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(54) CONTACTLESS POWER-SUPPLY SYSTEM, CONTACTLESS ADAPTER, AND POWER-SUPPLY DEVICE
KONTAKTLOSES ENERGIEVERSORGUNGSSYSTEM, KONTAKTLOSER ADAPTER UND LEISTUNGSVERSORGUNGSVORRICHTUNG
SYSTÈME D’ALIMENTATION ÉLECTRIQUE SANS CONTACT, ADAPTATEUR SANS CONTACT, ET DISPOSITIF D’ALIMENTATION ÉLECTRIQUE

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The present invention relates to a contactless power supply system, a contactless adapter, and a power supplying device.

In recent years, a contactless power supply that supplies power to an electrical appliance with high efficiency has become practical. Document JP 2011-151900 A describes an example of a contactless power supplying device including a primary coil embedded in a flat surface of a table. An electrical appliance incorporating a secondary coil is arranged above the primary coil so that the contactless power supplying device supplies power to the electrical appliance.

Situations greatly differ when using an electrical appliance such as a notebook computer, a tablet PC, or the like that requires a high output power supply of several watts to several tens of watts or greater on a desk. The inventors of the present invention have conducted research on electrical appliances, such as personal computers that can be supplied with a high output while performing tasks, and found a technique that keeps electrical appliances compact and easy to carry and store, while maintaining the convenience of wireless power supplying that enables the supply of a high output while ensuring compactness and portability of the electrical appliance.

A contactless power supply system of a first referential example includes a power supplying device and a notebook computer. The power supplying device includes a primary coil embedded in a corner of a desktop of a desk, for example, at one or a plurality of areas extending toward the rear. The notebook computer includes a secondary coil installed at the bottom of the computer. In the first referential example, power is not supplied to the notebook computer unless the notebook computer is placed immediately above a compact primary coil embedded in the corner of the desk. Thus, when using the notebook computer, the operator is forced to be in the same unnatural posture for a long period of time. This is not practical.

A contactless power supply system of a second referential example, a primary coil of a power supplying device is arranged at a central position of a desk. Since the position where the notebook computer can be comfortably used differs among individuals, the operator may be forced to be in the same unnatural posture for a long period of time in the second referential example as well. For example, when documents are laid out next to the notebook computer, the notebook computer cannot be moved. Thus, the operator will be forced to continue the same unnatural posture for a long period of time. This is not practical. Further, mobile equipment such as a notebook computer requires being compact. However, to receive power from a primary coil, a secondary coil needs to have an increased coil area and needs to be thicker. This imposes restrictions to miniaturization.

A contactless power supply system of a third referential example includes a contactless adapter incorporating a secondary coil that is connected to an electrical appliance, such as a personal computer or the like, by a power supplying cable. In the third referential example, a short power supplying cable is used to wire-connect the contactless adapter and the electrical appliance. Although the cable is an obstacle, the position of the electrical appliance can be changed in the vicinity of a limited power supplying space. Thus, the personal computer can be used while being charged. However, in order to supply a high output of several watts several tens of watts or greater to the electrical appliance, a secondary coil needs to have a wide area exceeding a diameter of five cm. This enlarges the contactless adapter. The large contactless adapter always needs to be carried together with the notebook computer. This adversely affects the usability of the compact notebook computer. Further, the contactless adapter needs to be connected whenever the notebook computer is used.

Document US 2012/032522 A1 discloses a wireless power transfer, methods and designs for implantable electronics and devices. Wireless energy transfer is utilized to eliminate cords and power cables puncturing the skin to power an implantable device.

Document EP 2400 629 A2 discloses an inductive charger comprising an inductive coil and a chargeable power pack. The inductive charger includes a driving circuit connectable to the power pack for providing a varying electrical potential to the inductive coil such that the inductive coil is inductively coupleable to a secondary coil wired to an electrical load. The inductive charger may further include a charging circuit for connecting the inductive coil to the power pack. When the inductive coil is inductively coupled to a primary coil, the power pack may be powered from the primary coil.

Document JP 2007 257013 A discloses a portable information processor for detachably fixing an AC adapter and a power cable on a side face of the main body of the processor. Two lines of projections for engagement 22, 23 are disposed on a side face of an AC adapter and a power cable. Two lines of projections for engagement 22, 23 are disposed on a side face of an AC adapter.

The inventors of the present invention have conducted research on electrical appliances, such as personal computers that can be supplied with a high output while performing tasks, and found a technique that keeps electrical appliances compact and easy to carry and store, while maintaining the convenience of wireless power supplying that allows high output to be supplied just by simply placing the electrical appliance, and the inventors have completed the invention of the present application.

It is an object of the present invention to provide a contactless power supply system that can increase the degree of freedom for arrangement of an electrical appliance and enable the supply of a high output while ensuring compactness and portability of the electrical appliance.

The object of the invention is defined by the features of the independent claims. Preferred embodiments are defined by the dependent claims.

Fig. 1 is a perspective view of a contactless power supply system.
A contactless power supply system according to a first embodiment of the present invention will now be described.

The contactless power supply system includes a power supplying device 10, a contactless adapter 30, and an electrical appliance such as a notebook computer 20. The contactless adapter 30 is electrically connected or magnetically coupled to the electrical appliance to supply power, in a contactless manner, from the power supplying device 10 to the electrical appliance such as a notebook computer 20. The contactless adapter 30 is electrically connected or magnetically coupled to the electrical appliance to supply power, in a contactless manner, from the power supplying device 10 to the electrical appliance such as a notebook computer 20.

As shown in Figs. 4 to 6, the contactless adapter 30 includes a plug unit 31 attached in a removable manner to a main body side surface 21 of the notebook computer 20. As shown in Fig. 4A, drive power is supplied from the power supplying device 10 to the notebook computer 20 via the contactless adapter 30.

As shown in Fig. 4A, a perspective view of a notebook computer, a contactless adapter, and the power supplying device, and Fig. 4B is a perspective view of the contactless adapter, in a contracted state, and the notebook computer. Fig. 5 is a perspective view showing the contactless adapter in a contracted state. Fig. 6 is a perspective view showing the contactless adapter in an extended state. Fig. 7 is a front view of a non-power receiving surface of a power receiving unit in a spread state. Fig. 8 is a front view of a power receiving surface of the power receiving unit in the spread state. Fig. 9 is a cross-sectional view of the power receiving unit in the spread state. Fig. 10 is a cross-sectional view of the power receiving unit in a folded state. Fig. 11 is a schematic cross-sectional view of the magnetically coupled power supplying device and the contactless adapter.

Fig. 12 is an electrical block circuit diagram of a power supply circuit unit of the contactless adapter. Fig. 13 is an electrical circuit diagram of the contactless power supply system. Fig. 14A is an equivalent circuit diagram of the magnetically coupled primary coil and the secondary coil, and Fig. 14B is an equivalent circuit diagram in which the circuit diagram of Fig. 14A is converted to the secondary side. Fig. 15 is a perspective view of a contactless adapter in a first modified example. Figs. 16A and 16B are perspective views of a contactless adapter in a second modified example. Figs. 17A and 17B are perspective views of a contactless adapter in a third modified example. Figs. 18A and 18B are perspective views of a contactless adapter in a fourth modified example. Figs. 19A and 19B are perspective views of a contactless adapter in a fifth modified example. Figs. 20A and 20B are perspective views of a contactless adapter in a sixth modified example. Figs. 21A and 21B are perspective views of a contactless adapter in a seventh modified example. Figs. 22A and 22B are perspective views of a contactless adapter in an eighth modified example. Fig. 23 is an electrical circuit diagram of a contactless adapter in a ninth modified example. Figs. 24A, 24B, and 24C are side views of a contactless adapter in a tenth modified example. Fig. 25 is a perspective view of the contactless adapter and a notebook computer in a second embodiment of a contactless power supply system. Fig. 26 is a perspective view of the contactless adapter and the notebook computer shown in Fig. 25 when the power receiving unit is in the spread state. Figs. 27A and 27B are perspective views of the power receiving unit. Fig. 28 is a schematic cross-sectional view of the magnetically coupled power supplying device and the contactless adapter. Fig. 29 is an electrical circuit diagram of the contactless power supply system in the second embodiment. Fig. 30 is a perspective view of a third embodiment of a contactless power supply system.
includes an output terminal 33 that projects from a shaft portion 32 of a tubular housing 31a, for example. When the shaft portion 32 is attached to the plug socket of the notebook computer 20, the output terminal 33 is electrically connected to a power supply input terminal of the notebook computer 20. When the shaft portion 32 is attached to the plug socket of the notebook computer 20, the housing 31a of the plug unit 31 is rotationally supported about the shaft portion 32 with respect to the notebook computer 20. As shown in Figs. 5 and 6, the plug unit 31 (housing 31a) is coupled to a power supply circuit unit 35 by a telescopic arm 34.

[0017] The sliding resistance when pivoting the shaft portion 32 with respect to the plug socket of the notebook computer 20 is set to a sliding resistance in which the plug unit 31 (contactless adapter 30) does not pivot with respect to the notebook computer 20 and such state is held unless a certain extent of force is applied. Thus, unless a force is applied in a desired direction at any pivoting position, the plug unit 31 (contactless adapter 30) is held at the pivoting position.

[0018] The telescopic arm 34 includes a plurality of (four in the first embodiment) pipes P1 to P4 and first and second universal joints J1, J2. The widest pipe P1 is coupled to the plug unit 31 (housing 31a) by the first universal joint J1 (see Fig. 4B). The narrowest pipe P4 is coupled to a housing 35a of the power supply circuit unit 35 by the second universal joint J2.

