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(54) **NON-CONTACT TYPE POWER RECEIVING APPARATUS, ELECTRONIC EQUIPMENT AND CHARGING SYSTEM USING THE POWER RECEIVING APPARATUS**

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(57) **ABSTRACT**

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A non-contact type power receiving apparatus including: a power receiving coil having a spiral coil; a rectifier; a secondary battery; an electronic device operated by being supplied with direct voltage from the secondary battery, wherein a composite magnetic body is provided to at least one portion between the secondary battery and the spiral coil, and a portion between the electronic device and the spiral coil. The composite magnetic body includes at least first and other layers of magnetic sheets through an insulating layer in which when a relative magnetic permeability of the first magnetic sheet provided to a side of the spiral coil is μd , a thickness of the first magnetic sheet is t_u , an average relative magnetic permeability of the other magnetic sheets other than the first magnetic sheet is μu , and a total thickness of the other magnetic sheets is t_u , the composite magnetic body satisfies the following relations: $\mu d \cdot t_d \leq 60$ [mm]; and $\mu u \cdot t_u \geq 100$ [mm].

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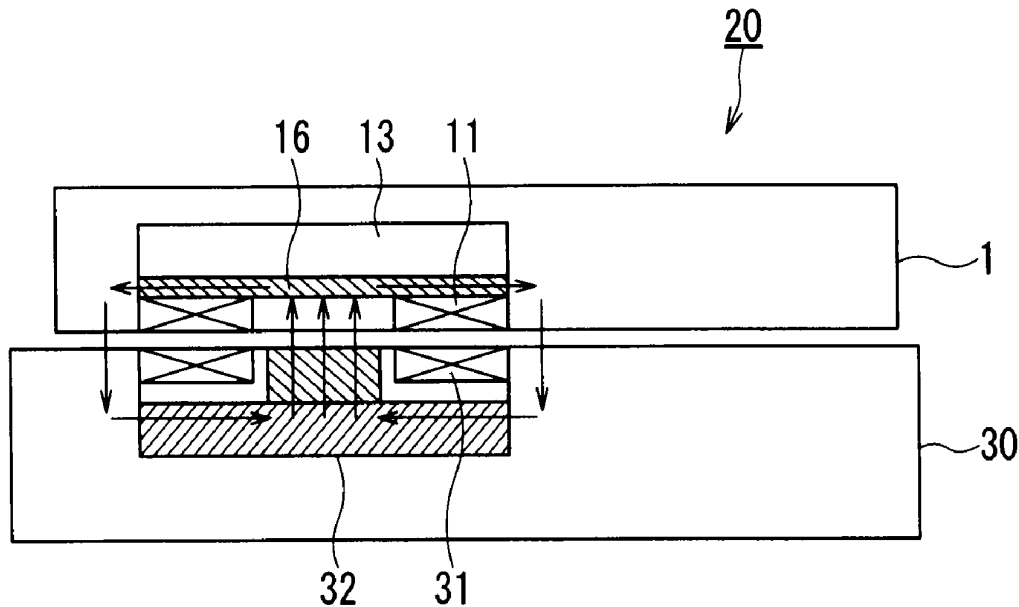
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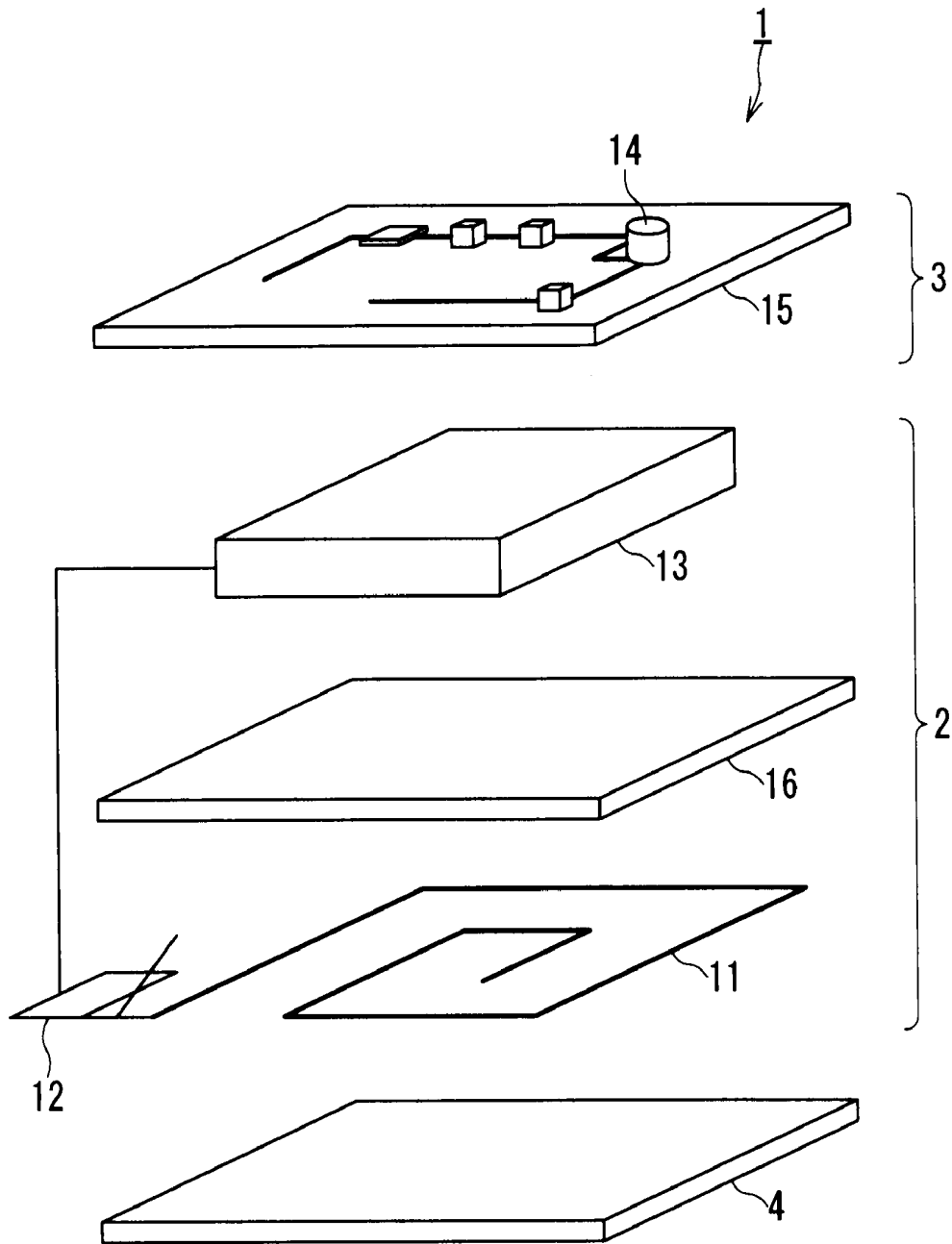


