(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
3 December 2009 (03.12.2009)

PCT

(10) International Publication Number
WO 2009/146328 A1

(51) International Patent Classification:
H02J 7/16 (2006.01)

(21) International Application Number:
PCT/US2009/045325

(22) International Filing Date:
27 May 2009 (27.05.2009)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
12/127,592 27 May 2008 (27.05.2008) US
12/176,261 18 July 2008 (18.07.2008) US

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report (Art. 21(3))*

(54) Title: ENERGY SAVING CABLE ASSEMBLIES

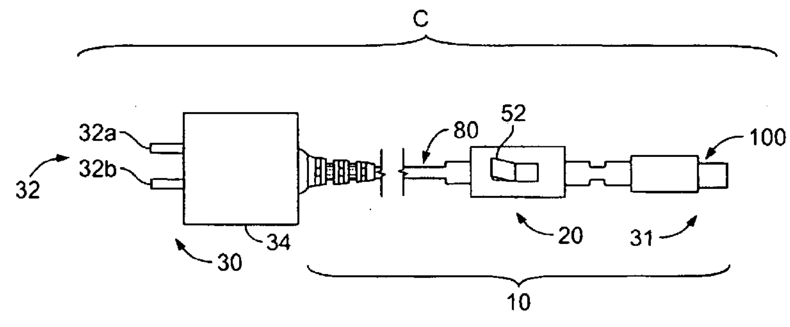

FIG. 1

(57) Abstract: A cable assembly for use with any power cable for an electrical device, the cable assembly including a remotely locatable switch for connecting or disconnecting the electrical device from power draw. Also, a cable assembly for a power device such as a charger for providing output power to an electronic device is disclosed, the cable assembly including two pairs of wires wherein a first pair provides output power for the electronic device and a second pair includes a switch for turning off the charger. The cable assembly allows the switch to be located remotely from a charger housing for the converter circuitry and remotely from a power source such as an outlet, and allows the switch to be generally co-located with and operable at the connector for connecting the power device with the electronic device.

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ENERGY SAVING CABLE ASSEMBLIES

CROSS-REFERENCE TO RELATED APPLICATION(S)

[0001] The present application claims priority to U.S. Serial Number 12/127,592, titled "Energy-Saving Power Adapter/Charger," filed May 27, 2008, pending, and hereby expressly incorporated by reference herein, and to U.S. Serial Number 12/176,261, titled "Energy-Saving Power Adapter/Charger," filed July 18, 2008, pending, and hereby expressly incorporated by reference herein, and which application is a continuation-in-part of U.S. Serial Number 12/127,592, titled "Energy-Saving Power Adapter/Charger," filed May 27, 2008.

FIELD OF THE INVENTION

[0002] The invention relates to power devices and, in particular, to power devices having a shut-off feature to reduce or eliminate useless power draw from an outlet and, more particularly to automatic shut-off power adapters and/or chargers removably connectable to electronic devices for powering by the adapters/chargers.

BACKGROUND

[0003] Currently, it is known to use power adapters and chargers for charging or powering a variety of electronic devices such as cellular telephones, so-called "smart phones", such as Blackberry devices provided by Research In Motion, Inc., personal data assistants, portable music or DVD players, and other similar devices. These devices typically include an on-board battery, and the chargers provide power to the battery. As used herein, the term "charger" refers to devices that provide a step in power (i.e., step power from an input voltage to an output voltage), convert power (i.e., convert input alternating current (AC) to output direct current (DC)) or both.

[0004] The charger generally has two connection points, a first one for receiving power and a second one for conveying power. The first connection point is generally prongs or blades that are inserted into a power outlet for receiving power therefrom which, in the United States, is alternating current power. The charger includes circuitry, generally disposed within a housing, for converting or adapting the input power received by the blades into output power delivered to the rechargeable device. For instance, the input power may be alternating current of a first voltage (such as 110/120V), and the output power may be direct current of a second, generally lower, voltage such as 5V.

[0005] The second connection point provides the output power to the rechargeable device. Generally speaking, for portable devices, the second connection point includes a connector that is removably connectable with the rechargeable device.

[0006] For most devices, the second connection point is remote from the first connection point. In other words, the charger has the blades connectable with the power outlet and mounted in the housing, the housing including the converter circuitry, and the charger has the connector and an electrical cord connecting the converter circuitry with the connector.

[0007] Such a configuration for the charger makes use thereof relatively simple. That is, a user may plug the charger blades into the power outlet of their choice (whether it is behind furniture or some other obstruction), and may leave the connector end in a place that is convenient for connecting and disconnecting the rechargeable device.

[0008] Despite this use being simple for a user, it has its own issues. In particular, the prior art chargers draw current at all times, regardless of being connected to the rechargeable device or not. This current or power draw is known as “phantom load”. To be more precise, phantom load is residual power consumption by power devices when not connected to their host electronic device, or when the electronic device is shut off.

[0009] Phantom load is becoming a greater issue for the public. Electrical devices that result in the described phantom load are continually increasing in per capita usage, populations increase exponentially, and great portions of the world's population are gaining the discretionary capital that enables the purchase of such devices. Energy is becoming more expensive on a monetary basis, and energy production overwhelmingly has an environmental impact, such as fossil fuel or nuclear energy.