[0019] The sliding resistances between the pipes P1 to P4 are set so that the pipes are not extended nor contracted and held is the same state unless a certain extent of force is applied. In the same manner, the sliding resistance between the pipe P1 and the first universal joint J1 is set such that the pipe P1 does not swing about the first universal joint J1 and is held in the same state unless a certain extent of force is applied. A sliding resistance between the second universal joint J2 and a distal end portion of the pipe P4 is set so that the housing 35a does not swing about the second universal joint J2 and is held in the same state unless a certain extent of force is applied. Therefore, the power supply circuit unit 35 can be extended in the desired direction and held in the same state by simply extending or contracting the pipes P1 to P4 and applying a force to the power supply circuit unit 35 in the desired direction. The housing 31a of the plug unit 31 can be rotated with respect to the notebook computer 20 with the telescopic arm 34 radially extended from the housing 31a. The telescopic arm 34 serves as an example of a coupling body. Each pipe of the telescopic arm 34 is a rigid body pipe in a preferred example, but can be a flexible pipe that can be curved in another preferred example.

[0020] An insulation coated connection line L that connects the output terminal of the power supply circuit unit 35 and the output terminal 33 of the plug unit 31 is wired in the telescopic arm 34. In the preferred example, a reel is arranged in the housing 31a of the plug unit 31. The reel reeles the connection line L wired in the pipes P1 to P4 into the housing 31a of the plug unit 31 when the telescopic arm 34 is contracted. Further, the connection line L is reeled out from the housing 31a of the plug unit 31 when the telescopic arm 34 is extended.

[0021] The housing 35a of the power supply circuit unit 35 is, for example, box-shaped. The second universal joint J2 of the telescopic arm 34 is coupled to one side surface of the housing 35a. The housing 35a of the power supply circuit unit 35 is coupled to a power receiving unit 40 including a secondary coil 41 at a side surface opposite to the surface coupled to the telescopic arm 34. Therefore, the power supply circuit unit 35 (housing 35a) and the power receiving unit 40 are coupled to the plug unit 31 by the telescopic arm 34 and can be extended in the desired direction with respect to the plug unit 31 (notebook computer 20).

[0022] A circuit substrate including various types of elements that form a resonance circuit 36, a rectifying circuit 37, and a constant voltage stabilizing circuit 38 shown in Fig. 12 is incorporated in the housing 35a of the power supply circuit unit 35. The resonance circuit 36, the rectifying circuit 37, and the constant voltage stabilizing circuit 38 in the power supply circuit unit 35 convert an induced electromotive force generated at the secondary coil 41 of the power receiving unit 40 to a desired direct current (DC) voltage and supplies the converted output voltage to the output terminal 33 of the plug unit 31 via the connection line L.

[0023] In the illustrated example, a display lamp LP is arranged on an outer side surface of the housing 35a of the power supply circuit unit 35. The display lamp LP displays a magnetically coupled state of the secondary coil 41 of the power receiving unit 40 and the primary coil 11 of the power supplying device 10. For example, the lamp LP is illuminated with a brightness corresponding to the coupled state. In the first embodiment, the brightness of the display lamp LP changes according to the value of the DC voltage rectified by the rectifying circuit 37 shown in Fig. 12. When the display lamp LP is the brightest, this means that the magnetically coupled state of the secondary coil 41 of the power receiving unit 40 and the primary coil 11 of the power supplying device 10 is in the best state. When the display lamp LP is not illuminated, this means that the secondary coil 41 and the primary coil 11 are not magnetically coupled or high frequency current is not supplied to the primary coil 11.

[0024] To control the indication of the display lamp LP, secondary current I2 (see Fig. 14) flowing to the secondary coil 41 may be detected, and the indication of the display lamp LP may be controlled based on the current value. A magnetic sensor such as a Hall element or the like may be arranged in the power receiving unit 40, and the indication of the display lamp LP may be controlled based on the detection result of the magnetic sensor.

[0025] As shown in Figs. 5 and 6, the power receiving unit 40 includes a fixed substrate 42 and a pivot substrate 43. The fixed substrate 42 is a rectangular plate made from a material having an electromagnetic shield property such as aluminum, copper, or the like. One short side surface of the fixed substrate 42 is coupled to a side surface of the power
supply circuit unit 35 (housing 35a). The pivot substrate 43 is made from the same material and has the same shape as the fixed substrate 42. As shown in Figs. 6 and 7, the pivot substrate 43 is coupled to the fixed substrate 42 by a hinge 44. In this example, the pivot substrate 43 pivots between two positions, a folded position (Fig. 5) where the pivot substrate 43 overlaps the fixed substrate 42 and a spread position (Fig. 6) where the pivot substrate 43 is arranged side by side with the fixed substrate 42. The hinge 44 is arranged on the long side, for example, of the fixed substrate 42 and the pivot substrate 43.

In the preferred example, the sliding resistance of when the hinge 44 pivots is set to the sliding resistance at which the pivot substrate 43 does not pivot with respect to the fixed substrate 42 and is held in the same state unless a certain extent of force is applied. Thus, the pivot substrate 43 is held at the same pivoting position unless force is applied in the desired direction at any pivoting position between the two positions, the folded position and the spread position.

In the fixed substrate 42 and the pivot substrate 43, surfaces that face each other when folded are referred to as non-power receiving surfaces 42a, 43a and surfaces that do not face each other are referred to as power receiving surfaces 42b, 43b.

As shown in Figs. 8 to 10, magnetic bodies 45 having the same shape and formed from silicon steel plates, ferrite cores, or the like are attached to the power receiving surfaces 42b, 43b of the fixed substrate 42 and the pivot substrate 43. Secondary coils 41 having the same shape and the same number of windings are each attached to the surface of one of the magnetic bodies 45. The magnetic bodies 45 and the secondary coils 41 attached to the power receiving surfaces 42b, 43b of the fixed substrate 42 and the pivot substrate 43 are covered with a protective film (not shown) made of synthetic resin. The surface of the protective film is formed to become the power receiving surfaces 42b, 43b of the pivot substrate 43.

When the pivot substrate 43 is at the spread position, the protective film of the fixed substrate 42 (coil surface of the secondary coil 41) and the protective film of the pivot substrate 43 (coil surface of the secondary coil 41) are flush with each other. The fixed substrate 42 and the pivot substrate 43 serve as an example of a substrate segment.

A starting end and a terminating end of the secondary coil 41 arranged on the fixed substrate 42 and the pivot substrate 43 are guided into the housing 35a of the power supply circuit unit 35. The secondary coils 41 of the fixed substrate 42 and the pivot substrate 43 are connected in series.

With the pivot substrate 43 in the spread position, the center position of the surface formed by arranging the fixed substrate 42 and the pivot substrate 43 side by side as shown in Fig. 8 is aligned with the marker 3 indicated on the surface of the desktop 2. As shown in Fig. 11, the magnetic flux of the primary coil 11 interlinks with the secondary coil 41, that is, the primary coil 11 and the secondary coil 41 are in the magnetically coupled state. The secondary coils 41 of the fixed substrate 42 and the pivot substrate 43 are supplied with the high frequency current to interlink with the alternating magnetic field generated from the primary coil 11 to generate the induced electromotive force.

Therefore, as shown in Fig. 1, when the notebook computer 20 is placed on the desk 1, the power supply circuit unit 35 and the power receiving unit 40 of the contactless adapter 30 attached to the notebook computer 20 are extended to the position of any marker 3 indicated on the desktop 2. Then, as shown in Fig. 4, the pivot substrate 43 of the power receiving unit 40 is spread out, and the center position when spread is aligned with the marker 3. Thus, the induced electromotive force generated by the power receiving unit 40 is input as a drive power to the notebook computer 20 through the power supply circuit unit 35. Therefore, the notebook computer 20 can receive power from the power supply device 10 by using the contactless adapter 30 even if spaced apart from the power supply device 10.

An electrical configuration of the contactless power supply system will now be described according to Fig. 13.

As shown in Fig. 13, the power supply device 10, which is connected to a commercial alternating current (AC) power supply 50, includes a power supply circuit 51, which converts AC voltage to DC power, and the high frequency inverter 12, which generates a high frequency current flowing through the primary coil 11 based on the DC power from the power supply circuit 51.

The power supply circuit 51 includes a rectifying circuit 52 and a smoothing capacitor 53. The rectifying circuit 52, which is connected to a power supply such as the commercial AC power supply 50, full-wave-rectifies the AC voltage, converts AC voltage to DC voltage, and outputs the DC voltage to the smoothing capacitor 53. The smoothing capacitor 53 smoothens the waveform of the DC voltage rectified by the rectifying circuit 52 and applies the DC voltage to the high frequency inverter 12 as DC power.

The high frequency inverter 12 is a half bridge type partial resonance circuit, and includes a voltage dividing circuit, in which a first capacitor 55a and a second capacitor 55b are connected in series between the terminals of the smoothing capacitor 53.

A drive circuit, which is a series circuit in which a first power transistor Q1 and a second power transistor Q2 are connected in series, is connected in parallel to the voltage dividing circuit. The first power transistor Q1 and the second power transistor Q2 are MOSFETs in the first embodiment, with flywheel diodes D1, D2 are connected between the source and the drain.

A series circuit of the primary coil 11 and a resonance series capacitor is connected between a connecting
A resonance parallel capacitor 57 is connected in parallel with respect to the series circuit of the primary coil 11 and the series capacitor 56.

A drive signal is provided to each gate terminal of the first power transistor Q1 and the second power transistor Q2 from an excitation synchronization signal generation circuit (not shown). The drive signal provided to each gate terminal of the first and second power transistors Q1, Q2 is a complementary signal. Thus, the first power transistor Q1 and the second power transistor Q2 are alternately activated and deactivated in a complementary manner. High frequency current thus flows to the primary coil 11. The primary coil 11 generates the alternating magnetic field with the high frequency current.

The high frequency inverter 12 is a half bridge type in the first embodiment, but may be a full bridge type in another example.

The contactless adapter 30 includes the secondary coil 41, the resonance circuit 36, the rectifying circuit 37, and the constant voltage stabilizing circuit 38. The secondary coil 41 is arranged in the power receiving unit 40. The resonance circuit 36, the rectifying circuit 37, and the constant voltage stabilizing circuit 38 are arranged in the power supply circuit unit 35.

