DESCRIPTION

TITLE OF INVENTION: NON-CONTACT POWER SUPPLY SYSTEM, POWER RECEPTION APPARATUS FOR NON-CONTACT POWER SUPPLY, AND SIGNAL TRANSMISSION METHOD REGARDING START OF NON-CONTACT POWER SUPPLY BY POWER RECEPTION APPARATUS FOR NON-CONTACT POWER SUPPLY

TECHNICAL FIELD

[0001] The present invention relates to a non-contact power supply system.

BACKGROUND ART

[0002] In the related art, in a case where a power transmission device for performing non-contact power supply includes multiple transmission antennas, there is known technology capable of detecting a transmission antenna, to which a power reception apparatus is disposed to face, from among the multiple transmission antennas.

For example, Patent Literature 1 discloses a non-contact power supply system in which a rated current is supplied to primary coils of multiple non-contact power supply units arranged on a wall of a building or the like during normal power supply operation at regular time intervals to generate a high-frequency magnetic field, and it is detected whether or not a non-contact power reception unit is disposed to face the non-contact power supply unit depending on a change pattern in which the impedance when the power receiving side is viewed from the non-contact power supply unit changes. Note that the multiple non-contact power supply units disclosed in Patent Literature 1 each include a primary coil. This primary coil functions as a transmission antenna.

CITATION LIST

transmission antennas to the power transmission device when supplied with power from the power supply unit and receiving an operation instruction; and the power transmission device including: an activation signal receiving unit for receiving the activation signal transmitted from the activation signal transmitting unit; a power transmission unit for starting power supply to the multiple transmission antennas when the activation signal receiving unit receives the activation signal; and an antenna determination unit for determining a power transmission target antenna to which the power supply from the power transmission unit is to be continued among the multiple transmission antennas, in which non-contact power supply to the reception antenna of the power reception apparatus is performed with the power transmission unit supplying power to the power transmission target antenna determined by the antenna determination unit.

The power reception apparatus is composed of a household electric appliance, and includes a response transmission unit for transmitting, to the power transmission device, a response signal indicating that non-contact power supply is started, when the reception antenna receives power in response to the power transmission device starting power supply to the multiple transmission antennas, and non-contact power supply is started. The power transmission device is installed in a structure included in a building, and includes a response reception unit for receiving the response signal transmitted from the response transmission unit.

The antenna determination unit performs a process of determining the power transmission target antenna depending on the response signal when the response reception unit receives the response signal.

The response signal is a signal for causing the power transmission device to start the process of determining the power transmission target antenna from among the

multiple transmission antennas.

ADVANTAGEOUS EFFECTS OF INVENTION

[0007] According to the present invention, unnecessary radiation of electromagnetic waves from a transmission antenna can be reduced.

BRIEF DESCRIPTION OF DRAWINGS

[0008] FIG. 1 is a diagram for explaining one example of a configuration of a non-contact power supply system according to a first embodiment.

FIG. 2A is a diagram illustrating a configuration example of the entire non-contact power supply system according to the first embodiment.

FIG. 2B is a diagram illustrating a specific configuration example of a power transmission control device included in a power transmission device in the first embodiment.

FIG. 2C is a diagram illustrating a specific configuration example of a power reception apparatus in the first embodiment.

FIG. 3 is a table illustrating an example of a relationship between parameters for which a foreign matter detecting unit detects a change and foreign matters detected by a change in the parameters in the first embodiment.

FIG. 4 is a flowchart for explaining the operation of the power reception apparatus according to the first embodiment.

FIG. 5 is a diagram illustrating one example of a state in which a reception antenna is installed across transmission antennas in the first embodiment.

FIG. 6 is a flowchart for explaining the operation of the power transmission control device according to the first embodiment.

FIGS. 7A and 7B are diagrams each illustrating an exemplary hardware configuration of the power reception apparatus according to the first embodiment.

FIGS. 8A and 8B are diagrams each illustrating an exemplary hardware configuration of the power transmission control device according to the first embodiment.

FIG. 9 is a diagram for explaining a configuration example of a power transmission device and a power reception apparatus in a non-contact power supply system according to a second embodiment.

DESCRIPTION OF EMBODIMENTS

[0009] To describe the present invention further in detail, embodiments for carrying out the present invention will be described below with reference to the accompanying drawings.

First Embodiment

In the following first embodiment, as an example, it is assumed that a non-contact power supply scheme of a resonance type is employed in a non-contact power supply system. Since the technology of the resonance-type non-contact power supply scheme is existing technology, detailed description will be omitted.