[0010] Extensive effort has been and continues to be put into development of energy-efficient devices of all sorts. The "Energy Star" program sponsored by the United States Environmental Protection Agency and the United States Department of Energy is well known, though principally for energy efficiency appliances and building products such as glass doors and windows. In parallel with Energy Star standards efforts, a variety of state and federal laws have been enacted that are directed toward external power-supply products, which includes power devices or chargers for portable electronic devices. The most-recent standard for such portable devices is version 2.0 and is considered a push beyond simply forcing the industry to use power efficient components and layouts, requiring more complex power devices and supplies.

[0011] A recent development that arose during the preparation of the present application is a prototype device from Nokia Corporation that operates with a mechanical switch.

Specifically, the Nokia device has a housing end receivable in a power receptacle and including internal circuitry for the charger/adapter functions. A button is located on the housing for turning the Nokia device on, and the circuitry automatically turns off by releasing the button.

[0012] While it is believed to have been developed after conception of the invention of present application, the Nokia device highlights some interesting points about efforts in this arena. For instance, the button of the Nokia device is a mechanical button and requires some type of mechanism for releasing the button for the "off" state. The button is also located on a housing for the internal circuitry that is separate from the electronic device connector, the connector being a two-terminal device (that is, having "+" and "-" terminals). The Nokia device also requires some type of mechanism for determining when the device should be shut down.

[0013] Most people do not bother to unplug a charger when the charged portable electronic device is removed therefrom. The Nokia device certainly relieves a user from such a burden in order to cut power, but it still requires the user to reach to wherever the device is received in a receptacle in order to turn on the device, such as behind a piece of furniture.

[0014] In order to be a true "zero-energy" device, the power input (i.e., AC input) to the power device itself must be cut. Therefore, the location within the circuit at which the power is cut is central. In other words, a switch that merely cuts the output power from the connector (such as might be used to prevent overcharging of a battery) while the converter/adapter circuitry remains under power is not a "zero-energy" device because the internal circuitry is allowed to draw power, the effect being no different than simply removing the electronic device itself. Towards this end, the Nokia device displays a uniform manner of thinking in the industry: a switch for connecting or disconnecting the AC power must be co-located with or closely proximate to the AC input such as the power prongs.

[0015] The switch/converter circuitry co-location paradigm demonstrates itself in industry practice and standards, particularly as to how such relate to safety. As background, an isolation switch is one that cuts power to a portion of a device or circuit (more appropriately, sub-circuit) in a manner that is sufficient to allow a person to work on that portion of the device without a safety issue. An isolation switch is one that completely cuts power and voltage, etc., from a circuit so that there is zero risk of shock from contact with that circuit. A functional switch is one that, while cutting power, may still allow voltage to be present in a circuit and, thus, a shock may occur from a person coming into contact with the circuit.

[0016] A commonly used and well-known standards and approval organization is Underwriters Laboratories (UL), which has a UL 60950-1 standard for direct plug-in power supply (DPIU) devices that states, in section 3.4.5, "isolating switches shall not be fitted in flexible cords." More broadly, this standard says a "disconnect device shall be provided to disconnect the equipment from the mains supply for servicing," section 3.4.1, and such "disconnect devices … shall be connected as closely as practicable to the incoming supply." Furthermore, it is stated that "Functional switches are permitted to serve as disconnect devices provided that they comply with all the requirements for disconnect devices. However, these requirements do not apply to functional switches where other means of isolation are provided." Generally speaking, a switch for a charger (the switch connecting/disconnecting AC or converted DC power) in a cable may be considered a functional switch if the disconnect device is the AC plug for the charger.

[0017] Beyond portable electrical devices with removable power chargers for charging the battery thereof, there are many devices which draw a current regardless of their use. For instance, while some devices such as video cassette recorders (VCRs) typically include a clock, many people do not even bother to set said clock, let alone rely upon such as a timepiece.

[0018] Accordingly, it is desirable and there is a need for an improved power device, charger or otherwise, for reducing phantom load when a portable electrical device is disconnected from the power device or otherwise not intended to be drawing power from the power device. It is also desirable to provide a device that allows disconnection of power to an electrical device, the electrical device continuing to utilize its manufacturer-supplied power cord.

SUMMARY

[0019] This summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter.

[0020] Described herein is technology for, among other things, a power device for supplying power to a portable rechargeable electronic device is disclosed including a first portion for receiving electrical input power from a power source, a second portion for delivering electrical output power to the electronic device, a connector located on the second portion and removably connectable with the electronic device, and a switch assembly located remote from the first portion, the switch assembly having a member movable to and between first and second positions corresponding to respective "on" and "off' states, wherein the power device receives the input power in the "on" state, and the power device draws no input power in the "off' state.

[0021] In some forms, the first portion includes a plug having a plug body and a first and second side, the first side having prongs for electrical connection with the power source in the form of a power outlet, the second side having a secondary power outlet for receiving prongs of the electrical device power cable for delivering electrical power thereto. The switch may be secured with a portion of the power cable. The switch may be secured with a connector of the power cable, the connector for removably connecting the power cable with the electrical device.

[0022] In some forms, the switch is a two-position user-actuated switch.

