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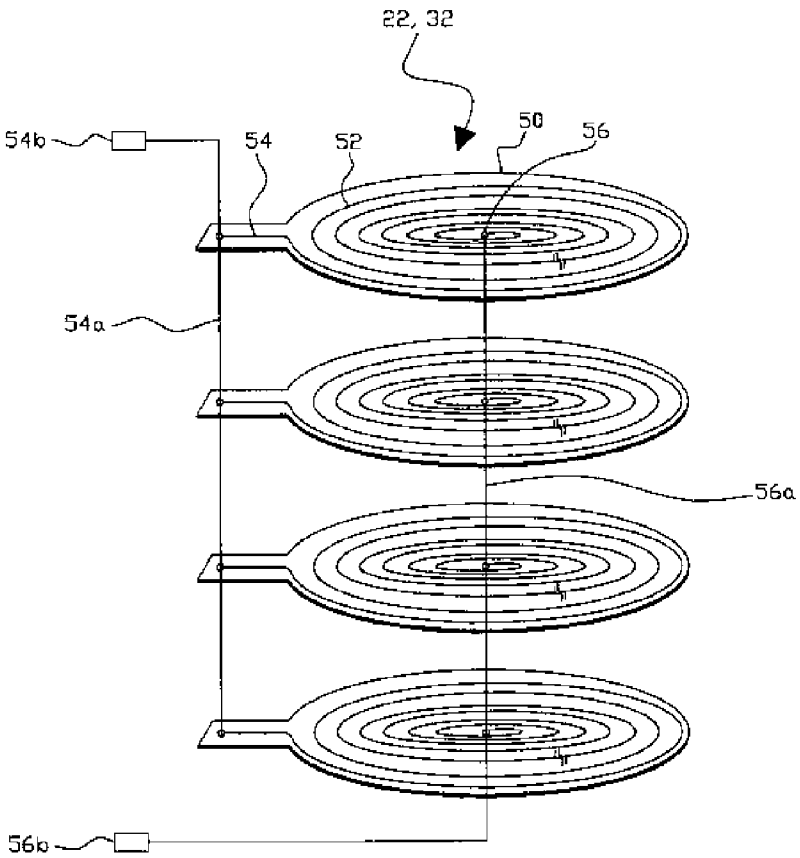
(54) Title: INDUCTION COIL FOR CORDLESS ENERGY CHARGING AND DATA TRANSFER



(57) Abstract: An induction coil for cordless energy charging and data transfer, which is used for charging a battery and transferring the data by using an induction connection between a charger and a battery without a direct electric contact, is disclosed. The induction coil is formed such that more than two printed circuit boards, on which a prescribed circuit pattern is formed, are laminated, wherein first ends positioned on an outside of the circuit patterns are electrically connected by a first connection part penetrating the first ends, and second ends positioned on an inside of the circuit patterns are electrically connected by a second connection part penetrating the second ends.

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Description

INDUCTION COIL FOR CORDLESS ENERGY CHARGING AND DATA TRANSFER

Technical Field

[1] This invention relates to an induction coil for cordless energy charging and data transfer, and more specifically, this invention relates to an induction coil for cordless energy charging and data transfer which is used in charging a battery or transferring data by using an induction connection between a charger and a battery without a direct electric contact.

[2]

Background Art

[3] Recently, as developments and common use of not only a portable electronic machine such as a mobile phone, a digital camera, and so on, but also an wireless electronic machine such as a robot cleaner, a wireless keyboard, and so on, the use of a battery pack which operates as a power supply in the machines has increased. The battery pack in the machines consists of an internal battery cell, an input/output terminal, and so on, and is charged through a direct electric contact with an exclusive charger, which is separately supplied. However, because the battery pack and the charger has various types and sizes according to products or company, the exclusive charger for the battery pack have to be used for charging, and there are problems such as a bad contact between a battery pack and a charger, a wrong operation by electrical short, and so on.

[4]

[5] To solve these problems, a method that a battery is cordlessly connected to a charger by using an induction connection between a charger and a battery has been studied. In the cordless charging method, a transmitting primary winding of a transformer which operates at high frequency is positioned on a charger and a receiving secondary winding of the transformer is positioned on a mobile apparatus such as a battery pack, so energy in the charger is supplied to the battery pack of the mobile apparatus by a magnetic connection. However, when a coil and a magnetic core is used as a means of the induction connection like a conventional transformer, there are disadvantages that it is complicated to prepare the coil and the magnetic core, and volume and weight of the charger and the mobile apparatus increase. Accordingly, in Korean Patent Laid-open No. 2002-57469 and Korean Utility model No. 0357251, a non-contacting battery in which a primary and secondary winding of a transformer are organized as a form of PCB (Printed Circuit Board) is disclosed. Specifically, in

