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(54) [Title of the Invention] Coil Module, and Electronic Device Equipped With the Coil Module

(57) [Abstract]

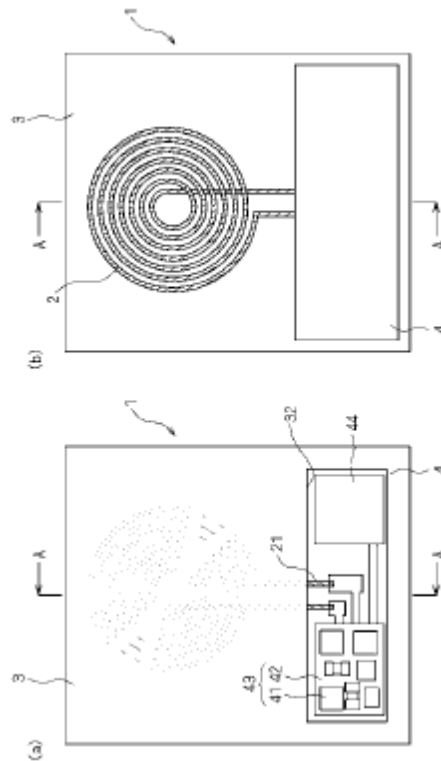
[Problem]

The present invention provides a coil module that can be made thin and compact, and an electronic device equipped with the coil module.

[Means for Solving the Problem]

The coil module 1 according to the present invention comprises a flat, plate-shaped coil 2, a circuit board 4 that is electrically connected to the coil 2 and is equipped with a plurality of electronic components that control power transmitted by the coil 2, and a flat, plate-shaped resin structure 3 containing a magnetic material. The coil 2 is built in, biased to one side of the resin structure 3, the circuit board 4 is arranged horizontally with respect to the coil 2, and at least a portion of the circuit board 4 is built into the resin structure 3.

[Chosen Drawing] Fig. 1



[Scope of Claims for Patent]

[Claim 1]

A coil module comprising:

a flat plate-shaped coil;

a circuit board electrically connected to the coil and equipped with a plurality of electronic components that control power transmitted by the coil; and

a flat plate-shaped resin structure containing a magnetic material;

wherein

the coil is built in biased to one side of the resin structure; and

the circuit board is arranged horizontally with respect to the coil, and at least a portion of the circuit board is built into the resin structure.

[Claim 2]

The coil module according to claim 1, wherein a portion of the coil is exposed to an exterior on the one side of the resin structure.

[Claim 3]

The coil module according to claim 1 or claim 2, wherein a portion of the circuit board is exposed to an exterior on one side of the resin structure.

[Claim 4]

The coil module according to any one of claims 1 to 3, wherein the resin structure is equipped with an opening in a region of the circuit board that is equipped with a plurality of the electronic components.

[Claim 5]

The coil module according to claim 4, wherein the resin structure comprises a seal material that covers the opening.

[Claim 6]

The coil module according to any one of claims 1 to 5, wherein the circuit board is equipped with a connector for connecting with an exterior.

[Claim 7]

The coil module according to any one of claims 1 to 6, wherein the plurality of the electronic components is electrically connected to a terminal formed on the circuit board and is mounted on the circuit board.

[Claim 8]

The coil module according to any one of claims 1 to 7, further comprising a sub-circuit board electrically connected to the terminal formed on the circuit board, wherein a plurality of the electronic components is electrically connected to the terminal formed on the sub-circuit board and is mounted to the circuit board via the sub-circuit board.

[Claim 9]

The coil module according to any one of claims 1 to 8, wherein the circuit board has a recess in a horizontal direction, and

the coil and the circuit board are arranged so that the recess in the circuit board and a portion of the coil overlap with each other.

[Claim 10]

An electronic device comprising the coil module according to any one of claims 1 to 9.

[Detailed Description of the Invention]

[Technical Field]

[0001]

The present invention relates to coil modules and electronic devices equipped with the coil module, and particularly to a coil module for contactless power transmission, and electronic devices equipped with the coil module.