FIG. 1

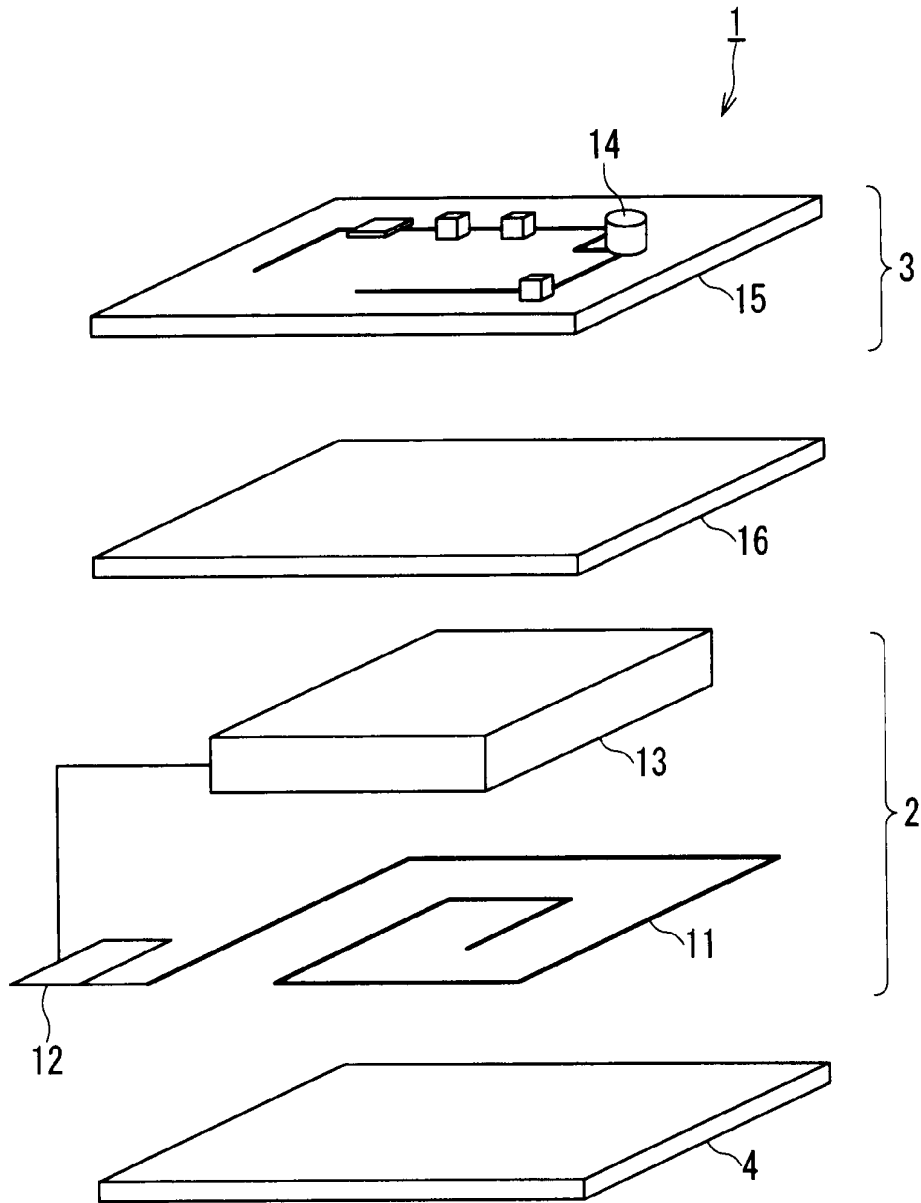


FIG. 2

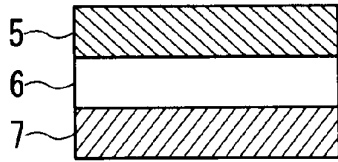


FIG. 3A

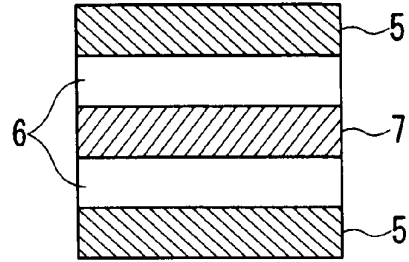


FIG. 3B

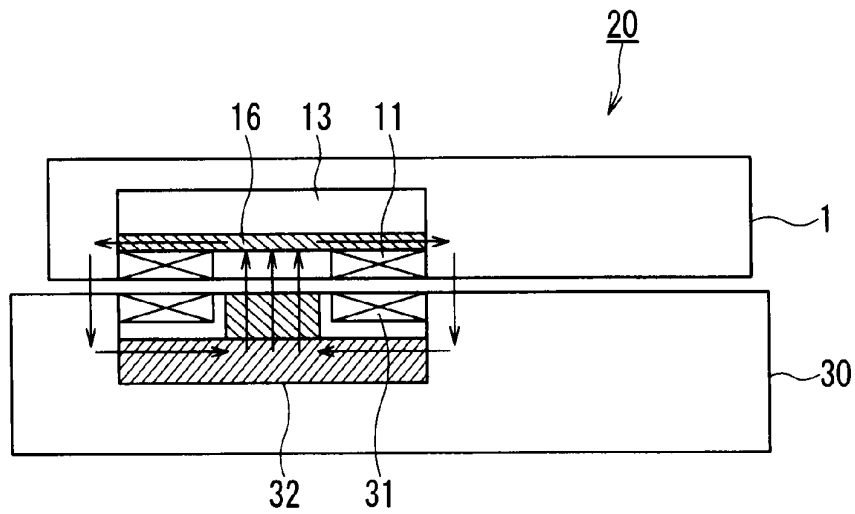


FIG. 4

**NON-CONTACT TYPE POWER RECEIVING
APPARATUS, ELECTRONIC EQUIPMENT
AND CHARGING SYSTEM USING THE
POWER RECEIVING APPARATUS**

TECHNICAL FIELD

[0001] The present invention relates to a non-contact (contactless) type power receiving apparatus, an electronic equipment (electronic apparatus) and a charging system (battery charging system) using the non-contact type power receiving apparatus that are capable of performing a non-contact power charging in various electronic equipments such as cellular phone, video camera and so on.

BACKGROUND ART

[0002] In recent years, a development of handheld communication gadgets is remarkable. Especially, downsizing and reduction in weight of mobile phones have advanced. Further, with respect to also various electronic equipments such as video camera (handy camera or the like), codeless phone, lap-top personal computer (notebook type personal computer) other than the mobile phone, such the downsizing and reduction in weight have been also advanced.