Korean Patent Laid-open No. 2002-57469, a contactless battery charger in which a pair of PCBs constituting a winding circuit pattern is used as a transmitting part and a receiving part of a transformer is disclosed. In Korean Utility model No. 0357251, a noncontacting type charging system, in which multiple layers of PCB constituting a winding circuit pattern are laminated and are series-connected, and then are used as a transmitting part or a receiving part to improve magnetic field strength in the receiving part, is disclosed. Like this, when multiple PCBs constituting a winding circuit pattern are series-connected, the magnetic field strength generated increases, so amounts of current transmission increase to some degree. However, because resistance value of the circuit pattern increase, power transmission efficiency decreases, and accordingly heats and electromagnetic waves are relatively increased. After all, the life of an apparatus is reduced and undesirable effects are given to a human body, and in addition, there is disadvantage that a series-connection process of PCBs is complicated.

[6]

Disclosure of Invention

Technical Problem

[7] Therefore, it is an object of the present invention to provide an induction coil for energy charging and data transfer of which power transmission efficiency and transmission velocity are excellent. It is another object of the present invention to provide an induction coil for energy charging and data transfer of which preparation and mass-production are easy. It is still another object of the present invention to provide an induction coil for energy charging and data transfer of which thin film process is easy. The induction coil according to the present invention has a characteristic that uniformity of product quality is good, and is formed with not a series type but a parallel type, and is made of metals such as copper, zinc, silver, gold, white gold, tin, as well as aluminum, and is prepared with various methods such as an etching method, a sputtering method, a printing method, and so on.

[8]

Technical Solution

[9] To accomplish these objects, the present invention provides an induction coil which is formed such that more than two printed circuit boards, on which a prescribed circuit pattern is formed, are laminated, wherein first ends positioned on an outside of the circuit patterns are electrically connected by a first connection part penetrating the first ends, and second ends positioned on an inside of the circuit patterns are electrically connected by a second connection part penetrating the second ends.

[10] Also, the present invention provides a cordless charging apparatus which comprises a current transmitting part which is connected to a power supply, and includes a

transmitting primary winding for transmitting a current generated from the power supply; and a current receiving part which receives the current with being induction-connected to the transmitting primary winding, and includes a receiving second winding for charging a battery with the current received, wherein at least one winding, which is selected from the group including the transmitting primary winding and the receiving second winding, is formed such that more than two printed circuit boards on which a prescribed circuit pattern is formed are laminated, and first ends positioned on an outside of the circuit patterns are electrically connected by a first connection part penetrating the first ends, and second ends positioned on an inside of the circuit patterns are electrically connected by a second connection part penetrating the second ends.

[11]

[12] Hereinafter, a more complete appreciation of the invention will be better appreciated by reference to the following detailed description.

[13] FIG. 1 is a drawing for showing a structure and an operation condition of an induction coil for cordless energy charging and data transfer according to an embodiment of the present invention. As shown in FIG. 1, a cordless charging apparatus according to the present invention, comprises a current transmitting part **20** which is connected to a power supply **10**, and includes a transmitting primary winding **22** for transmitting a current generated from the power supply **10**; and a current receiving part **30** which receives the current with being induction-connected to the transmitting primary winding **22**, and includes a receiving second winding **32** for charging a battery with the current received. The current receiving part **30** is united together with the battery **12** charged, or can be prepared in a wireless apparatus **14** to which the battery **12** is attached. Also the current receiving part **30** has a structure of attaching and detaching to the wireless apparatus **14**, together or separately with the battery **12**. Also, the current transmitting part **20** preferably has a structure of pad type. The current transmitting part **20** and the current receiving part **30** convert the common use power supply **10** to be suitable for charging the battery **12**, and include a general various electronic device for charging the battery **12**. Namely, the current transmitting part **20** can be equipped with a general diode rectifier, a free voltage converter, an AC/DC converter, a DC/DC converter, an inverter, and so on, and the current receiving part **30** can be equipped with a general rectifier, a capacitor, and so on, and a structure of these devices, for example, is disclosed in Korean Publication No. 2002-57469, Korean Utility No. 0357251, and so on.