[0023] In some forms, the switch assembly member is a throw. In some forms, the throw may be a toggle or rocker throw.

[0024] In some forms. the switch assembly member is a sheath longitudinally movable to and between the first and second positions.

[0025] In some forms, the switch assembly member is manually movable to both the first and second positions by a user. In some forms, the switch is user-actuated by a momentary connection across switch terminals thereof. The cable assembly may further include a timer, wherein actuation of the switch allows power to be provided to the third portion for a predetermined time, and the timer effects disconnection of the power after the predetermined time.

[0026] In some forms, the power device further includes a cable extending between the first portion and the second portion, and the first portion includes first and second prongs for electrical communication with a receptacle of a power outlet, circuitry electrically connected to the prongs and to the cable for changing the input power to the output power, and a housing from which the prongs and cable extend, the circuitry disposed within the housing, and the cable includes a first pair of wires for delivering power to the electronic device and a second pair of wires for communicating with the switch assembly. The second pair of wires may be connected such that the switch in the second position disconnects a prong from at least a portion of the circuitry to prevent power from being drawn by the power device. The switch assembly may be located proximate the second portion and connector thereof

[0027] In some forms, the cable assembly further includes a current sense element, wherein the power in the cable assembly is disconnected when a current level through the current sense element is below a threshold level. A predetermined delay period may be provided, wherein the power in the cable assembly remains connected for the delay period subsequent to actuation of the switch.

[0028] In another aspect, a power device for supplying power to a portable rechargeable electronic device is disclosed including a first portion for receiving electrical input power from a source, the input having an input voltage, a second portion for delivering electrical output power to the electronic device, the output power having an output voltage, circuitry for converting the input power voltage to the output power voltage and for determining an "off" state of the circuitry, a connector located on the second portion and removably connectable with the electronic device, and a switch assembly having powered terminals, the switch assembly responsive to movement of at least a movable portion thereof to electrically connect the terminals and to provide an output signal to activate the circuitry to the "on" state, wherein the circuitry automatically turns the circuitry to the "off" state, the circuitry drawing no power when in the "off" state.

[0029] In some forms, the switch assembly movable portion is biased to a first position and is movable to a second position by force applied by the user, cessation of the force permitting the movable portion to return to the first position, the switch assembly producing the output signal only when in the second position.

[0030] In some forms, the switch assembly movable portion is a pushbutton spring-biased to a first position and is movable to a second position by force applied by the user, the pushbutton in the second position electrically connecting the terminals to produce the output signal, the output signal being a momentary signal from a momentary connection of the terminals, and releasing the pushbutton perm its return thereof to the first position.

[0031] In some forms, the switch assembly movable portion is an orientation-dependent switch.

[0032] In some forms, the switch assembly movable portion is a motion-sensing switch.

[0033] In some forms, the circuitry includes a timer programmed with a predetermined time period, the timer providing a timer signal to the circuitry at the conclusion of the time period, and the circuitry automatically changes to the "off" state in response to the timer signal.

[0034] In some forms, the circuitry includes a power sensing portion programmed with a predetermined threshold power level, wherein the circuitry automatically changes to the "off" state in response to the output power being at or below the threshold power level.

[0035] In some forms, the circuitry includes a latching relay that is closed in response to the switch assembly output signal, the latching relay being opened in response to the output power being at or below a threshold power level to change the circuitry to the “on” state.

[0036] In some forms, the circuitry includes a solid state switch dement that opens in response to the output power being at or below a threshold power level to change the circuitry to the “off” state.

[0037] In some forms, the switch assembly is located remote from the first portion. The switch assembly may be located proximate the second portion.

[0038] In an additional aspect, a power device for supplying power to a portable rechargeable electronic device is disclosed including a first portion for receiving electrical input power from a source, the input having an input voltage, a second portion for delivering electrical output power to the electronic device, the output power having an output voltage, circuitry for converting the input power voltage to the output power voltage and for determining an “on” state of the circuitry, a connector located on the second portion and removably connectable with the electronic device. and a switch assembly having powered terminals to change the circuitry to the “on” state, wherein the circuitry automatically turns the circuitry to the “off” slate, the circuitry drawing no power when in the “off' state.

[0039] In some forms, the switch assembly movable portion is biased to a first position and is movable to a second position by force applied by the user to change the circuitry to the “on” state. Cessation of the force may permit the movable portion to return to the first position.

[0040] In some forms, the circuitry includes a timer programmed with a predetermined time period, the timer providing a timer signal to the circuitry at the conclusion of the time period, and the circuitry automatically changes to the “off” state in response to the timer signal.

[0041] In some forms, the circuitry includes a power sensing portion programmed with a predetermined threshold power level, wherein the circuitry automatically changes to the “off” state in response to the output power being at or below the threshold power level.

[0042] In some forms, the circuitry includes a latching relay that is closed in response to the switch assembly changing the circuitry to the “on” state, the latching relay being opened in response to the output power being at or below a threshold power level to change the circuitry to the “off” state.

[0043] In some forms, the circuitry includes a solid slate switch element that opens in response to the output power being at or below a threshold power level to change the circuitry to the "off" Slate.

[0044] In some forms, the switch assembly is located remote from the first portion.

[0045] In some forms, the switch assembly is located proximate the second portion.