In a resonance-type non-contact power supply scheme, power can be supplied from a power transmission device to a power reception apparatus even in a state in which the power reception apparatus that operates being supplied with power from the power transmission device is not installed to accurately face the power transmission device. The state in which the power reception apparatus is not installed to face the power transmission device refers to a state in which the surfaces and the centers of each of the power reception apparatus and the power transmission device do not face each

other so as to overlap.

[0010] FIG. 1 is a diagram for explaining one example of a configuration of a non-contact power supply system 1000 according to a first embodiment.

It is assumed in the first embodiment described below that the non-contact power supply system 1000 is used in a building such as a house.

A power transmission device 1 and a power reception apparatus 2 are included in the non-contact power supply system 1000.

In the non-contact power supply system 1000, the power transmission device 1 installed in a structure included in a building such as a floor or a wall of the building supplies power to the power reception apparatus 2 in a non-contact manner. In the first embodiment, as an example, the structure in which the power transmission device 1 is installed is a floor as illustrated in FIG. 1.

In the first embodiment, the power reception apparatus 2 is a household electric appliance. In FIG. 1, a television is illustrated as exemplary household electric appliance. Note that in this specification the term “household electric appliance” is not limited to electric appliances exclusively used in a general household, but also includes various electric appliances.

A user can install the power reception apparatus 2 as appropriate in an area where the power transmission device 1 can supply power. In addition, the user can remove the power reception apparatus 2 installed in the area where the power transmission device 1 can supply power to the outside of the area, or can move the power reception apparatus 2 within the area.

[0011] The power transmission device 1 includes a power transmission control device 10 and multiple transmission antennas 11, receives power supplied from a commercial power source, and supplies power to the power reception apparatus 2 installed in an area

where power can be supplied. Specifically, the power transmission control device 10 receives power and supplies high-frequency AC power (hereinafter, referred to as “high-frequency power”) to any one of the multiple transmission antennas 11. Having received supply of the high-frequency power from the power transmission control device 10, the transmission antenna 11 resonates at the same frequency as that of the high-frequency power and generates a magnetic field in a space (hereinafter, the state in which a transmission antenna 11 receives the supply of the high-frequency power and generates a magnetic field is in the space is referred to as an “activated state”.) When the power reception apparatus 2 is installed in an area where power can be supplied from the transmission antenna 11, power is supplied to a power reception device 21 included in the power reception apparatus 2 in a non-contact manner. As a result, non-contact power supply is performed from the power transmission device 1 to the power reception apparatus 2. Note that, in the following description, the multiple transmission antennas 11 are also simply referred to as transmission antennas 11.

the power.

[0035] In step ST403, the control unit 24 stands by until the power reception device 21 receives power from the power transmission control device 10 (in the case of “NO” in step ST403). When the power reception device 21 receives power from the power transmission control device 10 (in the case of “YES” in step ST403), the control unit 24 causes the power reception apparatus 2 to operate on the basis of the power received by the power reception device 21. Then, under the control of the control unit 24, the response transmission unit 2221 transmits a response signal to the communication unit 105 of the power transmission control device 10 (step ST404).

Then, the power reception apparatus 2 is driven by non-contact power supply from the power transmission device 1 (step ST405).

[0036] The control unit 24 causes the output unit 23 to output information indicating the power supply state in accordance with the power supply state from the power transmission device 1 while the power reception apparatus 2 is being driven by the non-contact power supply from the power transmission device 1.

Hereinafter, the operation in which the output unit 23 outputs information indicating the power supply state under the control of the control unit 24 will be described with a specific example.

Here, for example, assuming that the output unit 23 is an LED level meter including three LEDs (a first LED, a second LED, and a third LED), the control unit 24 controls lighting of the three LEDs on the basis of the power supply states corresponding to power measurement values.

For example, assuming that 1000 watts is ensured as the power transmitted from the power transmission device 1, the control unit 24 turns on different LEDs for each of cases where the power measurement value reaches 1000 watts (defined as a first

state), where the power measurement value is equal to or more than 500 watts and less than 1000 watts (defined as a second state), where the power measurement value is equal to or more than 200 watts and less than 500 watts (defined as a third state), and where the power measurement value is less than 200 watts (defined as a fourth state).

Specifically, the control unit 24 turns on all the first to third LEDs in the first state, turns on only the first and second LEDs in the second state, turns on only the first LED in the third state, and does not turn on any of the LEDs in the fourth state.