[14]

[15] FIG. 2 is an exploded perspective view for showing a structure of a transmitting primary winding **22** and/or a receiving second winding **32** used in an induction coil for

cordless energy charging and data transfer according to an embodiment of the present invention, and FIGS. 3 to 5 are respectively a front view, a rear view, and a side cross sectional view at line A-A of windings **22, 32** used in an induction coil for cordless energy charging and data transfer according to an embodiment of the present invention. As shown in FIGS. 2 to 5, the windings **22**, **32** used in a cordless charging apparatus according to the present invention are formed such that more than two printed circuit boards **50** are laminated, and on the respective printed circuit board **50**, a prescribed circuit pattern **52**, for example preferably a circular spiral circuit pattern **52** or a rectangular spiral circuit pattern, is formed with a same shape. Among both ends of the circuit pattern **52**, first ends **54** positioned on an outside of the circuit patterns **52** are electrically connected by a first connection part **54a** penetrating every first ends **54**, and second ends **56** positioned on an inside of the circuit patterns **52** are electrically connected by a second connection part **56a** penetrating every second ends **56**. The first connection part **54a** and second connection part **56a** are respectively connected to a first terminal **54b** and a second terminal **56b**, and as occasion demands, are connected to the power supply **10** or the battery **12** through a common charging device (see FIG. 1). Here, it is preferable that the transmitting primary winding **22** and the receiving second winding **32** have a same shape to improve power transmission efficiency.

[16]

[17] As shown in FIG. 1, the transmitting primary winding **22** and/or the receiving second winding **32,** having a similar shape, are respectively attached to an instrument for transmitting data and an instrument for receiving data, and then are used as an induction coil for data transfer. Namely, the transmitting primary winding **22** and/or the receiving second winding **32** can be used as the induction coil for not only powers transmit but also data transfer. For example, by a method of that powers having a signal interval or a signal strength corresponding to a prescribed data are supplied to the transmitting primary winding **22**, and then are received in the receiving second winding **32**, so the data can be transmitted from the instruments for transmitting data (the primary part) to the instruments for receiving data (the second part). Also, as shown in FIG. 6, in addition to the first connection part **54a** and the second connection part **56a**, a third connection part **55** is further formed with electronically connected to the circuit pattern **52**. When data signals are permitted to the third connection part **55**, the data signals permitted to the third connection part **55** are transmitted to the receiving second winding **32**, with the current permitted to the first connection part **54a** and the second connection part **56a**. Accordingly, the receiving second winding **32** can receive data by separating the data signal from the current received. Like this, by using the three terminals including the third connection part **55**, data can be more efficiently

transmitted as minimizing additional circuits. Eventually, a data transfer function can be carried out with a charging function.

[18]

[19] A laminated layer number of the printed circuit board **50**, on which the circuit pattern **52** is formed, is more than 2, preferably 3 to 15, and more preferably 3 to 10. If the laminated layer number of the printed circuit board **50** is too small, power transmission efficiency and transmission velocity may be insufficiently improved, and if the laminated layer number of the printed circuit board **50** is too many, power transmission efficiency can be rather reduced. Also, in the spiral circuit pattern **52** formed in the printed circuit board **50**, a number of the winding turns in the circuit pattern **52** is preferably 5 to 50, and more preferably 10 to 30, and the most outer diameter of the circuit pattern **52** is preferably 10 to 200 mm, and more preferably 20 to 80mm. If the number of winding turns and the diameter of the circuit pattern **52** are out of that range, there are problems that impedance can increase due to reduction of the circuit width, and power transmission efficiency can be rather reduced due to excessive increase of the circuit width. The circuit pattern **52** can has a circular shape as shown in FIG. 3, or a rectangular shape as shown in FIG. 7, and as occasion needed, can have various shapes such as triangle, trapezoid, diamond, and so on.

[20]

[21] As shown in FIGS. 4 and 5, a withdrawing line **57**, which withdraws the second connection part **56a** connecting the second ends **56** of the multiple spiral circuit patterns **52** out of the windings **22**, **32**, can be formed on a back side of the most bottom printed circuit board **50** of the windings **22**, **32**. Also, it is preferable that the withdrawing line **57** is connected to a third connection part **58** penetrating the multiple printed circuit boards **52**, and then is connected to a second terminal **56b** positioned on an upper part of the most top printed circuit board **50** among the multiple printed circuit boards **50**. Like this, the second connection part **56a** connecting the second ends **56** of the multiple spiral circuit patterns **52**, and the first connection part **54a** connecting the first ends **56** are positioned on the same plane, so the printed circuit board **50** can be efficiently arranged in the current transmitting part **20** and the current receiving part **30**. Also, as shown in FIG. 8, instead of that the withdrawing line **57** is formed on a back side of the most bottom printed circuit board **50**, a separate printed circuit board **59** on which the withdrawing line **57** is formed can be prepared, and can be bonded on the back side of the most bottom printed circuit board **50**, on which the second connection part **56a** and the third connection part **58** are formed.