[0046] In accordance with an additional aspect, a cable assembly for a power device having electrical circuitry for supplying output power to an electronic device comprising a first sub-cable including a switch and a pair of switch wires electrically connectable via the switch, a second sub-cable including a pair of output wires, each of the wires connected with output power from the power device and each of the output wires electrically connected with a connector for transmitting output power to the electronic device, wherein the switch is operable to open and close the electrical circuitry, the electrical circuitry drawing substantially no power when open.

[0047] In some forms, the first and second sub-cables are encased by a single jacket.

[0048] In some forms, the first and second sub-cables are joined by a bridge.

[0049] In some forms, the switch disconnects power from an input terminal of the power device electrically connected to a power source. The switch may disconnect the input terminal in the form of a plug prong of the power device from the power device electrical circuitry.

[0050] In some forms, the first and second sub-cables are substantially joined in parallel to extend a length from a housing of the power device in which the electrical circuitry is disposed to a switch assembly including the switch. The second sub-cable may extends from the switch assembly to the connector. The output wires may extend from the switch assembly to the connector.

[0051] In some forms, the switch is a functional switch.

[0052] In some forms, the switch is remotely located from the electrical circuitry.

[0053] In some forms, the power device is a step down AC to DC converter, and the switch cuts input AC power to the power device electrical circuitry.

[0054] In some forms, the switch is moveable between first and second positions corresponding to open and close the electrically circuitry.

[0055] In some forms, the cable assembly is elongated and flexible, the power device includes input prongs for receiving input power from a power source and includes a housing within which the electrical circuitry is generally disposed, and the switch is located remotely from the housing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0056] The accompanying drawings, which are incorporated in and form a part of this specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of embodiments of the invention:

[0057] Fig. 1 is a partially fragmentary view of a first form of a cable assembly of the present invention, the cable assembly having a first end for connecting with a power source, a second end for connecting with an electrical device, and a two-position switch;

[0058] Fig. 2 is a fragmentary view of a portion of the charger of Fig. 1 showing the cable assembly;

[0059] Fig. 3 is a simplified circuit diagram for the fragmentary portion of the power device of Fig. 2;

[0060] Fig. 4 is a representative circuit diagram showing an embodiment of the circuit of the charger of Fig. 1 having switch conductors electrically connectable through the switch assembly and output conductors or terminals for transmitting or delivering output power to an electrical device;

[0061] Figs. 5A and 5B are representative cross-sectional views of the cable assembly through the conductors showing the physical and electrical isolation thereof;

[0062] Fig. 6 is a representational view or a form of the power device including an outer sheath positioned proximate a connector;

[0063] Fig. 7 is a representational view of a form of the power device including a mechanically actuated switch, which may also include an integrated circuit coupled with the mechanically actuated switch;

[0064] Fig. 8 is a circuit diagram illustrating aspects of different forms of a power device of the current invention;

[0065] Fig. 9 is a partial circuit diagram showing an optional form of internal circuitry including a relay switch;

[0066] Fig. 10 is a circuit diagram or an exemplary form of the power device showing a power-on or activating switch;

[0067] Fig. 11 is a circuit diagram of an exemplary form or the power device showing an electromechanical relay provided to open and close the circuit;

[0068] Fig. 12 is a circuit diagram of an exemplary form of the power device showing a switch for determining the state of the power device with a current sensing circuit;

[0069] Fig. 13 is a form of a cable assembly of the present invention for use in conjunction with a primary power cable for an electrical device;

[0070] Fig. 14 is a first form of a circuit diagram for the cable assembly of Fig. 13;

[0071] Fig. 15 is a second form of a circuit diagram for the cable assembly of Fig. 13; and

[0072] Fig. 16 is an additional form of the circuit diagram of Fig. 15.

DETAILED DESCRIPTION

[0073] Reference will now be made in detail to the preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings. While the invention will be described in conjunction with the preferred embodiments, it will be understood that they are not intended to limit the invention to these embodiments. On the contrary, the invention is intended to cover alternatives, modifications and equivalents, which may be included within the spirit and scope of the invention as defined by the claims. Furthermore, in the detailed description of the present invention, numerous specific details are set forth in order to provide a thorough understanding of the present invention. However, it will be obvious to one of ordinary skill in the art that the present invention may be practiced without these specific details. In other instances, well known methods, procedures, components, and circuits have not been described in detail as not to unnecessarily obscure aspects of the present invention.

[0074] Generally stated, an embodiment of the present invention includes a power device, such as a charger or adapter, for providing power to an electrical device that is designed to shut off or at least reduce power draw from a power source when the electrical device does not need power. In a more finite form or the invention, the power device is an AC-DC charger and convener for a portable rechargeable electronic device that is connectable with the power device. In the preferred forms, the power device has a housing co-located at a first end with prongs for connecting with an electrical source such as an outlet, has a cable extending from the housing to a second end, and has a connector located at the second end for connecting with the portable electronic device. In a more preferred form, the power device includes switch components, located remotely from the first end, for switching the power device from an “off” state (when the electronic device is fully-charged or not connected to the connector) to an “on” state allowing power to be delivered to a connected electronic device. In one form, the switch components operate to cut power on the AC portion of the internal circuitry of the power device so that the power draw is zero or negligible (i.e., measured in microwatts). In another form, the switch components operate to initiate a power device “on” state while a timer circuit, a power sense circuit or other circuits in the power device are used to switch the power device to an “off” state so that the power draw is zero or negligible.