The secondary coil 41 of the fixed substrate 42 and the secondary coil 41 of the pivot substrate 43 are connected in series. In this case, the secondary coils 41 are connected in series to add the induced electromotive force generated at the secondary coil 41 of the fixed substrate 42 and the induced electromotive force generated at the secondary coil 41 of the pivot substrate 43 that are based on the alternating magnetic field from the primary coil 11. The series circuit of the two secondary coils 41 is connected in series with a resonance capacitor 36a of the resonance circuit 36, and the induced electromotive force in which the induced electromotive forces of the two secondary coils 41 are added is output to the rectifying circuit 37 via the resonance circuit 36.

The rectifying circuit 37 is a full-wave rectifying circuit 37a including a diode bridge circuit. The full-wave rectifying circuit 37a full-wave-rectifies the induced electromotive force supplied through the resonance circuit 36 and outputs the rectified DC voltage to the constant voltage stabilizing circuit 38.

The constant voltage stabilizing circuit 38 converts the DC voltage from the full-wave rectifying circuit 37a to a rated DC voltage for driving the notebook computer 20, and supplies the converted voltage to a load 22 of the notebook computer 20 through the connection line L and the output terminal 33. The notebook computer 20 can thus be used with the power supplied from the power supplying device 10.

A circuit representing the electromagnetic induction by the magnetic coupling of the primary coil 11 and the secondary coil 41 is extracted from the electrical circuit of Fig. 13 and shown in Fig. 14A.

In Fig. 14A, input voltage between the terminals of the primary coil 11 is represented by V1 and a primary current flowing to the primary coil 11 is represented by I1. Furthermore, when an output voltage between the terminals of the secondary coil 41 is V2, and a secondary current flowing to the secondary coil 41 is I2, equations (1), (2), and (3) are satisfied.

Here, L1 is self-inductance of the primary coil 11, L2 is self-inductance of the secondary coil 41, M is mutual inductance, and K is a coupling coefficient.
Using equations (1) and (3), equation (2) can be transformed to equation (4). Equation (4) can be further transformed to equation (5).

\[ V_2 = K \cdot \sqrt{\frac{L_2}{L_1}} \cdot V_1 - L_2 \left(1 - K^2\right) \frac{dI_2}{dt} \]  

\[ V_2 = E_2 - L_{02} \cdot \frac{dI_2}{dt} \]

\[ E_2 = K \cdot \sqrt{\frac{L_2}{L_1}} \cdot V_1 \quad L_{02} = L_2 \left(1 - K^2\right) \]

A first term of equation (5) indicates a secondary inductive voltage (induced electromotive force) \(E_2\) when the input side is viewed from the output side (secondary coil 41). A second term of equation (5) indicates a secondary conversion equivalent leakage inductance \(L_{02}\) connected in series with the secondary inductive voltage (induced electromotive force) \(E_2\) when the input side is viewed from the output side (secondary coil 41).

According to equation (5), the circuit of Fig. 14A can be represented as a secondary side converted simple equivalent circuit shown in Fig. 14B.

If the input voltage \(V_1\) between the terminals of the primary coil 11 can be controlled to be constant, the secondary inductive voltage (induced electromotive force) \(E_2\) also becomes constant. The equivalent leakage inductance \(L_{02}\) is alternating impedance on a line, where it is apparent that voltage drop occurs due to the flowing secondary current \(I_2\).

In this case, on the output terminal side of the secondary coil 41, power is supplied to the load 22 through the resonance circuit 36, the rectifying circuit 37, and the constant voltage stabilizing circuit 38. However, the relationship of the input voltage \(V_1\), the output voltage \(V_2\), and the secondary current \(I_2\) follows equation (4) regardless of the type of circuit and load connected to the output side of the secondary coil 41.

For example, when holding the input voltage \(V_1\) as a high frequency voltage having a constant amplitude of a sine wave or a square wave, if the relative position of the secondary coil 41 is changed with respect to the primary coil 11, the output voltage \(V_2\) causes the secondary inductive voltage (induced electromotive force) \(E_2\) and the equivalent leakage inductance \(L_{02}\) to change due to the change in the coupling coefficient \(K\) indicating the extent of the magnetic coupling degree of the primary coil 11 and the secondary coil 41. The secondary current \(I_2\) flows due to the secondary coil output side circuit and the load. The secondary current \(I_2\) causes a voltage drop in the equivalent leakage inductance \(L_{02}\).

In the first embodiment, when the positional relationship of the secondary coil 41 changes depending on each situation with respect to the primary coil 11. Thus, the value of the output voltage \(V_2\) differs when there is no load and when there is a load. This changes the supply voltage to the load (\(L_1\) and \(L_2\) also slightly change).

Therefore, in the first embodiment, even if the power receiving voltage or the power receivable power is changed, the secondary coil 41 needs to be used by facing the primary coil 11 within a range that entirely covers the range from no load (standby) to the maximum load of the notebook computer 20.

The operation of the contactless power supply system will now be described.

As shown in Fig. 1, the notebook computer 20 is placed on the desk 1 (desktop 2) spaced apart from the power supplying device 10. The contactless adapter 30 is attached to the main body side surface 21 of the notebook computer 20. As shown in Fig. 1, the housing 31a of the plug unit 31 of the contactless adapter 30, the contracted telescopic arm 34, the housing 35a of the power supply circuit unit 35, and the power receiving unit 40 in which the fixed substrate 42 and the pivot substrate 43 are in the folded state are arranged along the main body side surface 21 of the notebook computer 20.

From this state, the housing 31a of the plug unit 31 is rotated with respect to the notebook computer 20 to direct
the telescopic arm 34, the housing 35a of the power supply circuit unit 35, and the power receiving unit 40 toward the power supplying device 10 (marker 3 indicated on the desktop 2) located at the rear in order to receive power from the power supplying device 10 at the separated location.

[0060] The telescopic arm 34 is extended so that the housing 35a of the power supply circuit unit 35 and the power receiving unit 40 reach the vicinity of the marker 3. In this case, the first universal joint J1 that couples the basal end of the telescopic arm 34 (pipe P1) and the housing 31a of the plug unit 31 enables the angle between the telescopic arm 34 and the notebook computer 20 to be changed within a plane along the desktop 2. In the preferred example, the housing 35a of the power supply circuit unit 35 and the power receiving unit 40 can be drawn out in a target direction, for example, toward the position indicated by the marker 3 by slightly moving the notebook computer 20 or having no need to move the notebook computer 20 at all. After the housing 35a of the power supply circuit unit 35 and the power receiving unit 40 are drawn to an approximate position, the pivot substrate 43 is pivoted with respect to the fixed substrate 42 to have the power receiving unit 40 in the spread state.

[0061] As shown in Fig. 4, the center position of the fixed substrate 42 and the pivot substrate 43 in the spread state is aligned with the marker 3 indicated on the desktop 2. Preferably, the power receiving unit 40 is aligned so that the display lamp LP becomes the brightest. The telescopic arm 34 (pipes P1 to P4 and first and second universal joints J1, J2) that allows fine tuning enables accurate alignment of the power receiving unit 40. In the preferred example, the secondary coil 41 of the power receiving unit 40 can be adjusted to the optimum magnetically coupled state with respect to the primary coil 11 by slightly moving the notebook computer 20 or having no need to move the notebook computer 20 at all.

[0062] The secondary coils 41 of the fixed substrate 42 and the pivot substrate 43 of the power receiving unit 40 interlink with the alternating magnetic field generated at the primary coil 11 of the power supplying device 10 and generate induced electromotive force. The power supply circuit unit 35 converts the induced electromotive force to a predetermined DC voltage and supplies the DC voltage from the output terminal 33 of the plug unit 31 to the notebook computer 20 as drive power through the connection line L wired in the telescopic arm 34. Thus, the notebook computer 20 is driven when receiving the DC power from the contactless adapter 30. The plug unit 31 including the output terminal 33 serves as an example of an output unit.

[0063] The first embodiment has the following advantages.

1) In the first embodiment, the notebook computer 20 receives power from the power supplying device 10 with the contactless adapter 30 attached to the notebook computer 20 even if the notebook computer 20 is spaced apart from the power supplying device 10. This increases the degree of freedom for the position where the notebook computer 20 may be placed on the desk 1.

2) In the first embodiment, the power receiving unit 40 includes the secondary coil 41 in each of the fixed substrate 42 and the pivot substrate 43. The hinge 44 couples the fixed substrate 42 and the pivot substrate 43 so pivoting can be performed between the folded position and the spread position. When the pivot substrate 43 is spread to the spread position with respect to the fixed substrate 42, the secondary coil 41 of the fixed substrate 42 is flush with the secondary coil 41 of the pivot substrate 43. This enlarges the area of the coil surface of the secondary coils 41 of the power receiving unit 40 facing the coil surface of the primary coil 11, that is, the area of the coil surface configured by the secondary coil 41 of the fixed substrate 42 and the secondary coil 41 of the pivot substrate 43. Therefore, induced electromotive force of a high output is obtained from the alternating magnetic field of the primary coil 11 of the power supplying device 10.

3) In the first embodiment, the marker 3 indicating the arrangement position of the primary coil 11 accommodated in the desktop 2 is indicated on the desktop 2 of the desk 1. Therefore, alignment can be performed with the center of the primary coil 11 of the power supplying device 10 by simply aligning the center positions of the fixed substrate 42 and the pivot substrate 43 in the spread position with the marker 3 so that power is supplied with high efficiency. Furthermore, the highly accurate magnetic coupling of the secondary coils 41 with respect to the primary coil 11 is easy to visually recognize due to the illumination of the display lamp LP in the housing 35a of the power supply circuit unit 35. Thus, power can be supplied with high efficiency.

4) In the first embodiment, the pivot substrate 43 is folded to the folded position with respect to the fixed substrate 42 so that the secondary coil 41 of the fixed substrate 42 is overlapped with the secondary coil 41 of the pivot substrate 43. This reduces the area of the coil surface of the secondary coils 41 of the power receiving unit 40 as a whole. Thus, the overall size of the power receiving unit 40 becomes compact when not in use.