[22]

[23] The printed circuit boards **50**, **59** according to the present invention can be prepared by a method that a prescribed circuit pattern **52** or a pattern of the withdrawing line **57**

is formed on an upper part of a substrate made of a insulation material by a conventional photo-lithography. Preferably, The printed circuit boards **50**, **59** according to the present invention can be prepared by a method that a circuit pattern **52** or a pattern of the withdrawing line **57** is formed on an upper part of a heat-resistant plastic film such as a flexible polyester film, a polyimide film, and so on, like the case of a Flexible Printed Circuit (FPC), a flexible copper clad laminate, by using a conductive material such as copper, aluminum, white gold, nickel, zinc, silver, gold, tin, and conductive polymer. Namely, It is preferable to use the flexible copper clad laminate, because it is easy that the laminated films, the printed circuit boards **50**, **59**, are bonded by insulation adhesives or are physically laminated. Also, the printed circuit boards **50**, **59** according to the present invention can be prepared by a method of depositing by sputtering a conductive material on the substrate such as a heat-resistant film and so on, or a method of printing pastes including a conductive material on the substrate such as a heat-resistant film and so on, or a method of forming a conductive material layer on the substrate and then etching the conductive material layer in a prescribed shape. Here, it is preferable that the conductive material included in the pastes has a particle of nano size. Accordingly, by the above methods, a shape of the circuit pattern **52** can be freely organized, and a thickness of the circuit pattern **52** can be adjusted according to the usage. Accordingly, heat generation amounts generated from the printed circuit boards **50**, **59** will be controlled, by adjusting the shape and thickness of the circuit pattern. Also, an electromagnetic waves interception can be taken effect when the conductive material such as Si, Ag, Fe, and so on is coated on the insulation substrate such as the heat-resistant film, and so on as a paste form (here, it is preferable not to contact with the circuit pattern), or is impregnated into an inner substrate.

[24]

[25] Also, the first to third connection part **54a**, **56a**, **58** can be formed by penetrating the laminated circuit pattern **52** with a small drill, and inserting the conductive material such as conductive polymer, copper, and so on into the penetrating hole.

[26]

[27] By a organization like this, the spiral circuit pattern **52** formed in the multiple printed circuit boards **50** has a structure of parallel connection between the first connection part **54a** and the second connection part **56a**, that is, a pair of terminals **54b** , **56b**. That is, every beginning points of the spiral circuit pattern **52** formed in the printed circuit boards **50** is connected by the first connection part **54a**, and every ending points of the spiral circuit pattern **52** is connected by the second connection part **56a**, so the spiral circuit pattern **52** are parallel-connected. Because of the parallel connection between the spiral circuit patterns **52**, impedance of total circuits is increasingly reduced, and power transmission efficiency is improved, as compared with

a series connection in the spiral circuit patterns **52**. Also, when the every spiral circuit pattern **52** is series connected, currents in the adjacent printed circuit board **50** move in an opposite direction each other. However when the every spiral circuit pattern **52** is parallel connected according to the present invention, currents in adjacent printed circuit board **50** move in a same direction or trace. Accordingly, current intensity is amplified, and then power transmission efficiency is improved. Also, in the present invention, the every printed circuit board **50** has a same shape, and the first connection part **54a**, the second connection part **56a**, and as occasion needed, the third connection part **58**, can be formed respectively by one hole formation process in a lamination condition of the printed circuit boards **50**. So, there are advantages that a preparation process is simple, and a mass production is easy. Also, in the present invention, both the transmitting primary winding **22** and the receiving second winding **32** can be composed of the laminated printed circuit board **50**, and as occasion needed, either the transmitting primary winding **22** or the receiving second winding **32** may be composed of the laminated printed circuit board **50**.

[28]

Advantageous Effects

[29] A cordless charging apparatus according to the present invention has advantages that not only the power transmission efficiency and transmission velocity is excellent but also preparation and mass production is easy. Also, A cordless charging apparatus according to the present invention is prepared in a form of thin film such as pad, and so on, so the cordless charging apparatus can be applied to an wireless instrument of various battery type. Namely, the cordless charging apparatus according to the present invention can be usefully applied to every wired wireless apparatus being charged by a secondary cell, for example, not only a portable electronic instrument such as a mobile phone, a MP3 player, a PDA, a notebook PC, a digital camera, a camcorder, mobile electronic games, a PMP(portable media player), and so on, but also various wireless instruments such as a portable medical apparatus, a robot, a robot cleaner, a toy robot, a small motor vehicle, or an automobile, an auto-vacuum cleaner, an auto shaver, an wireless keyboard, and so on. Also, the cordless charging apparatus according to the present invention can be used for instant charging using instant induction current like the case of a mouse and a mouse pad.