[0075] Referring initially to Figs. 1 and 2, a charger C having a cable assembly 10 is illustrated, the cable assembly 10 includes a switch assembly 20 for disconnecting power to the charger C so that power or current draw by the charger C is zero or negligible. More specifically, as will be discussed below, the switch assembly 20 cuts power to internal circuitry of the charger C prior to the power conversion. The cable assembly 10 is generally elongated and flexible.

[0076] As can be seen, the charger C includes a first end 30 for connecting with a power source, generally a power outlet (not shown) supplying input power such as 120 VAC. The first end 30 includes at least a pair of blades or prongs 32 for insertion within the power outlet. The prongs 32 are mounted with a housing 34 in which electrical converter circuitry 36 is disposed. A first prong 32a is directly electrically connected with the circuitry 36, while a second switch prong 32b is electrically connected with the circuitry 36 through the switch assembly 20, as will be discussed in greater detail below. Accordingly, when the switch assembly 20 is in an open position, the switch prong 32b is electrically isolated and disconnected from the circuitry 36 so that the charger C itself is essentially open, and no power is drawn from the outlet.

[0077] Turning to Fig. 3, it can be seen that cable 80 includes the conductors 60a-60b and 70a-70b. Conductors 60a and 60b are shown having the switch terminals 52a, 52b, while conductors 70a and 70b are shown having output terminals 50a, 50b. Accordingly, the conductors 70a and 70b are also illustrated in Fig. 4 as being downstream from the transformer 48 and, specifically, are the portion extending electrically downstream from the housing 34.

[0078] In one embodiment, conductor 70a and output terminal 50a provide direct current output, conductor 70b and 50b provide a ground connection, conductor 60b provides a first “live” line, and conductor 60a provides a second “live” line, as are known for use with a mini-USB. The lives 60a-b are connected to the throw 42 such that they are electrically connected to each other when the throw 42 is in the “on” state, and such that they are disconnected when the throw 42 is in the “off” state. The direct current output and ground pass through the switch assembly 20 for connection to their respective pins of the mini-USB connector 100. When the connector 100 is used with the intermediate connector 723 shown in Fig. 7 and described in detail below, the secondary connector 723b thereof need only be provided with electrical connection with the output terminals 50a-b.

[0079] Fig. 4 illustrates a representative circuit 40 for the charger C incorporating a switch 42 within the switch assembly 20. As can be seen, the circuit 40 includes first and second inputs 44a and 44b corresponding to the prongs 32a and 32b, respectively. When the switch 42 is in the closed position, the circuit 40 receives input power (for the United States, typically 120 VAC) at the prongs 32a, 32b, transmits the power to a rectifying diode bridge 46 to convert the power to direct current (DC), further transmits the power to a transformer assembly 48 to step down the voltage (e.g., power at 5 VDC), and ultimately delivers the output power at output terminals 50a and 50b, which correspond to a second end 31 of the charger C.

[0080] With reference to Figs. 1 and 4, the switch assembly 20 includes a simple single-throw switch having a toggle member 52 for connecting across switch terminals 52a and 52b (see Fig. 3). In the open position illustrated in Figs. 3 and 4, the toggle member 52 is positioned so that that the terminals 52a and 52b are not electrically connected, and in the closed position the toggle member 52 is positioned to electrically connect the terminals 52a and 52b. In a preferred form, the switch assembly 20 and the toggle member 52 are rated for 120 to 240 VAC and 2.5 amps or greater.

[0081] Viewing Figs. 1, 3 and 4 together, the majority of the circuit 40 is disposed within the housing 34, including the circuitry 36 of the diode bridge 46 and the transformer 48. The prongs 32a, 32b extend from the housing 34 for connecting with a power source. The input from the switch prong 32b connects to conductor 60a and extends through an elongated sub-cable 64 to terminal 52b in the switch assembly 20. When the toggle 52 is in the closed position, the switch 42 electrically connects terminal 52b (and hence the switch prong 32b) with terminal 52a. Hence, the switch prong 32b is connected with the diode bridge 46.

[0082] The sub-cable 64 extends into and between the housing 34 and the switch assembly 20, and is provided with a companion sub-cable 74 for the conductors 70a and 70b. Specifically, each of the conductors 70a and 70b extends as shown in Fig. 4 from the circuitry 36 and through the sub-cable 74 in parallel with the sub-cable 64 and the conductors 60a, 60b. The conductors 70a and 70b terminate in the output terminals 50a, 50b providing the output power to the electrical device (not shown).

[0083] As shown, the charger C and the included cable assembly 10 satisfy the safety standard that prevents an “isolation” switch from being in a flexible cable. That is, because the switch assembly 20 cuts power at the input 44b / input prong 32b, the switch 40 acts as a functional switch with the plug (prongs 32 and housing 34) acting as the disconnect device. Additionally, the housing 34 and the circuitry 36 are generally maintained proximate to the power outlet, as is preferred by safety standards and users alike. Finally, the switch assembly 20 is allowed to be remote from the housing 34 so that it is proximate where users would actually connect and disconnect an electrical device to the charger C.