5) In the first embodiment, the contactless adapter 30 is attached to the main body side surface 21 of the notebook computer 20. The housing 31a of the plug unit 31 of the contactless adapter 30, the contracted telescopic arm 34, the housing 35a of the power supply circuit unit 35, and the power receiving unit 40, in which the fixed substrate 42 and the pivot substrate 43 are in the folded state, are arranged along the main body side surface 21 of the notebook computer 20. Therefore, the contactless adapter 30 is compact when attached to the notebook computer 20, and the notebook computer 20 may be carried with the contactless adapter 30 attached thereto without the portability...
Therefore, the angle of the coil surface of the secondary coil 41 can be adjusted relative to the coil surface of
the primary coil 11 of the power supplying device 10, and the relative angle at which power can be received most
effectively is always ensured.

In the first embodiment, the magnetic body 13 is arranged on the lower side of the coil surface of the primary
coil 11. This reduces magnetic flux that leaks to open space. Furthermore, the electromagnetic shield plate 14 is
fixed to the lower side of the magnetic body 13. This blocks electromagnetic waves radiated toward the outer side.

In the first embodiment, the magnetic body 45 is arranged on the power receiving surfaces 42b, 43b of the fixed
substrate 42 and the pivot substrate 43, and the secondary coil 41 is arranged on each surface of the magnetic
body 45. This reduces magnetic flux that leaks to open space. Furthermore, the fixed substrate 42 and the pivot
substrate 43 have electromagnetic shielding properties and block electromagnetic waves radiated toward the outer
side.

In the first embodiment, the hinge 44 that couples the fixed substrate 42 and the pivot substrate 43 is set to have
a sliding resistance so that the pivot substrate 43 is not pivoted with respect to the fixed substrate 42 and held in
the same state unless a certain extent of force is applied.

In the first embodiment, the configuration where the magnetic body 45 is arranged on the power receiving
surfaces 42b, 43b of the fixed substrate 42 and the pivot substrate 43 is set to have a sliding resistance so that
the pivot substrate 43 is not pivoted with respect to the fixed substrate 42 and held in the same state unless a
certain extent of force is applied.

In the first embodiment, the fixed substrate 42 and the pivot substrate 43 are rectangular but do not have to be so.
For example, the fixed substrate 42 and the pivot substrate 43 may have different diameters, and the widest tubular substrate 61 is fixed to the power supply circuit unit 35. The second

In the first embodiment, the fixed substrate 42 and the pivot substrate 43 are set to have
a sliding resistance so that the pivot substrate 43 is not pivoted with respect to the fixed substrate 42 and held in
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substrate 42 and the pivot substrate 43, and the secondary coil 41 is arranged on each surface of the magnetic
body 45. This reduces magnetic flux that leaks to open space. Furthermore, the fixed substrate 42 and the pivot
substrate 43 have electromagnetic shielding properties and block electromagnetic waves radiated toward the outer
side.

In the first embodiment, the hinge 44 that couples the fixed substrate 42 and the pivot substrate 43 is set to have
a sliding resistance so that the pivot substrate 43 is not pivoted with respect to the fixed substrate 42 and held in
the same state unless a certain extent of force is applied.
widest tubular substrate 61 is arranged in the widest tubular substrate 61, and the narrowest tubular substrate 61 is incorporated in the second widest tubular substrate 61. The power receiving unit 40 thus has an extensible structure. Preferably, each tubular substrate 61 has a cylindrical shape.

When in use, the second widest tubular substrate 61 and the narrowest tubular substrate 61 are extended to the spread state. When not in use, the narrowest tubular substrate 61 is arranged in the second widest tubular substrate 61, and the second widest tubular substrate 61 is arranged in the widest tubular substrate 61 so that the power receiving unit 40 is compact, as shown in Fig. 19B. Each tubular substrate 61 is another example of a substrate segment.

In the first embodiment, the contactless adapter 30 is attached to the main body side surface 21 of the notebook computer 20. In the example shown in Figs. 20A and 20B, an accommodation compartment 21a is provided in the main body side surface 21 of the notebook computer 20. The contactless adapter 30 is accommodated in the accommodation compartment 21a when not in use as shown in Fig. 20A. The contactless adapter 30 is pulled out from the accommodation compartment 21a when used as shown in Fig. 20B.

In this case, the power supply circuit unit 35 and the power receiving unit 40 may have the same configuration as the first embodiment, and the telescopic arm 34 is omitted. The insulation coated connection line L is pulled out from the power supply circuit unit 35, and the distal end of the connection line L that is pulled out is connected to a power supply input terminal of the notebook computer 20 arranged in the main body of the notebook computer 20 as an output terminal.

A cord reel is arranged in the accommodation compartment 21a. When the power supply circuit unit 35 and the power receiving unit 40 are accommodated in the accommodation compartment 21a, the insulation coated connection line L is reeled into the accommodation compartment 21a by the cord reel.

When drawing the power supply circuit unit 35 and the power receiving unit 40 out of the accommodation compartment 21a, the insulation coated connection line L is reeled out from the accommodation compartment 21a by the cord reel, and pulled out together with the power supply circuit unit 35 and the power receiving unit 40. In this case, when the connection line L is no longer pulled, the cord reel holds the connection line L in the same state even if tension is released. In such a state, the contactless adapter 30 can be supplied with power from the power supplying device 10 at a position spaced apart from the notebook computer 20.

When stopping the supply of power, tension is applied to the connection line L and then immediately released so that the cord reel reels in the connection line L. This accommodates the connection line L in the accommodation compartment 21a together with the power supply circuit unit 35 and the power receiving unit 40.

Therefore, when not in use, the contactless adapter 30 is completely accommodated in accommodation compartment 21a, as shown in Fig. 20A. This further improves the portability of the notebook computer 20.

In the first embodiment, the contactless adapter 30 receives power from the power supplying device 10 and supplies the power to the notebook computer 20 in a contactless manner. As shown in Figs. 21A and 21B, a first plug outlet S1 is provided in the housing 31a of the plug unit 31, and a second plug outlet S2 is provided in the housing 35a of the power supply circuit unit 35.

As shown in Fig. 21A, a plug PL1 of an AC adapter 65 that rectifies AC voltage of the commercial AC power supply 50 and converts the AC voltage to DC voltage of a predetermined value is inserted to the first plug outlet S1 to electrically connect a terminal of the plug PL1 of the AC adapter 65 to the output terminal 33 of the plug unit 31. This supplies DC voltage from the AC adapter 65 to the notebook computer 20.

A cord 66 shown in Fig. 21B has a household plug P2 inserted to a home socket on one end and an output side plug PL3 inserted to the second plug outlet S2 on the other end. The household plug PL2 is inserted to the home socket, and the output side plug PL3 is inserted to the second plug outlet S2.

This electrically connects the terminal of the output side plug PL3 to between the input terminals of the full-wave rectifying circuit 37a of the power supply circuit unit 35. At this time, the series circuit of the secondary coil 41 and the resonance capacitor 36a is insulated from the full-wave rectifying circuit 37a.

Therefore, the AC voltage of the commercial AC power supply 50 is rectified by the full-wave rectifying circuit 37a and converted to the DC voltage, and then supplied to the notebook computer 20 via the constant voltage stabilizing circuit.

The AC voltage of the AC power supply 50 is directly rectified by the full-wave rectifying circuit 37a of the power supply circuit unit 35. However, a dedicated rectifying circuit for rectifying the AC voltage may be arranged on the power supply circuit unit 35.

Thus, the contactless adapter 30 is applicable to various power supplies, and the notebook computer 20 to which the contactless adapter 30 is attached has more options for the power that can be obtained. In addition, portability is further improved. The plug PL1 and the plug PL3 serve as input terminals.

The contactless adapter 30 shown in Figs. 21A and 21B includes the first and second plug outlets S1, S2, but may include only either one of them.

In the first embodiment, the telescopic arm 34 is arranged between the plug unit 31 and the power supply circuit unit 35. The telescopic arm 34 may be omitted, and the plug unit 31 and the power supply circuit unit 35 may be directly
coupled, as shown in Figs. 22A and 22B. The power receiving unit 40 shown in Fig. 22B has the entire non-power receiving surface of the fixed substrate 42 securely attached to a wide outer side surface of the housing 35a of the power supply circuit unit 35. The pivot substrate 43 is coupled to the fixed substrate 42 by the hinge 44.

In the first embodiment, the secondary coil 41 arranged in the fixed substrate 42 and the secondary coil 41 arranged in the pivot substrate 43 are connected in series, and one resonance capacitor 36a is connected in series to the series circuit. The series circuit including the two secondary coils 41 and one resonance capacitor 36a is connected to one full-wave rectifying circuit 37a, and the induced electromotive forces generated from the two secondary coils 41 are input to the full-wave rectifying circuit 37a. As shown in Fig. 23, the resonance capacitor 36a and the full-wave rectifying circuit 37a may be provided for each secondary coil 41.

For example, the resonance capacitor 36a is connected in series to each secondary coil 41. The series circuit including one secondary coil 41 and one resonance capacitor 36a is connected to each full-wave rectifying circuit 37a. The induced electromotive force generated from the corresponding one secondary coil 41 is input to each full-wave rectifying circuit 37a. Each full-wave rectifying circuit 37a outputs the DC voltage obtained by rectifying the induced electromotive force generated by the respective secondary coil 41 to one constant voltage stabilizing circuit 38.

In the contactless adapter 30 shown in Figs. 16 to 19, the secondary coils 41 may be connected in series, and one resonance capacitor 36a and one full-wave rectifying circuit 37a may be provided for the series circuit like in the first embodiment.

In the first embodiment, the contactless adapter 30 is directly attached in a removable manner to the main body side surface 21 of the notebook computer 20. If the contactless adapter 30 is accommodated in a dedicated case like a tablet PC, which serves as an electrical appliance, the contactless adapter 30 may be attached in a removable manner to the main body side surface of the tablet PC through the dedicated case.