[30]

Brief Description of the Drawings

[31] FIG. 1 is a drawing for showing a structure and an operation condition of an induction coil for cordless energy charging and data transfer according to an embodiment of the present invention.

[32] FIG. 2 is an exploded perspective view for showing a structure of a transmitting primary winding or a receiving second winding used in an induction coil for cordless energy charging and data transfer according to an embodiment of the present invention.

[33] FIGS. 3 to 5 are respectively a front view, a rear view, and a side cross sectional view at line A-A of windings used in an induction coil for cordless energy charging and data transfer according to an embodiment of the present invention.

[34] FIG. 6 is a front view of a winding used in an induction coil for data transfer according to another embodiment of the present invention.

[35] FIG. 7 is a front view of a winding used in an induction coil for cordless energy charging and data transfer according to still another embodiment of the present invention.

[36] FIG. 8 is a side cross sectional view of a winding used in an induction coil for cordless energy charging and data transfer according to still another embodiment of the present invention.

[37]

Best Mode for Carrying Out the Invention

[38] Hereinafter, the preferable examples are provided for better understanding of the present invention. However, the present invention is not limited to the following examples.

[39]

[40] [Example 1]

[41] A spiral circuit pattern, in which a number of winding turns was 18, and an outer diameter was 42mm, and a thickness (a thickness of circuit) was 0.65mm, and a distance between the patterns was 0.2mm, was formed on an upper part of a polyimide film of thickness of 10□ by using copper, and then were laminated with 8 layers to be used as a transmitting primary winding of a current transmitting part of pad type. A spiral circuit pattern, in which a number of winding turns was 18, and an outer diameter was 30mm, and a thickness (a thickness of circuit) was 0.54mm, and a distance between the patterns was 0.2mm, was formed on an upper part of a polyimide film of thickness of 10□ by using copper, and then were laminated with 4 layers to be used as a receiving second winding of a current receiving part of pad type. The current transmitting part and the current receiving part were contacted, and a current of 0.151A and 4.62V was applied to the transmitting primary winding, and then the current and voltage generated in the receiving second winding were measured, and accordingly, the current of 0.112A and 3.81V was detected, and the power transmission efficiency was 61%. Here, the power transmission efficiency was calculated by means of that the

power transmission efficiency = (current×voltage of the receiving second winding)÷(current×voltage of the transmitting primary winding)×100.

[42]

[43] [Example 2]

[44] The same transmitting primary winding in the Example 1 was used as a transmitting primary winding of a current transmitting part of pad type. A spiral circuit pattern, in which a number of winding turns was 18 and an outer diameter was 35mm, and a thickness (a thickness of circuit) was 0.67mm, and a distance between the patterns was 0.2mm, was formed on an upper part of a polyimide film of thickness of 10□ by using copper, and then were laminated with 5 layers to be used as a receiving second winding of a current receiving part of pad type. The current transmitting part and the current receiving part were contacted, and a current of 0.151A and 4.62V was applied to the transmitting primary winding, and then the current and voltage generated in the receiving second winding were measured, and accordingly, the current of 0.115A and 3.85V was detected, and the power transmission efficiency was 63%.

[45]

[46] [Example 3]

[47] The same transmitting primary winding in the Example 1 was used as a transmitting primary winding of a current transmitting part of pad type. A rectangular circuit pattern, in which a number of winding turns was 16, and an outer diameter was 34mm, and a thickness (a thickness of circuit) was 0.75mm, and a distance between the patterns was 0.2mm, was formed on an upper part of a polyimide film of thickness of 10□, by using copper, and then were laminated with 6 layers to be used as a receiving second winding of a current receiving part of pad type. The current transmitting part and the current receiving part were contacted, and a current of 0.151A and 4.62V was applied to the transmitting primary winding, and then the current and voltage generated in the receiving second winding were measured, and accordingly, the current of 0.119A and 3.88V was detected, and the power transmission efficiency was 66%.

[48]

[49] [Comparative Example]

[50] The same transmitting primary winding in the Example 1 was used as a transmitting primary winding of a current transmitting part of pad type. A spiral circuit pattern, in which a number of winding turns was 16, and an outer diameter was 30mm, and a thickness (a thickness of circuit) was 0.54mm, and a distance between the patterns was 0.2mm, was formed on an upper part of a polyimide film of thickness of 10□ by using copper, and then the pattern was used without a lamination step as a receiving second winding of a current receiving part of pad type. The current transmitting part and the current receiving part were contacted, and a current of 0.151A and 4.62V was applied

to the transmitting primary winding, and then the current and voltage generated in the receiving second winding were measured, and accordingly, the current of 0.072A and 3.10V was detected, and the power transmission efficiency was 32%.