[0084] It is noted that the Underwriters Laboratories (UL) incorporates a National Electrical

Code (NEC) standard known as ANSI/NFPA 70, including section 725.55 that essentially states primary (i.e., input AC powered) conductors and separated/safety extra-low voltage (SELV) conductors should not be in the same cable. The SELV conductors are, by definition, of sufficiently low voltage and amperage that a user may grasp the exposed “hot” leads without risk of electric shock.

[0085] The preference for the primary and SELV conductors to be in separate cables is principally due to a concern of accidental connection between the primary and SELV which, in the case of someone touching the SELV leads, may allow a person to come into contact with line voltage (i.e., 120 VAC). It is for these exact reasons, among others, that the present cable assembly 10 and charger C are novel: not only do the standards organizations point to requiring switches (generally isolation switches) be co-located with the charger housing 34, the standards generally suggest that the primary conductors must be in a separate cable.

[0086] To address these issues, the cable assembly 10 not only presents a novel manner for providing the switch assembly 20 remote from the housing 34, but also provides the sub-cables 64 and 74 as the “separate” cables. Turning to Figs. 5A and 5B, embodiments of a cable 80 including sub-cables 64 and 74 are illustrated. The focus of the sub-cables 64, 74 within the cable 80 is, essentially, isolation—both physical and electrical. In one embodiment, each of the sub-cables 64, 74, as well as the cable 80 itself, is approximately 72 inches in length (between the housing 34 and the switch assembly 20).

[0087] The sub-cable 64 includes the primary conductors 60a, 60b, which may be formed of 26 AWG, as a pair of twisted wires within an insulation jacket 82a suitable for stand-alone use as a primary power cable. The sub-cable 74 includes the SELV conductors 70a, 70b, which may be formed of 22 AWG, as a pair of twisted wires within an insulation jacket 82b suitable for use with a SELV cable, though preferably the jacket 82b is also suitable as a primary power (i.e., direct AC power) cable jacket. It should be noted that each jacket and wire gauge, as described herein, should be selected for the particular usage of the charger C itself, among other parameters. It should be noted that the term "jacket" as used herein refers to a combination of insulation layer(s) around individual conductors/wires, common insulation around the pair of conductors / wires, and/or external layers encasing the conductors and insulation layer(s). At least between the SELV sub-cable 74 and the primary sub-cable 64, the isolation should be at least 3kV, including within the switch assembly 20. In a preferred form, the primary sub-cable 64 includes a double insulation such as with Teflon or polyvinyl chloride (PVC), while the SELV sub-cable 74 may simply be a basic insulation such as PVC.

[0088] In Fig. 5A, the sub-cables 64 and 74 are then clad with a second overall jacket 86 to give the appearance of a single cable. Reliance is then had on the jackets 82a, 82b to sufficiently protect and isolate the conductors 60a, 60b, 70a, and 70b.

[0089] For Fig. 5B, the sub-cables 64 and 74 are offset from each other with a bridge 88. The bridge 88 is preferably substantially continuous between the jackets 82a and 82b along the length between the housing 34 (where the sub-cables 64, 74 are brought together) and the switch assembly 20 (where the sub-cables 64, 74 are split apart). The bridge 88 provides additional isolation and can be selectively sized for the offset.

[0090] Referring again to Fig. 3, the SELV conductors 70a, 70b (and preferably the entire SELV sub-cable 74) simply pass through the switch assembly 20. In the form of either Fig. 5A or 5B, the jacket 82b provides sufficient isolation so that it may be a unitary along its length up to a connector 100.

[0091] In greater detail, the output terminals 50a, 50b provide output power (e.g., 5 VDC) to an electronic device via a connector 100 that is preferably removably connectable with the electronic device. In the present form, the connector 100 is a mini USB connector, though any standard or non-standard connector style may be used.

[0092] Strain reliefs are provided on the cable assembly 10, as best seen in Fig. 2. A first strain relief 92 is provided where the cable 80 enters the switch assembly 20, a second strain relief 94 is provided where the SELV sub-cable 74 exits the switch assembly 20 (electrically downstream), and a third strain relief 96 is provided between the downstream SELV sub-cable 74 and the connector 100. The second and third strain reliefs 94 and 96 should be sized not to be in contact or otherwise be in physical interference. In a preferred form, the first strain relief 92 is 0.75 inches, the second strain relief is 0.5 inches, and the overall distance between the switch assembly 20 and the connector 100 is approximately 2.0 inches, as an example.

[0093] It should be noted that isolation is provided within the switch assembly 20 between the switch 42 and conductors 60a, 60b, and the SELV sub-cable 74. Essentially, if the SELV sub-cable 74 is provided with a jacket 82b that is sufficient for primary power, no more need be done between the primary conductors 60 and the SELV conductors 70. Alternatively or in addition, a barrier (not shown) may be placed within the switch assembly 20 therebetween or, preferably, surrounding the primary conductors 60 and being open only to accommodate the switch 42 / toggle 52.