For example, as shown in Figs. 24A to 24C, a tablet PC 70 is accommodated in a case 71. An accommodation recess 72 having a size allowing the contactless adapter 30 to be connected is cut out from the case 71 at a side surface facing the side surface where the plug socket (outlet) of the tablet PC 70 is formed. A through-hole (not shown) extends through the inner side surface of the accommodation recess 72 at a position facing the plug socket of the tablet PC 70.

A long shaft portion 32 formed in the plug unit 31 of the contactless adapter 30 is inserted to the through-hole, and attached to the plug socket of the tablet PC 70. This arranges the contactless adapter 30 in the accommodation recess 72 formed in the side surface of the case 71, as shown in Fig. 24A.

Therefore, when not in use, the contactless adapter 30 is integrated with the case 71 and is not an obstacle when carried. Furthermore, even if the tablet PC 70 is held upright as shown in Fig. 24B, the contactless adapter 30 is held in the accommodation recess 72 and is not an obstacle.

When placing the tablet PC 70 upright and using the tablet PC 70 while receiving power, as shown in Fig. 24C, the telescopic arm 34 is extended so that the secondary coil 41 of the power receiving unit 40 faces the primary coil 11 of the power supplying device 10. The tablet PC 70 can thus be used while receiving power from the power supplying device 10.

In the first embodiment, the resonance circuit 36 including the resonance capacitor 36a is arranged in the power supply circuit unit 35. However, the resonance circuit 36 may be omitted when the voltage at the power supplying device 10 is high or when the voltage output to the load 22 is small.

In the first embodiment, the resonance circuit 36, the rectifying circuit 37, and the constant voltage stabilizing circuit 38 are arranged in the housing 35a of the power supply circuit unit 35. However, such circuits may be incorporated in the housing 31a of the plug unit 31. In this case, the housing 35a of the power supply circuit unit 35 functions as a supporting structure of the power receiving unit 40.

The display lamp LP may be arranged on either one of the housing 31a of the plug unit 31 or the housing 35a of the power supply circuit unit 35.

In the first embodiment, the power supplying device 10 (primary coil 11) is arranged at three areas, left, right, and central positions, toward the rear of the desktop of the desk 1. The contactless adapter 30 is arranged such that the secondary coil 41 faces one primary coil 11 to receive power from the power supplying device 10. For example, a plurality of primary coils 11 may be arranged in an array extending in a lateral direction at the rear side of the desktop 2 of the desk 1, and the secondary coil 41 of the contactless adapter 30 may face and extend across the plurality of primary coils 11. In this case, the contactless adapter 30 can receive greater power from the power supplying device 10 of the plurality of primary coils 11 through the secondary coil 41.

A second embodiment of the contactless power supply system will now be described. The feature of the second embodiment is in the power receiving unit 40 of the contactless adapter 30. The feature will be described in detail, and parts that are the same as the first embodiment will not be described.
As shown in Figs. 25 and 26, the power receiving unit 40 arranged on the other side surface of the housing 35a of the power supply circuit unit 35 includes a film substrate 75 serving as a flexible substrate. The film substrate 75 is a film made of synthetic resin and changes shapes between a planar form when spread as shown in Fig. 27A and a cylindrical form when rolled as shown in Fig. 27B.

The film substrate 75 has a rectangular shape in the spread state. One long side is coupled to a side surface of the housing 35a of the power supply circuit unit 35. The film substrate 75 is coupled so that when the film substrate 75 is spread in the planar form, one side surface (power receiving surface 75a) of the film substrate 75 is flush with the side surface of the housing 35a of the power supply circuit unit 35.

When the film substrate 75 is spread in the planar form, the length in the spread direction is set to be the same as the fixed substrate 42 and the pivot substrate 43 spread out in the first embodiment. Furthermore, when the film substrate 75 is spread in the planar form, the length in the direction orthogonal to the spread direction coincides with the length of the fixed substrate 42 and the pivot substrate 43 in the first embodiment.

As shown in Fig. 27A, an electromagnetic shield seal 76 such as aluminum foil or the like is formed on a power receiving surface 75a of the film substrate 75, and a magnetic body film 77 including an amorphous thin film or the like is formed on the electromagnetic shield seal 76. The secondary coil 41 in which a copper wire is configured by a print pattern is formed on the surface of the magnetic body film 77. The electromagnetic shield seal 76, the magnetic body film 77, and the secondary coil 41 can change shapes with the film substrate 75 to a planar form when spread or a cylindrical form when rolled. The changing of shapes does not cause breakage, disconnection, or the like.

The film substrate 75 is normally in the spread state, and is rolled to a cylindrical form. When released from the state rolled into the cylindrical form, the film substrate 75 is automatically spread due to its resiliency. Therefore, in order to hold the film substrate 75 rolled into the cylindrical form, the film substrate 75 includes hook-and-loop fasteners 78a, 78b respectively arranged at predetermined positions shown in Figs. 27A and 27B of the power receiving surface 75a and a non-power receiving surface 75b.

Therefore, by combining the hook-and-loop fasteners 78a, 78b with the film substrate 75 rolled to the cylindrical form, the film substrate 75 is held rolled into the cylindrical form without being spread by its resiliency due to the coupling force of the hook-and-loop fasteners 78a, 78b.

The force coupling the hook-and-loop fasteners 78a, 78b is eliminated by pulling the hook-and-loop fasteners 78a, 78b away from each other. This allows the film substrate 75 to be easily spread by its resiliency.

One secondary coil 41 is formed in the power receiving surface 75a of the film substrate 75 on the electromagnetic shield seal 76 and the magnetic body film 77. This differs from the first embodiment in which the secondary coil 41 is formed on each of the fixed substrate 42 and the pivot substrate 43. The coil shape of the secondary coil 41 formed on the film substrate 75 is rectangular in shape like the film substrate 75 in the spread state, and the coil area becomes greater than the total coil area of the secondary coils 41 of the fixed substrate 42 and the pivot substrate 43 in the first embodiment.

Therefore, when the film substrate 75 is in the spread state, the center position of the film substrate 75 is positioned on the marker 3 indicated on the desktop 2. The primary coil 11 and the secondary coil 41 are thus in a magnetically coupled state in which the magnetic flux of the primary coil 11 interlinks with the secondary coil 41 as shown in the schematic diagram of Fig. 28.

The secondary coil 41 of the film substrate 75 interlinks with the alternating magnetic field generated by the primary coil 11, through which high frequency current flows, to generate the induced electromotive force.

The telescopic arm 34 is omitted from between the housing 35a of the power supply circuit unit 35, to which the film substrate 75 is attached, and the housing 31a of the plug unit 31. Therefore, the insulation coated connection line L connecting the power supply circuit unit 35 (constant voltage stabilizing circuit 38) and the plug unit 31 (output terminal 33) is reeled by the cord reel in the housing 31a of the plug unit 31. That is, when not in use, the connection line L is reeled into the housing 31a of the plug unit 31 and the plug unit 31 is automatically spread due to its resiliency. Therefore, in

When the power supply circuit unit 35 is pulled away from the plug unit 31, the insulation coated connection line L is reeled out of the housing 31a of the plug unit 31 by the cord reeling/re-reeling mechanism, and the power supply circuit unit 35 and the power receiving unit 40 are arranged at the desired positions. In this case, when the connection line L is no longer pulled, the cord reel remains in the same state and does not reel in the connection line L even if tension is released. Therefore, the power receiving unit 40 can face the primary coil 11 at the position spaced apart from the notebook computer 20, and power can be supplied from the power supplying device 10.

When stopping the supply of power, tension is applied to the connection line L, and then immediately released so that the connection line L is reeled in by the cord reel. This reels the connection line L into the housing 31a of the plug unit 31, and the power supply circuit unit 35 and the plug unit 31 are held in contact with each other. When not in
use, the contactless adapter 30 is held along the main body side surface 21 of the notebook computer 20. Thus, the notebook computer 20 has superior portability like in the first embodiment.

[0122] The electrical configuration of the contactless power supply system differs from the first embodiment in that the contactless adapter 30 includes only one secondary coil 41, as shown in the electrical circuit of Fig. 29. In other words, one resonance capacitor 36a is connected in series to one secondary coil 41. 

[0123] The operation of the contactless adapter 30 will now be described.

[0124] When the contactless adapter 30 is not in use, the plug unit 31 of the contactless adapter 30 is attached to the main body side surface 21 of the notebook computer 20. In this case, the contactless adapter 30 is arranged so that the housing 31a of the plug unit 31, the housing 35a of the power supply circuit unit 35, and the film substrate 75 (power receiving unit 40), which is rolled into a cylindrical form, are laid out along the main body side surface 21 of the notebook computer 20.

[0125] In the same manner as the first embodiment, the housing 35a of the power supply circuit unit 35 and the power receiving unit 40 (film substrate 75 rolled to a cylindrical form) are drawn out from the plug unit 31 to an approximate position where the marker 3 is indicated. After pulling out the housing 35a of the power supply circuit unit 35 and the power receiving unit 40 to the approximate position, the hook-and-loop fasteners 78a, 78b are pulled apart to spread out the film substrate 75 from the state rolled into the cylindrical form.

[0126] In this state, the center position of the spread film substrate 75 is aligned with the marker 3 indicated on the desktop 2, as shown in Fig. 26. In this case, the alignment is performed in the same manner as the first embodiment.

[0127] Thus, the secondary coil 41 of the film substrate 75 of the power receiving unit 40 interlinks with the alternating magnetic field generated from the primary coil 11 of the power supplying device 10 to generate induced electromotive force, which is output to the power supply circuit unit 35. The power supply circuit unit 35 converts the induced electromotive force to a predetermined DC voltage, which is sent from the output terminal 33 of the plug unit 31 to the notebook computer 20 as a drive power through the connection line L reeled out from the housing 31a of the plug unit 31.

[0128] When stopping the supply of power with the contactless adapter 30, the spread film substrate 75 is rolled into a cylindrical form and the film substrate 75 is held rolled into the cylindrical form by attaching the hook-and-loop fasteners 78a, 78b. When the tension is applied to the connection line L and immediately released, the connection line L is reeled in by the cord reeling/re-reeling mechanism. The power supply circuit unit 35 and the plug unit 31 are held in contact with each other.