Claims

[1] An induction coil which is formed such that more than two printed circuit boards, on which a prescribed circuit pattern is formed, are laminated, wherein first ends positioned on an outside of the circuit patterns are electrically connected by a first connection part penetrating the first ends, and second ends positioned on an inside of the circuit patterns are electrically connected by a second connection part penetrating the second ends.

[2] The induction coil according to the claim 1, wherein the circuit pattern has a spiral form, and a laminated layer number of the printed circuit board, on which the circuit pattern is formed, is 2 to 15, and a number of winding turns of the spiral circuit pattern is 5 to 50, and the most outer diameter of the spiral circuit pattern is 10 to 200 mm.

[3] The induction coil according to the claim 1, wherein the circuit pattern is selected from the group including a circular spiral circuit pattern and a rectangular spiral circuit pattern.

[4] The induction coil according to the claim 1, wherein in the printed circuit board, the circuit pattern is formed on an upper part of a substrate made of an insulation material by using a conductive material selected from the group including copper, aluminum, white gold, nickel, zinc, silver, gold, tin, and a conductive polymer.

[5] The induction coil according to the claim 4, wherein the circuit pattern is formed by more than one method selected from the group including a method of depositing by sputtering the conductive material on the substrate, a method of printing pastes including the conductive material on the substrate, and a method of forming the conductive material layer on the substrate and etching the conductive material layer in a prescribed shape.

[6] The induction coil according to the claim 4, wherein the printed circuit board is formed by a photo-etching method.

[7] The induction coil according to the claim 1, wherein the printed circuit board is a flexible copper clad laminate.

[8] The induction coil according to the claim 1, wherein the induction coil is used for data transfer.

[9] The induction coil according to the claim 8, wherein a connection part for data transfer, which is electrically connected to the circuit pattern, is further formed.

[10] A cordless charging apparatus which comprises a current transmitting part which is connected to a power supply, and includes a transmitting primary winding for transmitting a current generated from the power supply; and a current receiving

part which receives the current with being induction-connected to the transmitting primary winding, and includes a receiving second winding for charging a battery with the current received, wherein at least one winding, which is selected from the group including the transmitting primary winding and the receiving second winding, is formed such that more than two printed circuit boards on which a prescribed circuit pattern is formed are laminated, and first ends positioned on an outside of the circuit patterns are electrically connected by a first connection part penetrating the first ends, and second ends positioned on an inside of the circuit patterns are electrically connected by a second connection part penetrating the second ends.

[11] The cordless charging apparatus according to the claim 10, wherein the current transmitting part has a structure of pad type, and the current receiving part is united together with the battery charged.

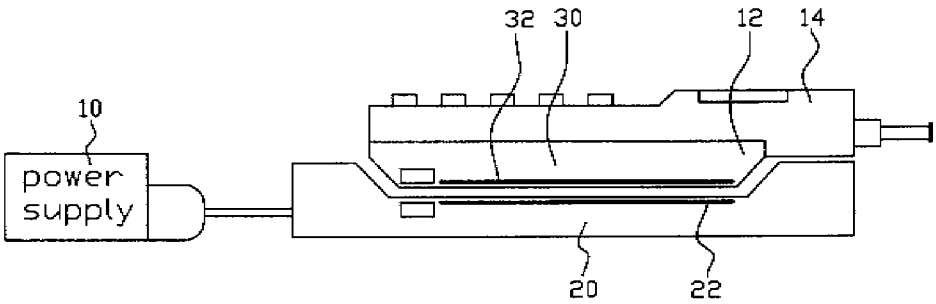
[12] The cordless charging apparatus according to the claim 10, wherein the first connection part is connected to a first terminal positioned on an upper part of the most top printed circuit board among the printed circuit boards, and a withdrawing line, which withdraws the second connection part connecting the second ends of the circuit patterns out of the winding, is formed on a back side of the most bottom printed circuit pattern of the winding, and the withdrawing line is connected to a third connection part penetrating the multiple printed circuit boards, and then is connected to a second terminal positioned on the upper part of the most top printed circuit board.

[13] The cordless charging apparatus according to the claim 12, wherein the withdrawing line is formed on a separate printed circuit board, and then is bonded on the back side of the most bottom printed circuit board, on which the second connection part and the third connection part are formed.