[0094] Turning to Fig. 6, a second form of a power device 100 is shown, also including a mini-USB connector 140. More specifically, a different form of switch assembly 50 is shown. For simplicity, the power device 100 is shown having a cable 102 and a second end 104, and it is understood that a first end and circuitry for the power conversion and step down would be incorporated into the power device 100 despite not being illustrated. In this form, the switch assembly 50 is shown as a sheath 110 provided on a portion of the cable 102. The sheath 110 is longitudinally movable to and between a first position, illustrated in dashed lines, and a second position, illustrated in solid lines, wherein the first and second positions respectively correspond to the "on" and "off" states discussed above. The sheath 110 is slid rearwardly and away from an end 140a of the connector 140 when an electronic device 20 is connected thereto. In so doing, a contact 112 positioned on the sheath 110 is moved into electrical connection with first and second terminals T (also corresponding to terminals 50a and 50b in Figs. 3 and 8) to close the circuit and allow the power device 100 to deliver power from the connector 140. Preferably, the sheath 110 is biased forwardly so that, when the electronic device 20 is disconnected, the sheath 110 automatically turns the power device 100 to the "off" state.

[0095] In another form, Fig. 7 illustrates a power device 700 including a mechanical motion-sensing switch 702 located proximate a connector 740. In one form, the switch 702 may be a position-dependent switch, such as a mercury switch, so that the switch state ("on" or "off") is dependent on the orientation of the switch 702 and the connector 740. In another form, the switch 702 may he connected to an integrated circuit (IC) 710 (see, e.g., Fig. 8) so that, with a brief connection across terminals T, the IC 710 activates the switch 702 to the "on" state. Such brief connection-type switch 702 may be a mercury switch, may be a cantilever-contact switch, or another type or switch.

[0096] In some forms, which may or may not be incorporated into the power device 700 of Fig. 7, the IC 710 may control a switch 734 located therein. For instance, the IC 710 may include a timer for shifting the switch 734 to the "off" state, or the IC 710 may control the switch 734 in the form or an electromechanical relay or a solid state equivalent such as a MOSFET switch, as will be appreciated by one skilled in the art. To return the switch 734 to the "on" state, a number of means may be employed. such as a mechanical switch depressed briefly by a user, a position-dependent switch, a quick or brief connection switch that communicates with the IC 710, as mere examples.

[0097] In another form using the IC 710 and switch 734, a load sensing device 400 may be incorporated within the IC 710, as also shown in Fig. 8. The load sensing device 400 measures the power or load (i.e., walls or amperage) being drawn from the power device 10.

The load is markedly higher when the electronic device 720 is connected thereacross and drawing power than when the electronic device 720 is either removed or is powered off, or not charging it's battery.

[0098] Accordingly, the IC 710 and load sensing device 400 recognize power draw or a lack thereof. The IC 710 can then open the switch 734 and/or possibly a switch external to the IC, to cease the current draw when it is recognized that no electronic device 720 is drawing therefrom. Preferably, such a form for the IC 710 includes a timer so that a slight pause in power or brief disconnect between the electronic device 20 and the connector at the ground and direct power outputs does not cause the IC 710 to shut the power off by opening the switch 734. As an example, the load sensing device 400 senses the pulse width and recognizes how slow or fast the pulse is repeated to determine the load. As such, when the battery 720a of the electronic device 720 ceases to draw power, the power device 10 can be calibrated to switch to the "off" state.

[0099] It should be noted that the IC 710, switch 734 and load sensing device 400 may be on-line or off-line and may be in a variety or configurations. As an example, the load sensing device 400 and IC 710 may be a pulse-width modulation (PWM) or other type of switch that carries its own IC, the PWM device shutting off a portion of the power device 10 while allowing a small portion (such as an incoming diode bridge 420 and input filter capacitors 422, see Fig. 8) to remain powered by a low current. Pressing a switch (discussed above) can be used to communicate with the small portion (i.e., the incoming diode bridge 420 and filter capacitors 422) to re-actuate and power-up the power device 10. In such a case, the PWM itself is also shut off until the power device is re-actuated. Therefore, while the power device 10 is not completely off, it is in a ultra-low power consumption state and is able to power-up more quickly.

[0100] To be more specific with respect to pressing a switch, Fig. 9 illustrates portions of a circuit diagram showing such usage and arrangement. In detail, it can be seen that the circuit 500 includes an input 502 and a rectifying diode bridge 504 that leads to filter capacitors 506, which in turn lead to an optical isolation coupler 508 and nodes 510 for connection to IC 710 and transformer T (see Fig. 8). As can be appreciated, an entire power device circuit is not illustrated, though the other portions of such are shown and described elsewhere herein, or would be understood by one skilled in the art.

[0101] The circuit 500 includes a start switch 520, which may be any type of switch for making at least a brief electrical connection. Preferably, the start switch 520 is a push-button switch so that, upon releasing, the contacts of the start switch 520 are disconnected and the start switch 520 is open. Upon brief electrical connection by the start switch 520 (such as by being depressed), a relay electrical contact 530 is connected. To detail, closing the start switch 520 causes electrical connection thereacross and, resultingly, powers a relay coil 532. The relay coil 532 is akin to a solenoid so that it physically moves, this movement bringing the plates 530a and 530b of the relay 530 together. The relay 530 is a latching-type relay so that it remains closed until otherwise instructed, powered or not. As can be seen, the relay coil 532 is connected to the start switch 520 by a closing diode 536 to effect this; the relay coil 532 is also connected to an opening diode 538 that is reversed in operation to the closing diode 536. As will be discussed, when the power device 10 recognizes a sufficiently low power draw, a transistor 540 is activated to cause power to flow through the opening diode 538 and, thus, reverse the physical movement of the relay coil 532, which in turn opens the relay plates 530a, 530b. In this manner, the power device 10 is returned to its "off" state.