[0129] Then, the housing 31a of the plug unit 31, the housing 35a of the power supply circuit unit 35, and the film substrate 75 (power receiving unit 40) rolled to a cylindrical form, which are parts of the contactless adapter 30, are arranged along the main body side surface 21 of the notebook computer 20. The plug unit 31 is attached to the main body side surface 21 of the notebook computer 20 until the contactless adapter 30 is used the next time power is supplied.

[0130] The second embodiment has the following advantages.

(1) In the second embodiment, the notebook computer 20 receives power from the power supplying device 10 via the contactless adapter 30 attached to the notebook computer 20 even if the notebook computer 20 is spaced apart from the power supplying device 10. This improves the degree of freedom for the position where the notebook computer 20 can be placed on the desk 1.

(2) In the second embodiment, the power receiving unit 40 includes the secondary coil 41 formed on the film substrate 75. The film substrate 75 is configured to be rollable into the cylindrical form so that the film substrate 75 can be in rolled or spread. In the rolled state, the hook-and-loop fasteners 78a, 78b are attached so that the film substrate 75 is held in the rolled state. The film substrate 75 is spread to a planar form by its resiliency by pulling apart the attached hook-and-loop fasteners 78a, 78b.

Therefore, the secondary coil 41 formed on the film substrate 75 increases the area of the coil surface formed on the film substrate 75 having a wide area in the spread state, and obtains the induced electromotive force of high output from the alternating magnetic field of the primary coil 11 of the power supplying device 10.

(3) In the second embodiment, the film substrate 75 is rolled to be held in the cylindrical form, and the overall size of the film substrate 75 is compact when not used.

(4) In the second embodiment, the contactless adapter 30 is attached to the main body side surface 21 of the notebook computer 20. The power receiving unit 40 including the housing 31a of the plug unit 31 of the contactless adapter 30, the housing 35a of the power supply circuit unit 35, and the film substrate 75 rolled into the cylindrical form are arranged along the main body side surface 21 of the notebook computer 20. Therefore, the contactless adapter 30 is compact when attached to the notebook computer 20. This allows the notebook computer 20 to be carried together with the contactless adapter 30 without the portability being adversely affected.

(5) In the second embodiment, the magnetic body film 77 is formed on the power receiving surface 75a of the film substrate 75, and the secondary coil 41 is formed on the surface of the magnetic body film 77. This reduces the magnetic flux that leaks to open space. Furthermore, since the electromagnetic shield seal 76 is formed between the film substrate 75 and the magnetic body film 77, the electromagnetic wave radiated to the outer side is blocked.
In the second embodiment, the housing 35a of the power supply circuit unit 35 and the housing 31a of the plug unit 31 are coupled to the connection line L that can be reeled in and reeled out but may be coupled to the telescopic arm 34 like in the first embodiment.

In the same manner as the first embodiment, the display lamp LP that indicates the magnetic coupling of the secondary coil 41 to the primary coil 11 may be arranged on the housing 35a of the power supply circuit unit 35 so that the magnetic coupling is easy to visually recognize from the illumination of the display lamp LP.

A third embodiment of the contactless power supply system will now be described. The feature of the third embodiment is in the power supplying device 10 of the contactless power supply system.

As shown in Fig. 30, a sideboard 80 is fixed upright at the rear of the desktop 2 of the desk 1. The sideboard 80 may configure part of the desk 1 or may be separate from the desk 1. The power supplying device 10 is arranged in the sideboard 80. The power supplying device 10 may include a housing accommodating the power supply circuit 51 and the high frequency inverter 12.

An accommodation recess 81 is formed on the front surface of the sideboard 80 where the housing of the power supplying device 10 is accommodated. The accommodation recess 81 accommodates three coil formation substrates 82, each including the primary coil 11 (not shown in Fig. 30), in an overlapped state. The primary coils 11 formed on the three coil formation substrates 82 are connected in series.

The three coil formation substrates 82 include a middle coil formation substrate 82a, and two coil formation substrates 82b coupled, in a foldable manner, to two sides of the middle coil formation substrate 82a by hinges (not shown). The coil formation substrates 82 on the two sides are folded to overlap the middle coil formation substrate 82a so that the three coil formation substrates 82 are overlapped in three layers.

An accommodation compartment 83 is formed at the middle of the accommodation recess 81. A telescopic arm 84 is arranged in the accommodation compartment 83. The telescopic arm 84 has a configuration similar to the telescopic arm 34 of the first embodiment and includes a plurality of pipes having an extensible structure. The telescopic arm 84 (pipe) may be projected from the sideboard 80.

The distal end of the telescopic arm 84 is coupled to the middle coil formation substrate 82a, for example, by a universal joint (not shown). An insulation coated connection line (not shown) is wired in the telescopic arm 84. The connection line supplies the high frequency current generated by the high frequency inverter 12 to the primary coils 11, which are connected in series.

The sliding resistance between the plurality of pipes configuring the telescopic arm 84 and the universal joint is set in the same manner as the first embodiment. Therefore, when drawn out to the desired position, the coil formation substrates 82 are maintained in the same state unless force is applied.

Preferably, the connection line wired in the telescopic arm 84 is reeled out and in in accordance with the extension and contraction of the telescopic arm 84 by a reel arranged in the housing of the power supplying device 10 in the same manner as the first embodiment.

Preferably, the coil formation substrate 82 is a plate having an electromagnetic shield property like the substrates 42, 43 of the first embodiment. A magnetic body (not shown) is arranged on the coil formation substrate 82a, and the primary coil 11 is formed on the magnetic body.

The operation of the power supplying device 10 will now be described.

When the power supplying device 10 is not used, the telescopic arm 84 is contracted and arranged in the accommodation compartment 83, and the coil formation substrates 82 are folded into three layers and fitted into the accommodation recess 81 of the sideboard 80.

When using the power supplying device 10, the folded coil formation substrates 82 are drawn out from the accommodation recess 81 to near a television 85 serving as an electrical appliance. In this case, the telescopic arm 84 is also extended. The coil formation substrates 82 that are folded into three layers are spread as shown in Fig. 30. The spread primary coil 11 is aligned to face the secondary coil (not shown) incorporated in the television 85. Thus, the secondary coil of the television 85 receives power through the primary coil 11 of the power supplying device 10.

When stopping the supply of power from the power supplying device 10, the spread coil formation substrates 82 are folded into three layers. The telescopic arm 84 is contracted and arranged inside the accommodation compartment 83. The coil formation substrates 82, which are folded into three layers, are fitted into the accommodation recess 81 of the sideboard 80.

The power supplying device 10 of Fig. 30 supplies power to the television 85 including the secondary coil for contactless power supply but can also supply power to the notebook computer 20 attached with the contactless adapter 30 of the first embodiment. For example, the power supply can be performed by aligning the spread coil formation substrates 82 with the fixed substrate 42 and the pivot substrate 43 of the power receiving unit 40 of the contactless adapter 30.

The third embodiment has the advantages described below.
(1) In the third embodiment, the primary coils 11 (coil formation substrates 82) of the power supplying device 10 are arranged at a desired position within a range in which the telescopic arm 84 is extendable. Thus, the television 85 is supplied with power from the power supplying device 10 even when spaced apart from the sideboard 80 (power supplying device 10). This improves the degree of freedom in the position of the television 85 on the desk 1.

[0148] Furthermore, in the notebook computer 20 to which the contactless adapter 30 shown in the first embodiment is attached, the degree of freedom in the position of the notebook on the desk 1 is further improved.

[0149] Each embodiment may be modified as below.

[0150] In each embodiment, the contactless adapter 30 may have a measuring function for detecting the optimum magnetically coupled state of the primary coil 11 and the secondary coil 41 and indicating the magnetically coupled state with the display lamp LP. The measuring function may be provided for the notebook computer 20 (electrical appliance) or the power supplying device 10. In an example in which the notebook computer 20 has the measuring function, the magnetically coupled state is detected based on the output voltage of the output terminal 33 and the detection result is indicated by the display lamp LP arranged on the notebook computer 20.

[0151] In the example in which the power supplying device 10 has the measuring function, the magnetically coupled state is detected (e.g., primary current I1 is detected) based on an impedance as viewed from the primary coil 11, and the detection result is indicated by the display lamp arranged on the desktop 2 adjacent to the primary coil 11.

[0152] In each embodiment, the magnetically coupled state is visually notified by the display lamp LP but may be audibly notified by a buzzer.

[0153] In each embodiment, the contactless adapter 30 has the output terminal 33 of the plug unit 31 electrically connected to the input terminal of the notebook computer 20 to supply the DC voltage to the notebook computer 20. In another example, the DC voltage output from the constant voltage stabilizing circuit 38 is converted to alternating current by the DCAC conversion circuit in the power supply circuit unit 35 of the contactless adapter 30. The alternating current excites the power supplying coil arranged on the connection line L. The power supplying coil and the secondary coil incorporated in the electrical appliance are magnetically coupled so that the alternating magnetic field generated from the excited power supplying coil interlinks with the secondary coil thus causing the secondary coil of the electrical appliance to generate the induced electromotive force.

[0154] The coil formation substrates 82 of the third embodiment are not limited to three and may be configured to be one, two, or four or more. If the coil formation substrate 82 is one or two, preferably, each coil formation substrate 82 is enlarged.

[0155] The desk 1 serves as an object having a setting surface on which the electrical appliance can be placed. The sideboard 80 serves as an object arranged on a setting surface, on which the electrical appliance can be placed, or including the installing surface. The power supplying device 10 may be arranged on an object other than the desk 1 and the sideboard 80 as long as the object includes a setting surface or the object is arranged on the installing surface.

[0156] The embodiments and modifications may be combined.