[0037] For example, in a case where the reception antenna 211 is installed across multiple transmission antennas 11, the power reception apparatus 2 is not supplied with the power that is ensured as the power supplied from the power transmission device 1, and thus, for example, one or two out of the first to third LEDs are lit up.

In the first embodiment, “for one reception antenna 211 to be installed across multiple transmission antennas 11” refers to a positional relationship between the one reception antenna 211 and the multiple transmission antennas 11 in which non-contact power supply can be performed from any of the multiple transmission antennas 11 to the one reception antenna 211.

FIG. 5 is a diagram illustrating one example of a state in which the reception antenna 211 is installed across transmission antennas 11 in the first embodiment.

FIG. 5 is a diagram illustrating one example in which a reception antenna **X** (211) is installed across a transmission antenna **A** (11a) and a transmission antenna **B** (11b).

As illustrated in FIG. 5, when the reception antenna 211 is installed across the transmission antennas 11, the reception antenna 211 cannot receive the power guaranteed as the power supplied from the power transmission device 1.

[0038] A user can instantly grasp the power supply status as to whether the power is

supplied or the power is being supplied but is not sufficient by looking at the lighting state of the output unit 23.

In addition, the user can grasp the relative position between the power transmission device 1 and the power reception apparatus 2 from the lighting state of the output unit 23.

For example, if the user checks the lighting state of the output unit 23 and determines that the power reception apparatus 2 is supplied with power but not sufficiently, the user moves the power reception apparatus 2 to a position where power is sufficiently supplied to.

[0039] In addition, when an error signal is transmitted from the power transmission device 1 while the power reception apparatus 2 is beng driven by power supply from the power transmission device 1 (see step ST610 in FIG. 6 described later), the error reception unit 2222 receives the error signal.

When the error signal is output from the error reception unit 2222, the control unit 24 causes the output unit 23 to output error information. Specifically, the control unit 24 causes, for example, error information indicating that a foreign matter has been detected or error information indicating that power supply has been stopped to be output. Note that the control unit 24 causes the error information to be temporarily output. It is assumed that the time when the error information is output is set in advance.

By confirming the error information, the user can grasp that a foreign matter has been detected or that power supply has been stopped.

The user confirms the error information and removes the foreign matter. Then, when the user performs the operation of turning off the switch 3 and then turning

embodiment is basically the same as the operation flow of the power reception apparatus 2 described with reference to FIG. 4 in the first embodiment, and the specific operation in the second embodiment is as follows.

In the power reception apparatus 2 according to the second embodiment, if the switch 3 is turned on from the OFF state (in the case of "YES" in step ST401), the activation signal transmitting unit 221 receives power from the power supply unit 25 and transmits an activation signal to each of the power transmission control devices 10 with the power (step ST402).

The response transmission unit 2221 transmits a response signal to a communication unit 105 of each of the power transmission control devices 10 under the control of the control unit 24 (step ST404).

Other operations have already been explained in the first embodiment, and thus redundant description is omitted.

In addition, when an error signal is transmitted from the power transmission device 1 while the power reception apparatus 2 is being driven by power supply from the power transmission device 1, the error reception unit 2222 receives the error signal.

When the error signal is output from the error reception unit 2222, the control unit 24 causes the output unit 23 to output error information. In the second embodiment, there are two types of error information that the control unit 24 outputs when error information indicating that a foreign matter has been detected is transmitted from the power transmission device 1 or when an error signal indicating that power supply has been stopped is transmitted. The specific content of the operation by the control unit 24 to cause error information to be output in the power reception apparatus 2 will be described in the description of the operation of the power transmission control device 10 with reference to FIG. 6 described later.

CLAIMS

1. A non-contact power supply system, comprising:

a power reception apparatus, including:

a reception antenna capable of receiving power from any of multiple transmission antennas included in a power transmission device in a non-contact manner;

a power supply unit; and

an activation signal transmitting unit for transmitting an activation signal for activating the multiple transmission antennas to the power transmission device when supplied with power from the power supply unit and receiving an operation instruction; and

the power transmission device, including:

an activation signal receiving unit for receiving the activation signal transmitted from the activation signal transmitting unit;

a power transmission unit for starting power supply to the multiple transmission antennas when the activation signal receiving unit receives the activation signal; and

an antenna determination unit for determining a power transmission target antenna to which the power supply from the power transmission unit is to be continued among the multiple transmission antennas,

wherein non-contact power supply to the reception antenna of the power reception apparatus is performed with the power transmission unit supplying power to the power transmission target antenna determined by the antenna determination unit,

the power reception apparatus is composed of a household electric appliance, and includes a response transmission unit for transmitting, to the power transmission device, a response signal indicating that non-contact power supply is started, when the

reception antenna receives power in response to the power transmission device starting power supply to the multiple transmission antennas, and non-contact power supply is started,

the power transmission device is installed in a structure included in a building, and includes a response reception unit for receiving the response signal transmitted from the response transmission unit,

the antenna determination unit performs a process of determining the power transmission target antenna depending on the response signal when the response reception unit receives the response signal,

the response signal is a signal for causing the power transmission device to start the process of determining the power transmission target antenna from among the multiple transmission antennas.