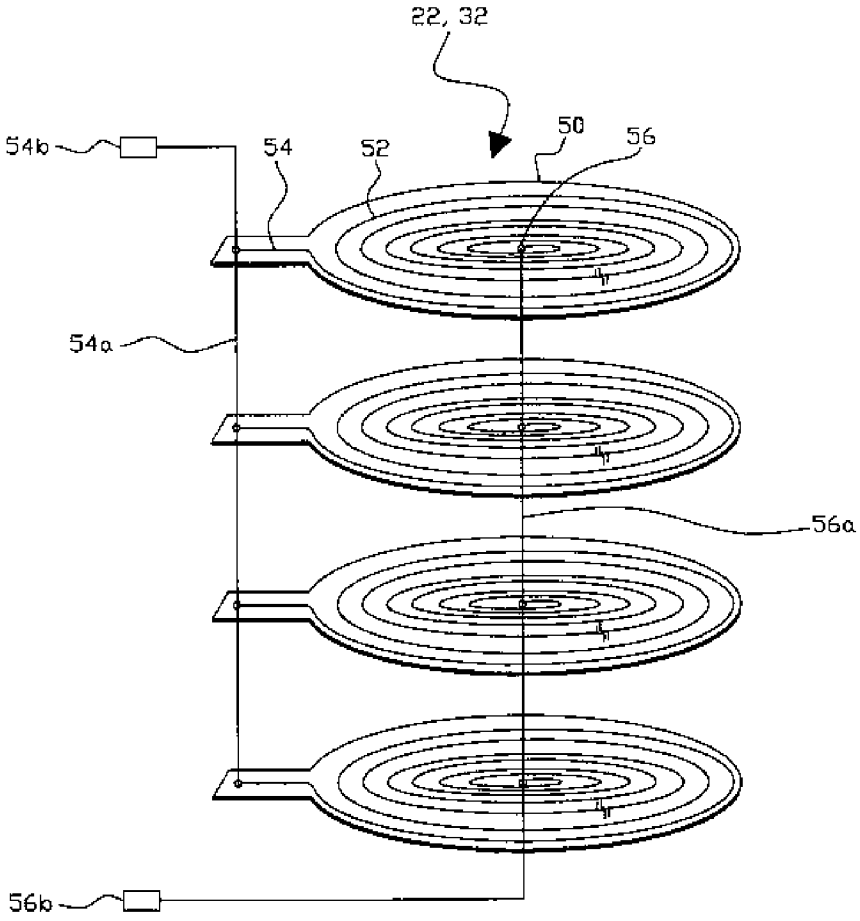
[14] The cordless charging apparatus according to the claim 10, wherein the cordless charging apparatus can carry out data transfer, and is used in an apparatus which need to be charged by more than one secondary cell and is selected from the group including a mobile phone, a MP3 player, a PDA, a notebook PC, a digital camera, a camcorder, mobile electronic games, a PMP(portable media player), a portable medical apparatus, a robot, a robot cleaner, a toy robot, a small motor vehicle, an automobile, an auto-vacuum cleaner, an auto shaver, an wireless keyboard, and a mouse.

[15] The cordless charging apparatus according to the claim 10, wherein the transmitting primary winding and the receiving second winding have a same shape.

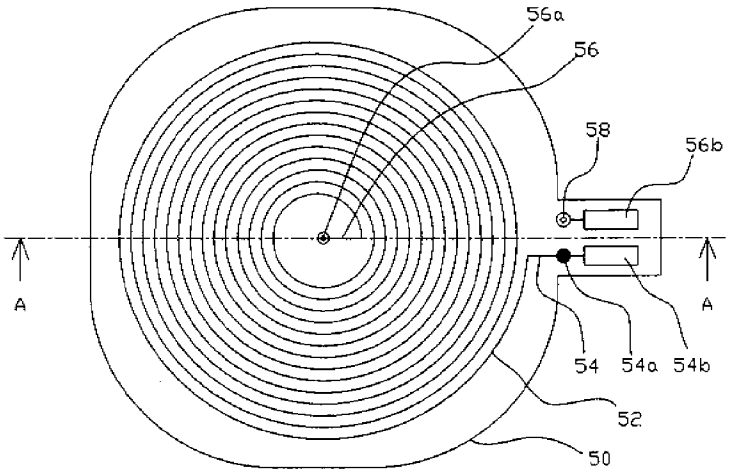
[Fig. 1]



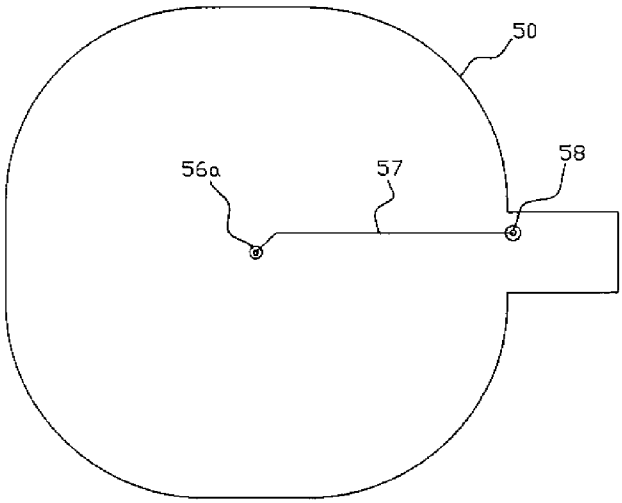
[Fig. 2]