Claims

1. A contactless adapter (30) comprising:

   a secondary coil (41) that is arranged on a substrate (61, 75, 42, 43) and configured to generate an induced electromotive force;
   a power supply circuit unit (35) that is configured to convert the induced electromotive force generated at the secondary coil (41) to a predetermined output voltage;
   a plug unit (31) including an output terminal (33) and serving as an output unit configured to be able to be electrically connected or magnetically coupled to an electrical appliance (20, 85) to supply the output voltage converted by the power supply circuit unit (35) to the electrical appliance (20, 85);
   wherein the contactless adapter (30) is configured to be attached to the electrical appliance (20, 85) so that the contactless adapter (30) can be carried integrally with the electrical appliance (20, 85);
   a connection line (L) that is configured to connect the power supply circuit unit (35) and the output unit;
   a housing (35a) of the power supply circuit unit (35), wherein a portion of the substrate (61, 75, 42, 43) is coupled to the housing (35a);
   characterized by
   a telescopic arm (34) configured to serve as a coupling body that couples the housing (35a) of the power supply circuit unit (35) and the output unit so that a distance and an angle are variable, wherein the connection line (L) is arranged along the coupling body;
   wherein the substrate (61, 75, 42, 43) is a substrate that is rollable into and spreadable from a cylindrical form.
or a substrate that is foldable and spreadable; the output unit of the contactless adapter (30) is configured to be attached in a removable manner to the electrical appliance (20, 85); and when the output unit is attached to the electrical appliance (20, 85), the contactless adapter (30) is pivotally supported by the electrical appliance (20, 85).

2. The contactless adapter (30) according to claim 1, wherein the substrate (42, 43) is configured by a plurality of substrate segments coupled in a foldable manner, and the secondary coil (41) is arranged on each substrate segment (42, 43).

3. The contactless adapter (30) according to claim 2, wherein each substrate segment (42, 43) includes a magnetic body (13) and an electromagnetic shield plate (14), the secondary coil (41) is arranged on one side surface of the magnetic body (13), and the electromagnetic shield plate (14) is arranged on another side surface of the magnetic body (13).

4. The contactless adapter (30) according to claim 1, wherein the substrate (61, 75) that is rollable into and spreadable from a cylindrical form is a single flexible substrate (75) including the secondary coil (41).

5. The contactless adapter (30) according to claim 4, wherein the flexible substrate (75) includes a magnetic thin film and an electromagnetic shield thin film formed on the magnetic thin film, and the secondary coil (41) is formed on the magnetic thin film at a side opposite to a surface on which the electromagnetic shield thin film is formed.

6. The contactless adapter (30) according to any one of claims 1 to 5, wherein the housing (35a) of the power supply circuit unit (35) includes an input terminal (PL1, PL3) connected to a commercial AC power supply (50); and the power supply circuit unit (35) is configured to convert input voltage supplied to the input terminal (PL1, PL3) to a predetermined output voltage and supplies the output voltage to the electrical appliance (20, 85) via the output unit.

7. The contactless adapter (30) according to any one of claims 1 to 6, wherein the output unit includes an input terminal (PL1, PL3) connected to an output terminal of an AC adapter (30) configured to AC-DC-convert commercial AC power and supply the electrical appliance (20, 85) with DC power supply input to the input terminal (PL1, PL3).

8. The contactless adapter (30) according to any one of claims 1 to 7, wherein the contactless adapter (30) includes a display function for detecting and displaying a magnetic coupling state of the secondary coil (41) and a primary coil (11).

9. A contactless power supply system comprising:

- a power supplying device (10) including a high frequency inverter, which is connected to a power supply (50) and which is configured to generate a high frequency current, and a primary coil (11), which is connected to the high frequency inverter and which is supplied with the high frequency current;
- the contactless adapter (30) according to any one of claims 1 to 8; and
- an electrical appliance (20, 85) electrically connected or magnetically coupled to the output unit of the contactless adapter (30) to receive the output voltage of the contactless adapter (30).

10. The contactless power supply system according to claim 9, wherein the electrical appliance (20, 85) includes an accommodation compartment (21a) formed to accommodate the contactless adapter (30); and the contactless adapter (30) is accommodated and held in the accommodation compartment (21a) when not in use and drawn out of the accommodation compartment (21a) when used.

11. The contactless power supply system according to claim 9 or 10, wherein the electrical appliance (20, 85) is accommodated in a dedicated case (71), and the contactless adapter (30) is attached to the electrical appliance (20, 85) through the dedicated case (71).

12. The contactless power supply system according to any one of claims 9 to 11, wherein any one of the power supplying device (10), the contactless adapter (30), and the electrical appliance (20, 85) includes a display function for detecting and displaying a magnetic coupling state of the primary coil (11) and the secondary coil (41).
13. The contactless power supply system according to any one of claims 9 to 12, wherein the power supplying device (10) is one of a plurality of power supplying devices, and the primary coils (11) of the plurality of power supplying devices (10) are arranged in an array so that the secondary coil (41) of the contactless adapter (30) when spread faces and extends across the plurality of primary coils (11).

Patentansprüche

1. Kontaktloser Adapter (30), aufweisend:
   eine Sekundärspule (41), die auf einem Substrat (61, 75, 42, 43) angeordnet ist und dazu eingerichtet ist, eine induzierte elektromotorische Kraft zu erzeugen;
   eine Energieversorgungsschaltungseinheit (35), die dazu eingerichtet ist, die induzierte elektromotorische Kraft, die an der Sekundärspule (41) erzeugt wird, in eine vorbestimmte Ausgangsspannung umzuwandeln;
   eine Steckereinheit (31), die einen Ausgangsanschluss (33) enthält und als eine Ausgangseinheit dient, die dafür ausgelegt ist, mit einem elektrischen Gerät (20, 85) elektrisch verbunden oder magnetisch gekoppelt zu werden, um die Ausgangsspannung, die durch die Energieversorgungsschaltungseinheit (35) umgewandelt wird, für das elektrische Gerät (20, 85) vorzusehen;
   wobei der kontaktlose Adapter (30) dazu eingerichtet ist, an dem elektrischen Gerät (20, 85) angebracht zu werden, so dass der kontaktlose Adapter (30) vollständig mit dem elektrischen Gerät (20, 85) getragen werden kann;
   eine Verbindungsleitung (L), die dafür ausgelegt ist, die Energieversorgungsschaltungseinheit (35) und die Ausgangseinheit zu verbinden;
   ein Gehäuse (35a) der Energieversorgungsschaltungseinheit (35), wobei ein Abschnitt des Substrats (61, 75, 42, 43) an das Gehäuse (35a) gekoppelt ist;
   gekennzeichnet durch
   einen Teleskoparm (34), der dafür ausgelegt ist, als ein Koppelkörper zu dienen, der das Gehäuse (35a) der Energieversorgungsschaltungseinheit (35) und die Ausgangseinheit so koppelt, dass ein Abstand und ein Winkel variabel sind, wobei die Verbindungsleitung (L) entlang des Koppelkörpers angeordnet ist;
   wobei das Substrat (61, 75, 42, 43) ein Substrat ist, das sich in eine zylindrische Gestalt rollen und daraus ausbreiten lässt, oder ein Substrat, das faltbar und ausbreitbar ist;
   die Ausgangseinheit des kontaktlosen Adapters (30) dazu eingerichtet ist, an dem elektrischen Gerät (20, 85) abnehmbar angebracht zu werden; und
   wobei der kontaktlose Adapter (30), wenn die Ausgangseinheit an dem elektrischen Gerät (20, 85) angebracht ist, durch das elektrische Gerät (20, 85) schwenkbar gelagert ist.

2. Kontaktloser Adapter (30) nach Anspruch 1, wobei das Substrat (42, 43) durch mehrere Substratsegmente konfiguriert ist, die faltbar verbunden sind, und die Sekundärspule (41) auf jedem Substratsegment (42, 43) angeordnet ist.

3. Kontaktloser Adapter (30) nach Anspruch 2, wobei jedes Substratsegment (42, 43) einen magnetischen Körper (13) und eine elektromagnatische Abschirmplatte (14) enthält, die Sekundärspule (41) an einer Seitenfläche des magnetischen Körpers (13) angeordnet ist, und die elektromagnatische Abschirmplatte (14) an einer weiteren Seitenfläche des magnetischen Körpers (13) angeordnet ist.

4. Kontaktloser Adapter (30) nach Anspruch 1, wobei das Substrat (61, 75), das sich in eine zylindrische Gestalt rollen und daraus ausbreiten lässt, ein einzelnes flexibles Substrat (75) ist, das die Sekundärspule (41) enthält.

5. Kontaktloser Adapter (30) nach Anspruch 4, wobei das flexible Substrat (75) eine magnetische Dünnschicht und eine elektromagnatische Abschirmdünnschicht, die auf der magnetischen Dünnschicht ausgebildet ist, enthält, und die Sekundärspule (41) auf der magnetischen Dünnschicht auf einer Seite ausgebildet ist, die einer Koppelstelle gegenüberliegt, auf der die elektromagnatische Abschirmdünnschicht ausgebildet ist.

6. Kontaktloser Adapter (30) nach einem beliebigen der Ansprüche 1 bis 5, wobei das Gehäuse (35a) der Energieversorgungsschaltungseinheit (35) einen Eingangsanschluss (PL1, PL3) enthält, der mit einer kommerziellen Wechselspannungsquelle (50) verbunden ist, und die Energieversorgungsschaltungseinheit (35) dazu eingerichtet ist, eine Eingangsspannung, die an dem Eingangsanschluss (PL1, PL3) anliegt, in eine vorbestimmte Ausgangsspannung umzuwandeln, und die Ausgangsspannung
über die Ausgabeeinheit dem elektronischen Gerät (20, 85) liefert.

7. Kontaktloser Adapter (30) nach einem beliebigen der Ansprüche 1 bis 6, wobei die Ausgangseinheit einen Eingangsanschluss (PL1, PL3) enthält, der mit einem Ausgangsanschluss eines Wechselstromadapters (30) verbunden ist, der dazu eingerichtet ist, eine handelsübliche Wechselspannung von Wechselstrom in Gleichstrom umzuwandeln und das elektrische Gerät (20, 85) mit einer Gleichspannungsversorgung zu versorgen, die die in den Eingangsanschluss (PL1, PL3) eingegeben wird.