[0003] Since these electronic equipments are provided with a secondary battery to an electronic equipment body, the electronic equipments can be available without plugging in, so that a portability and convenience have been greatly improved. At the present time, a capacity of the secondary is limited to some extent, so that the secondary battery is necessary to be performed with a power-charging operation at least once every several days to several weeks.

[0004] As a power charging method, there are two types of charging methods: a contact-type charging system; and a non-contact type charging system. The contact-type charging system is a system in which an electrode of a power receiving apparatus and an electrode of a power supplying apparatus are directly contacted to each other thereby to perform the power charging. The contact-type charging system has a simple structure for constituting the apparatus, so that the contact-type charging system has been generally adopted in wide application field.

[0005] However, in accordance with the progress of the downsizing and reduction in weight of the electronic equipments in recent years, there has been posed problems such that a weight of each electronic equipments is reduced, so that a contact pressure between the electrode of the power receiving apparatus and the electrode of the power supplying apparatus becomes insufficient thereby to cause a charging defect (charging fault). Further, the secondary battery has a small resistance to heat, so that it is necessary to avoid a temperature rise of the secondary battery, and a circuit design requires to be carefully performed so as not to cause an over discharge and an overcharge. In order to cope with these problems, the non-contact type charging system has been reviewed in these days.

[0006] The non-contact type charging system is a power charging system utilizing an electromagnetic induction caused by coils provided to both the power receiving apparatus and the power supplying apparatus. In this type of the charging system, due to the non-contact type, there is no need to pay attention to the contact pressure between the electrodes of the two apparatuses. Further, it is unnecessary to pay atten-

tion to the contact pressure between the electrodes of the apparatuses.

[0007] The conventional non-contact type charging system has been used for electronic equipments such as electric toothbrush, electric shaver or the like that are driven by a low power consumption and require a long charging time. As the secondary battery at that time, a nickel-hydrogen battery is mainly used, so that most of the nickel-hydrogen batteries require a long charging time of about 8 hours. In recent years, as a novel secondary battery, a high capacity and high density batteries such as lithium-ion secondary battery or the like have come into existence. As a result, with respect to the electronic equipments such as mobile phone, personal computer or the like that are driven by a high power consumption and require a rapid charging operation, the non-contact type charging system has been eagerly reviewed in these days.

[0008] As one example of the non-contact type charging apparatus, there have been proposed systems in Japanese Unexamined Patent Application Publication No. 11-265814 (Patent Document 1) or Japanese Unexamined Patent Application Publication No. 2000-23393 (Patent Document 2). Both systems adopt a structure in which a ferrite core is used as a magnetic core and a coil is wound around the magnetic core thereby to realize the apparatus which is reduced in size.

[0009] Further, in the charging apparatus disclosed in Japanese Unexamined Patent Application Publication No. 9-190938 (Patent Document 3), ferrite powder and amorphous powder are mixed thereby to form a resin substrate and a coil or the like is mounted on the resin substrate thereby to realize the charging apparatus reduced in size and thickness.

[0010] However, when ferrite is worked to be thin shape, the thin ferrite becomes brittle and has a low impact resistance, so that there has been posed a problem such that the power receiving system turns out to be defective due to a dropping or collision or the like of the apparatus. Further, in order to reduce a size in thickness of a power receiving portion so as to correspond to the reduction in thickness of the electronic equipment, there has been adopted a planar coil which is formed by printing a metal powder paste onto a coil. As one example of structure for strengthening bondage by using the planar coil and a magnetic sheet, there have been proposed the structures disclosed in Japanese Unexamined Utility Model Application Publication No. 58-80753 (Patent Document 4), Japanese Unexamined Patent Application Publication No. 4-122007 (Patent Document 5) or Japanese Unexamined Patent Application Publication No. 8-148360 (Patent Document 6). In these proposed structures, a magnetic body (magnetic sheet) is used as a core material for strengthening the bondage between a primary coil and a secondary coil.

[0011] On the other hand, when an electric transmission rate is increased to be large, defects due to heat generation are liable to occur at portions not only the bondage between adjacent transformers but also peripheral parts of the transformers. That is, in a case where the planar coil is used, a magnetic flux passing through the planar coil is interlinked to a substrate or the like provided inside the equipment, so that a temperature of an inside of the apparatus is increased to generate heat due to eddy current caused by electromagnetic induction. As a result, there has been posed a problem such that high electric power cannot be transmitted and it takes long time to charge the electricity.

[0012] To cope with this problem, the magnetic body (mag-

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