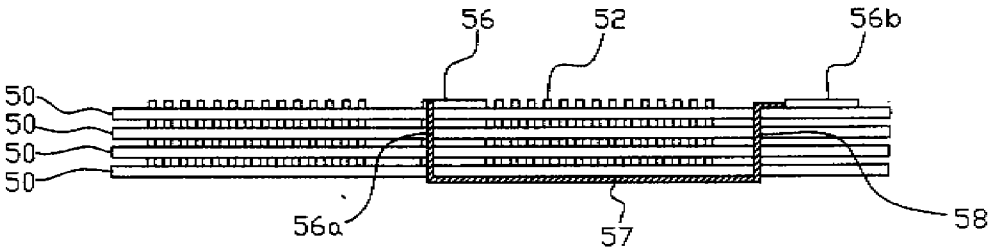
[Fig. 3]



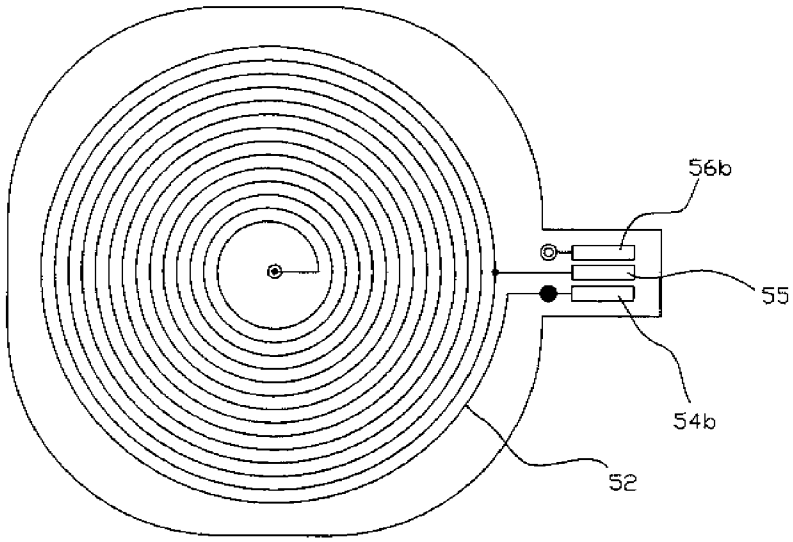
[Fig. 4]



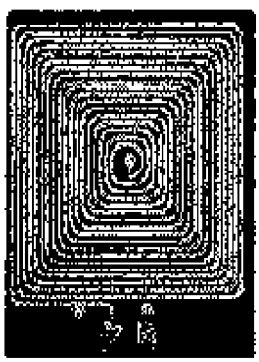
[Fig. 5]



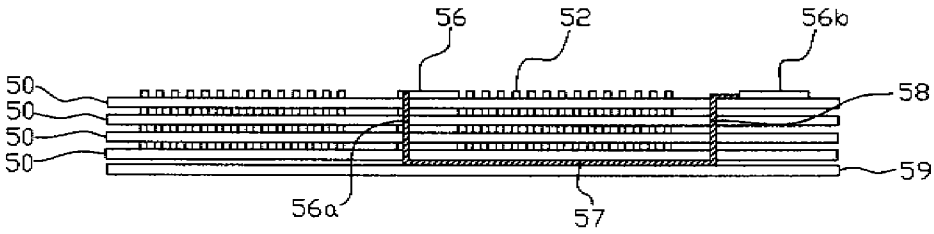
[Fig. 6]



[Fig. 7]



[Fig. 8]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2007/003731

A. CLASSIFICATION OF SUBJECT MATTER

H02J 17/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 8: H02J 7/00, 7/02, 17/00, H01F 38/14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Utility models and applications for Utility Models since 1975
Japanese Utility models and applications for Utility Models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKIPASS(KIPO internal) "cordless", "charge", "induction"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 10-2005-0016879 A (SPLASHPOWER LIMITED) 21 February 2005 See the abstract; figure 4	1-15
A	KR 10-2004-0096353 A (HYUNDAI MOTOR COMPANY) 16 November 2004 See the abstract; figures 1, 2	1-15
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☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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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
13 NOVEMBER 2007 (13.11.2007)	**13 NOVEMBER 2007 (13.11.2007)**

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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