8. Kontaktloser Adapter (30) nach einem beliebigen der Ansprüche 1 bis 7, wobei der kontaktlose Adapter (30) eine Anzeigefunktion aufweist, um einen Zustand der magnetischen Kopplung der Sekundärspule (41) und einer Primärspule (11) zu detektieren und anzuzeigen.

9. Kontaktloses Energieversorgungssystem, aufweisend:
   eine Leistungsversorgungsvorrichtung (10) mit einem Hochfrequenzwechselrichter, der mit einer Spannungsquelle (50) verbunden ist und dazu eingerichtet ist, einen Hochfrequenzstrom zu erzeugen, und eine Primärspule (11), die mit dem Hochfrequenzwechselrichter verbunden ist und die mit dem Hochfrequenzstrom versorgt wird;
   den kontaktlosen Adapter (30) nach einem beliebigen der Ansprüche 1 bis 8; und
   ein elektrisches Gerät (20, 85), das mit der Ausgangseinheit des kontaktlosen Adapters (30) elektrisch verbunden oder magnetisch gekoppelt ist, um die Ausgangsspannung des kontaktlosen Adapters (30) aufzunehmen.

10. Kontaktloses Energieversorgungssystem nach Anspruch 9, wobei das elektrische Gerät (20, 85) ein Aufnahmefach (21a) aufweist, das zur Unterbringung des kontaktlosen Adapters (30) gebildet ist; und
   der kontaktlose Adapter (30), wenn er nicht in Gebrauch ist, in dem Aufnahmefach (21a) untergebracht und gehalten wird, und aus dem Aufnahmefach (21a) gezogen wird, wenn er verwendet wird.

11. Kontaktloses Energieversorgungssystem nach Anspruch 9 oder 10, wobei das elektrische Gerät (20, 85) in einem eigenen Gehäuse (71) untergebracht ist, und der kontaktlose Adapter (30) an dem elektrischen Gerät (20, 85) über das eigene Gehäuse (71) angebracht ist.

12. Kontaktloses Energieversorgungssystem nach einem beliebigen der Ansprüche 9 bis 11, wobei ein beliebiges von der Leistungsversorgungsvorrichtung (10), dem kontaktlosen Adapter (30) und dem elektrischen Gerät (20, 85) eine Anzeigefunktion aufweist, um einen Zustand einer magnetische Kopplung der Primärspule (11) und der Sekundärspule (41) zu detektieren und anzuzeigen.

13. Kontaktloses Energieversorgungssystem nach einem beliebigen der Ansprüche 9 bis 12, wobei die Leistungsversorgungsvorrichtung (10) eine von mehreren Leistungsversorgungsvorrichtungen (10) ist, und die Primärspulen (11) der mehreren Leistungsversorgungsvorrichtungen (10) in einer Gruppe angeordnet sind, so dass die Sekundärspule (41) des kontaktlosen Adapters (30) im ausgebreiteten Zustand den mehreren Primärspulen (11) zugewandt ist und sich über diese hinweg erstreckt.

Revendications

1. Adaptateur sans contact (30) comprenant :
   une bobine secondaire (41) qui est agencée sur un substrat (61, 75, 42, 43) et configurée pour générer une force électromotrice induite ;
   une unité de circuit d alimentation (35) qui est configurée pour convertir la force électromotrice induite générée au niveau de la bobine secondaire (41) en une tension de sortie prédéterminée ;
   une unité de prise (31) comprenant une borne de sortie (33) et servant en tant qu unité de sortie configurée pour pouvoir être connectée électriquement ou couplée magnétiquement à un appareil électrique (20, 85) pour fournir la tension de sortie convertie par l unité de circuit d alimentation (35) à l appareil électrique (20, 85) ;
   dans lequel l adaphte sans contact (30) est configuré pour être attaché à l appareil électrique (20, 85) de sorte que l adaptateur sans contact (30) puisse être transporté intégralement avec l appareil électrique (20, 85) ;
   une ligne de connexion (L) qui est configurée pour connecter l unite de circuit d alimentation (35) et l unite de sortie ;
un logement (35a) de l’unité de circuit d’alimentation (35), dans lequel une partie du substrat (61, 75, 42, 43) est accouplée au logement (35a) ;

 caractérisé par
 un bras télescopique (34) configuré pour servir en tant que corps d’accouplement qui accouple le logement (35a) de l’unité de circuit d’alimentation (35) et l’unité de sortie de sorte qu’une distance et un angle soient variables, dans lequel la ligne de connexion (L) est agencée le long du corps d’accouplement ;
 dans lequel le substrat (61, 75, 42, 43) est un substrat qui peut être enroulé en une forme cylindrique et étalé à partir de celle-ci ou un substrat qui peut être plié et étalé ;
 l’unité de sortie de l’adaptateur sans contact (30) est configurée pour être attachée d’une manière amovible à l’appareil électrique (20, 85) ;
 lorsque l’unité de sortie est attachée à l’appareil électrique (20, 85), l’adaptateur sans contact (30) est supporté de manière pivotante par l’appareil électrique (20, 85) .

2. Adaptateur sans contact (30) selon la revendication 1, dans lequel
 le substrat (42, 43) est configuré par une pluralité de segments de substrat accouplés de manière pliable, et
 la bobine secondaire (41) est agencée sur chaque segment de substrat (42, 43).

3. Adaptateur sans contact (30) selon la revendication 2, dans lequel chaque segment de substrat (42, 43) comprend un corps magnétique (13) et une plaque de protection électromagnétique (14), la bobine secondaire (41) est agencée sur une surface latérale du corps magnétique (13), et la plaque de protection électromagnétique (14) est agencée sur une autre surface latérale du corps magnétique (13).

4. Adaptateur sans contact (30) selon la revendication 1, dans lequel le substrat (61, 75) qui peut être enroulé en une forme cylindrique et étalé à partir de celle-ci est un substrat souple (75) unique comprenant la bobine secondaire (41) .

5. Adaptateur sans contact (30) selon la revendication 4, dans lequel le substrat souple (75) comprend un film mince magnétique et un film mince de protection électromagnétique formé sur le film mince magnétique, et la bobine secondaire (41) est formée sur le film mince magnétique d’un côté opposé à une surface sur laquelle le film mince de protection électromagnétique est formé.

6. Adaptateur sans contact (30) selon l’une quelconque des revendications 1 à 5, dans lequel le logement (35a) de l’unité de circuit d’alimentation (35) comprend une borne d’entrée (PL1, PL3) connectée à une alimentation alternative secteur (50) ;
 et
 l’unité de circuit d’alimentation (35) est configurée pour convertir la tension d’entrée fournie à la borne d’entrée (PL1, PL3) en une tension de sortie prédéterminée et fournit la tension de sortie à l’appareil électrique (20, 85) par l’intermédiaire de l’unité de sortie.

7. Adaptateur sans contact (30) selon l’une quelconque des revendications 1 à 6, dans lequel l’unité de sortie comprend une borne d’entrée (PL1, PL3) connectée à une borne de sortie d’un adaptateur alternatif (30) configuré pour convertir d’alternatif en continu la puissance alternative secteur et alimenter l’appareil électrique (20, 85) avec l’alimentation continue appliquée à la borne d’entrée (PL1, PL3).  

8. Adaptateur sans contact (30) selon l’une quelconque des revendications 1 à 7, dans lequel l’adaptateur sans contact (30) comprend une fonction d’affichage pour détecter et afficher un état de couplage magnétique de la bobine secondaire (41) et d’une bobine primaire (11).

9. Système d’alimentation sans contact comprenant :
 un dispositif d’alimentation (10) comprenant un onduleur haute fréquence, qui est connecté à une alimentation (50) et qui est configuré pour générer un courant haute fréquence, et une bobine primaire (11), qui est connectée à l’onduleur haute fréquence et qui reçoit le courant haute fréquence ;
 l’adaptateur sans contact (30) selon l’une quelconque des revendications 1 à 8 ; et
 un appareil électrique (20, 85) connecté électriquement ou couplé magnétiquement à l’unité de sortie de l’adaptateur sans contact (30) pour recevoir la tension de sortie de l’adaptateur sans contact (30).

10. Système d’alimentation sans contact selon la revendication 9, dans lequel
 l’appareil électrique (20, 85) comprend un compartiment de réception (21a) formé pour recevoir l’adaptateur sans contact (30) ; et
l’adaptateur sans contact (30) est reçu et maintenu dans le compartiment de réception (21a) lorsqu’il n’est pas utilisé et sorti du compartiment de réception (21a) lorsqu’il est utilisé.

11. Système d’alimentation sans contact selon la revendication 9 ou 10, dans lequel l’appareil électrique (20, 85) est reçu dans un boîtier dédié (71), et l’adaptateur sans contact (30) est attaché à l’appareil électrique (20, 85) par l’intermédiaire du boîtier dédié (71).

12. Système d’alimentation sans contact selon l’une quelconque des revendications 9 à 11, dans lequel l’un quelconque du dispositif d’alimentation (10), de l’adaptateur sans contact (30), et de l’appareil électrique (20, 85) comprend une fonction d’affichage pour détecter et afficher un état de couplage magnétique de la bobine primaire (11) et de la bobine secondaire (41).

13. Système d’alimentation sans contact selon l’une quelconque des revendications 9 à 12, dans lequel le dispositif d’alimentation (10) est l’un d’une pluralité de dispositifs d’alimentation, et les bobines primaires (11) de la pluralité de dispositifs d’alimentation (10) sont agencées en un réseau de sorte que la bobine secondaire (41) de l’adaptateur sans contact (30) lorsqu’elle est étalée soit face à la pluralité de bobines primaires (11) et s’étende sur celles-ci.
Fig. 12

Resonance Circuit

Rectifying Circuit

Constant Voltage Stabilizing Circuit
Fig. 14A

Fig. 14B
Fig. 15
Fig. 28
Fig.30
REFERENCES CITED IN THE DESCRIPTION

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