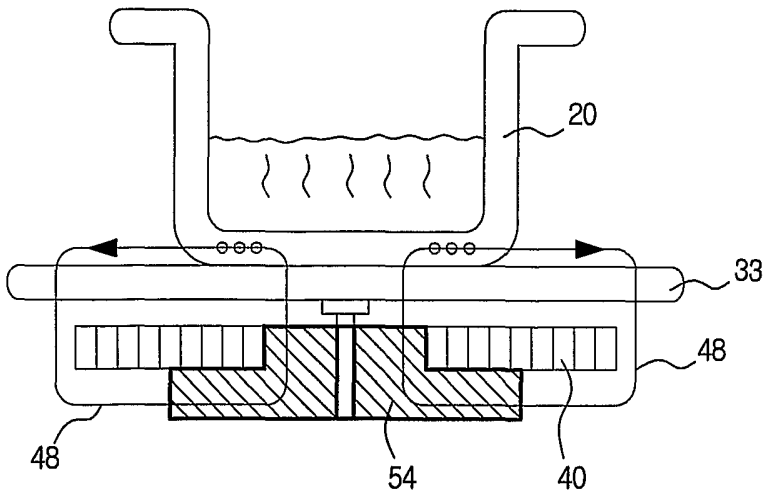


FIG. 13A

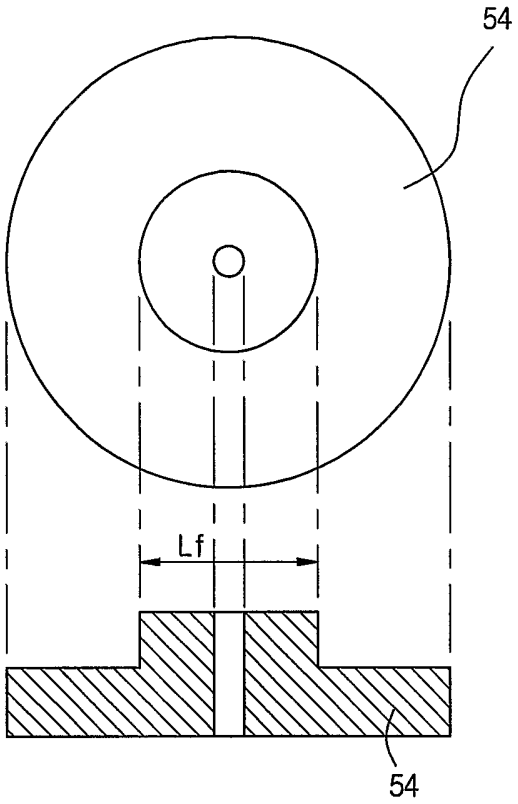


FIG. 13B

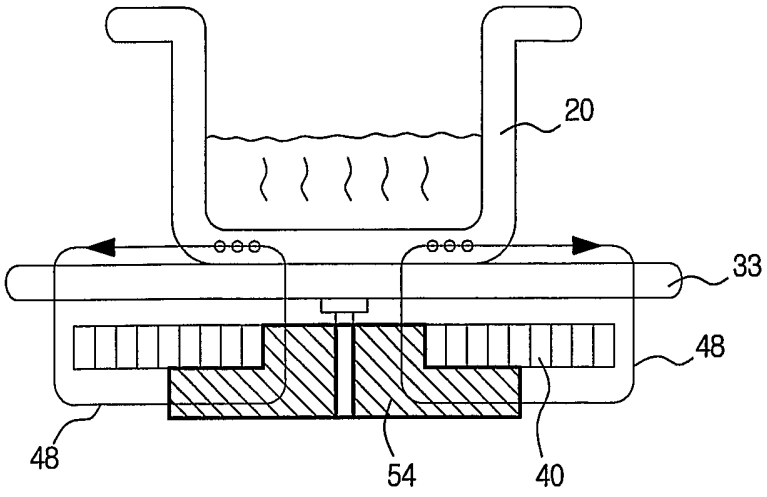


FIG. 14A

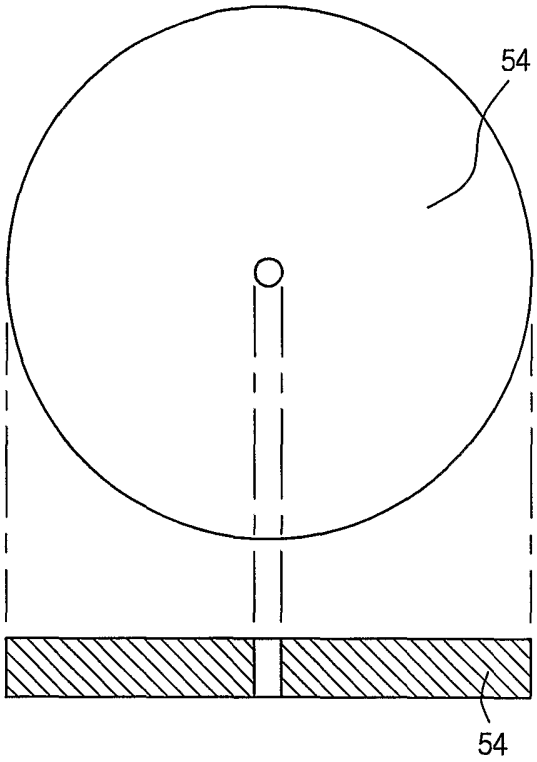
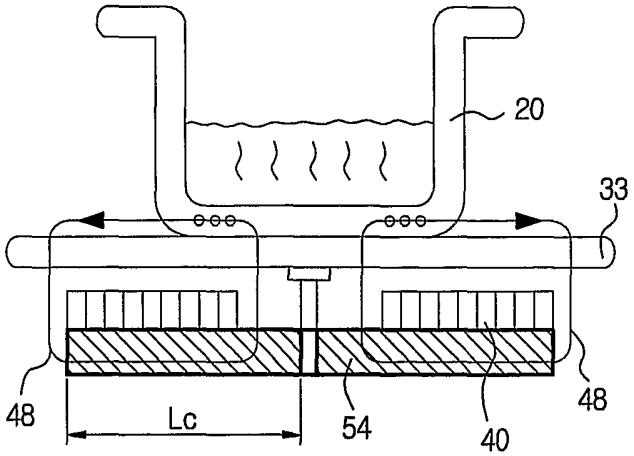


FIG. 14B



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR03/01605

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 H05B 6/12

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)

IPC7 H05B, H02M, A24F, H01F, G03G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Patents and applications for inventions since 1975
Korean Utility models and applications for Utility models since 1975

Electronic data base consulted during the intertnational search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,208,433 A (Rotelec S. A) 4 MAY 1993 See column 1. - column 2. Figure 6.	1, 8
Y	US 4,969,158 A (ASEA Brown Boveri) 6 Nov 1990 See the whole document	1, 8
A	JP11-126679 A (TOSHIBA Corp.) 11 MAY 1999 See the whole document	1

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 NOVEMBER 2003 (24.11.2003)	24 NOVEMBER 2003 (24.11.2003)

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Telephone No. 82-42-481-5642

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR03/01605

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5,208,433	04-05-1993	ZA 9104570 A	25-03-1992
		KR 222214 B	01-10-1999
		WO 9120168 A	26-12-1991
		EP 462011 A	18-12-1991
		AU 638147 B	17-06-1993
		AU 8083191 A	07-01-1992
		DE 69103969 T	19-01-1995
		AT 111672 E	15-09-1994
		ES 2060323 T	16-11-1994
		FR 2663490 A	20-12-1990
		JP 2934313 B	16-08-1999
		CA 2044656 C	21-08-2001
		JP 5500729 T	12-02-1993
		CA 2044656 A	16-12-1991
US 4,969,158	06-11-1990	JP 62229681 A	08-10-1987
		DE 3770179 C	27-06-1991
		SE 8600616 A	12-02-1986
		EP 232846 A	19-08-1987
JP 11126679	11-05-1999	NONE	