[Background Art]

[0002]

In recent years, electronic devices such as communication devices that transmit and charge power in a non-contact manner have been developed. In order to transmit power contactless in an electronic device, it is necessary to dispose a coil module for contactless power transmission in each of the electronic devices on the power transmitting side and the electronic device on the power receiving side. For example, Patent Document 1 discloses a coil module that is equipped with a coil and a plurality of electronic components that control the power to be transmitted, on a circuit board. Also, Patent Document 2 discloses a coil module in which a circuit board that is equipped with a plurality of electronic components that control the power to be transmitted is overlapping the coil.

[Prior Art Publications]

[Patent Publications]

[0003]

Patent Document 1: Japanese unexamined patent application publication Hei 07-335443

Patent Document 2: Japanese unexamined patent application publication No. 2005-260122

[Summary of the Invention]

[Problem to be Solved by the Invention]

[0004]

Also, in recent years, electronic devices have become smaller and lighter so it is necessary to reduce the size and weight of the coil modules disposed in the electronic devices as well. However, the coil module was limited in reducing the coil diameter because of the reduced ability to transmit power when the coil diameter was reduced. For this reason, it is important to reduce the thickness of the coil module while maintaining the ability to transmit power in order to reduce the size of the coil module.

[0005]

For example, in the coil module disclosed in Patent Document 1, a coil is mounted on a circuit board; it cannot be made thinner than the combined thickness of the coil and the circuit board. Also, in the coil module disclosed in Patent Document 2, a circuit board that is equipped with a plurality of electronic components is overlapping the coil; the coil and the circuit board that is equipped with the plurality of electronic components cannot be made thinner than the combined thickness.

[0006]

The present invention was attained in consideration of the circumstances described above. It is an object of the present invention to provide a coil module that can be made thin and compact while maintaining the ability to transmit power, and an electronic device equipped with the coil module.

[Means for Solving the Problems]

[0007]

To attain the object described above, the coil module according to a first invention comprises a flat, plate-shaped coil, a circuit board that is electrically connected to the coil and is equipped with a plurality of electronic components that control power transmitted by the coil, and a flat, plate-shaped resin structure that contains a magnetic material; the coil is built in, biased to one side of the resin structure, the circuit board is arranged horizontally with respect to the coil, and at least a part of the circuit board is built into the resin structure.

[0008]

Also, in the coil module according to a second invention, a part of the coil is exposed to an exterior on the side of the resin structure, in the first invention.

[0009]

Also, in the coil module according to a third invention, the circuit board is partially exposed to an exterior on the side of the resin structure, in the first or second invention.

[0010]

Also, in the coil module according to a fourth invention, the resin structure is equipped with an opening in a region of the circuit board that is equipped with a plurality of the electronic components, in any one of the first to the third invention.

[0011]

Also, in the coil module according to a fifth invention, the resin structure comprises a seal material covering the opening, in the fourth invention.

[0012]

Also, in the coil module according to a sixth invention, the circuit board is equipped with a connector for connection with an exterior, in any one of the first to the fifth inventions.

[0013]

Also, in the coil module according to a seventh invention, a plurality of the electronic components is electrically connected to a terminal formed on the circuit board and mounted on the circuit board, in any one of the first to the sixth inventions.

[0014]

Also, in the coil module according to an eighth invention further comprises a sub-circuit board that is electrically connected to the terminal formed on the circuit board, in any one of the first through the seventh invention, and a plurality of the electronic components is electrically connected to the terminal formed on the sub-circuit board and is mounted to the circuit board via the sub-circuit board.

[0015]

Also, in a coil module according to a ninth invention, the circuit board has a recess in a horizontal direction, and the coil and the circuit board are arranged so that the recess in the circuit board and a portion of the coil overlap, in any one of the first to the eighth inventions.

[0016]

Also, the electronic device according to a tenth invention comprises a coil module according to any one of the first to the ninth inventions.

[0017]

In the first invention, in a coil module comprising a flat, plate-shaped coil, a circuit board that is equipped with a plurality of electronic components, and a flat, plate-shaped resin structure that contains a magnetic material, the coil is built-in biased to one side of the resin structure, the circuit board is arranged horizontally with respect to the coil, and at least a portion of the circuit board is built into the resin structure, and for that reason the coil module can be made thinner and more compact while maintaining an ability to ensure a necessary diameter of the coil to transmit power without overlapping the coil and the circuit board.

[0018]

In the second invention, a portion of the coil is exposed to an exterior on one side where the coil is built in biased to the resin structure, so power is efficiently transmitted by transmitting power from the one side of the resin structure where the coil is exposed.