2. The non-contact power supply system according to claim 1, wherein

the power transmission device further includes

an antenna control unit for causing the power transmission unit to continue the power supply to the power transmission target antenna determined by the antenna determination unit and to stop the power supply to transmission antennas other than the power transmission target antenna.

3. The non-contact power supply system according to claim 1, wherein

the activation signal transmitted by the activation signal receiving unit includes information related to the power reception apparatus, and

the antenna determination unit determines the power transmission target antenna on a basis of information for specifying the power reception apparatus and a

state of power supply to the multiple transmission antennas performed by the power transmission unit when the power transmission unit starts power supply to the multiple transmission antennas.

4. The non-contact power supply system according to claim 1, wherein

the response signal transmitted by the response transmission unit includes information for identifying the power reception apparatus, and

the antenna determination unit determines the power transmission target antenna on a basis of information for specifying the power reception apparatus when the response reception unit receives the response signal transmitted from the response transmission unit.

5. The non-contact power supply system according to claim 1, wherein

the antenna determination unit determines the power transmission target antenna on a basis of a state of the power supply to the transmission antennas by the power transmission unit.

6. The non-contact power supply system according to claim 2, wherein

the power transmission device further includes

a foreign matter detecting unit for detecting a foreign matter present between the transmission antennas and the reception antenna on a basis of a state of the power supply to the power transmission target antenna while the power transmission unit is performing the power supply to the power transmission target antenna, and

the antenna control unit causes the power transmission unit to stop the power supply to the power transmission target antenna when the foreign matter detecting unit

detects the foreign matter.

7. The non-contact power supply system according to claim 2, wherein

the antenna control unit causes the power transmission unit to perform the power supply to the power transmission target antenna, and then maintains a state in which the power supply to the power transmission target antenna is continued until the activation signal is output again from the activation signal transmitting unit while maintaining a state in which the power supply to transmission antennas other than the power transmission target antenna is stopped.

8. The non-contact power supply system according to claim 1, wherein

the transmission antennas are for performing non-contact power supply to the power reception apparatus by a resonance-type non-contact power supply scheme.

9. The non-contact power supply system according to claim 1, wherein

the power transmission device further includes the activation signal receiving unit, the power transmission unit, and the antenna determination unit corresponding to each of the multiple transmission antennas.

10. A power reception apparatus for non-contact power supply, the power reception apparatus comprising:

a reception antenna capable of receiving power from any of multiple transmission antennas included in a power transmission device installed in a structure included in a building in a non-contact manner;

a power supply unit;

an activation signal transmitting unit for transmitting an activation signal for activating the multiple transmission antennas to the power transmission device when supplied with power from the power supply unit and receiving an operation instruction, and

a response transmission unit for transmitting, to the power transmission device, a response signal indicating that non-contact power supply is started, when the reception antenna receives power in response to the power transmission device starting power supply to the multiple transmission antennas, and non-contact power supply is started,

the response signal is a signal for causing the power transmission device to start the process of determining the power transmission target antenna from among the multiple transmission antennas.

11. The power reception apparatus for non-contact power supply according to claim 10, wherein

the activation signal transmitting unit outputs the activation signal when a power source switch is turned on or off.

12. A signal transmission method regarding start of non-contact power supply by a power reception apparatus composed of a household electric appliance for non-contact power supply, the method comprising:

receiving, by an activation signal transmitting unit, an operation instruction; and

transmitting, by the activation signal transmitting unit, an activation signal for activating multiple transmission antennas included in a power transmission device installed in a structure included in a building, to the transmission device when the

operation instruction is received, and

transmitting, by a response transmission unit, to the power transmission device, a response signal indicating that non-contact power supply is started, when the reception antenna receives power in response to the power transmission device starting power supply to the multiple transmission antennas, and non-contact power supply is started,

the response signal is a signal for causing the power transmission device to start the process of determining the power transmission target antenna from among the multiple transmission antennas.