[0019]

In the third invention, a portion of the circuit board is exposed to the exterior on a side where the coil of the resin structure is built in biased, and for that reason one side of the coil and one side of the circuit board can be arranged on the same side to make the coil module thinner and more compact.

[0020]

In the fourth invention, the resin structure is disposed with an opening in a region of the circuit board that is equipped with a plurality of electronic components so it is possible to prevent a phenomenon where solder that connects the electronic components to the circuit board is re-melted by heat thereby creating a fine gap that causes a short circuit in the electronic components (a solder flash). Also, because the plurality of electronic components are surrounded by a wall formed by an opening in the resin structure that contains the magnetic material, stable operations are possible by reducing the effects of electromagnetic waves applied to the plurality of electronic components from the coil.

[0021]

In the fifth invention, the resin structure is equipped with a seal material that covers the opening, so stable operation of the electronic components is possible by reducing the effects of electromagnetic waves from the coil applied from the opening of the resin structure onto the plurality of electronic components.

[0022]

In the sixth invention, the circuit board is equipped with a connector for connecting with an exterior, so it is easy to attach a coil module to the electronic device using the connector.

[0023]

In the seventh invention, a plurality of electronic components is electrically connected to a terminal formed on the circuit board and mounted on the circuit board, so the height of the circuit board equipped with a plurality of electronic components can be suppressed, and the coil module can be made thinner and more compact.

[0024]

The eighth invention further comprises a sub-circuit board that is electrically connected to a terminal formed on the circuit board, and because the plurality of electronic components is electrically connected to a terminal formed on a sub-circuit board and is mounted to the circuit board via the sub-circuit board, it is possible to change the constitution of the plurality of electronic components mounted to the circuit board by simply changing the sub-circuit board.

[0025]

In the ninth invention, the circuit board has a recess in the horizontal direction, and the coil and the circuit board are arranged so that the recess in the circuit board and a portion of the coil overlap, so a length of the coil and the circuit board arranged in the horizontal direction can be shortened, and the coil module can be made more compact.

[0026]

In the tenth invention, the coil module according to any one of the first to the ninth invention is equipped, so the coil module can be made thinner and more compact, the electronic device can be made thinner and more compact.

[Effect of the Invention]

[0027]

The coil module according to the present invention comprises a flat plate-shaped coil, a circuit board that is equipped with a plurality of electronic components, and a flat plate-shaped resin structure that contains a magnetic material, the coil is built-in biased to one side of the resin structure, the circuit board is arranged horizontally with respect to the coil, and at least a portion of the circuit board is built into the resin structure, and for that reason the coil module can be made thinner and more compact while maintaining an ability to ensure a necessary diameter of the coil to transmit power without overlapping the coil and the circuit board.

[Brief Description of the Drawings]

[0028]

Fig. 1 is a plan view of a coil module according to a first embodiment of the present invention;

Fig. 2 is a sectional view at A-A of the coil module depicted in Fig. 1;

Fig. 3 is a schematic view to explain a manufacturing method of the coil module pursuant to the first embodiment of the present invention;

Fig. 4 is a plan view of a constitution of a coil module according to a second embodiment of the present invention;

Fig. 5 is a sectional view at B-B of the coil module depicted in Fig. 4;

Fig. 6 is a plan view of a constitution of a coil module according to a third embodiment of the present invention;

Fig. 7 is a plan view of a constitution of a coil module according to a fourth embodiment of the present invention;

Fig. 8 is a plan view of an different constitution of a coil module according to the fourth embodiment of the present invention;

Fig. 9 is a plan view of a constitution of a coil module according to a fifth embodiment of the present invention;

and

Fig. 10 is a schematic view of a constitution of an electronic device according to a sixth embodiment of the present invention.

[Mode for Carrying Out the Invention]

[0029]

The coil module according to embodiments of the present invention and an electronic device equipped with the coil module will now be described in detail with reference to the drawings. It can go without saying that the following embodiments do not limit the invention described in the patent claims, and that not all combinations of the characteristic matters described in the embodiments are requirements of a solution.

[0030]

Also, the coil module according to the embodiments of the present invention have the coil module used in an electronic device on the power-transmitting side and the coil module used in an electronic device on the power-receiving side, but it does not matter whether the following descriptions indicate either coil module unless otherwise specified.

[0031]

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