[0102] With respect to the above-described sufficiently low power draw, it is noted that the power device 10 may be calibrated for the amount of load by an electronic device 720 or amount of load when no electronic device 720 is connected. The amount of power being drawn, as discussed above, can be measured by the size and frequency of the pulses. The voltage can be measured across a capacitor within a circuit that connects to a transformer output winding of the electronic device 720. In one form, when the power load is sufficiently small, the capacitor will drain faster than the recharging thereof, eventually resulting in the transistor 540 being charged to open the relay plates 530a, 530b. In another form, the capacitor can be connected to a comparator (such as a simple IC) so that the comparator switches to a state that again charges the transistor 540.

[0103] In other related forms, intermittent monitoring for the presence of the electronic device 720 may be performed. In one form, for instance, the IC 710 and switch 734 may intermittently monitor the load via the load sensing device 400. For instance, the IC 710 may shut down most of the power device, yet power up the load sensing 400 periodically (i.e., every couple minutes) for a fraction of a second to determine if the electronic device 720 is present (which would be recognized by the load characteristics across ground G and the direct power output).

[0104] As described, various power devices include a variety of features that may be selected and/or combined within the scope of the present invention to provide a means for low-power consumption of phantom load, for intermittent power consumption, or for no power consumption. As can be seen, some or these power devices are dependent in operation on the presence or absence or the electronic device, such as would be best suited for a portable, rechargeable device that is removed when charged, while others are independent of the presence or absence of the electronic device, such as would be useful for a computer which is commonly left plugged in and connected to a power device (i.e., power brick) when turned off.

[0105] It should be noted that a variety of the features discussed herein may be combined with other features discussed herein. Towards this end, Fig. 8, for instance, shows a number of features which are not necessary for practicing the invention in all its forms. As described above, Fig. 9 is directed towards a form of the power device utilizing a relay 530 driven to close the circuit, and Fig. 11 shows a similar form of a circuit for such power device utilizing a relay 530' driven by a relay coil 532', the relay 530' being located in the circuit at a position so that opening the relay 530' disconnects all power consumption for the power device. Fig. 3, discussed above, shows a relatively simple circuit architecture in which a switch 20 connects at or proximate one of the prongs 32 for disconnecting the input power before the power-consuming components, resulting in a zero current draw. As noted in Fig. 3, the switch 20 may be integrated into the cable 80 so that the switch 20 is remote from the other circuitry, as has been discussed above. Figure 10 shows a circuit architecture for the power device wherein the Gain and Level Detection operates to monitor pulses from a transformer secondary winding SW to drive a Primary Switch in the with a voltage proportional to the load current. The form of Fig. 10 utilizes a momentary connection at switch 20 to activate the power device, via a brief current resulting from the connection, and Controls operate the Primary Switch as an automatic shut-off feature when the power device is to he turned off, such as due to the electronic device being charged or disconnected. It should be noted that the Gain and Level Detection, the Control, and the Primary Switch may be included in an IC not shown or in the IC shown in the Fig. 10. Fig. 12 shows the switch 20 preferably being a solid state switch, and the power device circuit architecture is designed so that upon momentary connection (including connection and subsequent release) a small current through the switch 20 is recognized to power on or activate the device from an "off" state, and current at resistor R_{sense} is recognized by Gain and Level Detection to control the Primary Switch, voltage below a threshold being used to determine and switch to an "off" state for the power device.

[0106] Turning now to Figs. 13-15, another form of the present invention is illustrated. While the previously-discussed and illustrated forms of the invention are generally directed towards a cable assembly that is a part of a power charger, as a single device, it is recognized that different electrical devices have different electrical requirements. Furthermore, it is also recognized that people may prefer to continue using the manufacturer-provided charger or that the manufacturer-provided power cord may not be removable from the device (i.e., the power cord is hardwired, such as for a VCR).

[0107] Accordingly, Figs. 13-15 illustrate a cable assembly 200 for use with any power cable (not shown) for any electrical device (not shown). The cable assembly 200 has a first end 202 including a plug 204 having a plug body 206 with structure for connection with a power source in the form of prongs 208 extending from a first face 210. The plug body 206 has a second face 212, oriented opposite the first face 210, for electrical connection with the electrical device in the form of openings 214 forming a secondary power outlet 216.

[0108] When the electrical device is connected with the cable assembly 200, which is connected with the power source, the cable assembly 200 allows a user to connect or disconnect the power supply to the electrical device via the cable assembly 200. Towards this end, a cable 220 extends from the body 206 including a pair of wires 222a, 222b (see Fig. 14, e.g.) generally corresponding to wires 60a and 60b of the previous embodiments. The cable assembly 200 includes a second end 224 to which the cable 220 extends, the second end 224 including a user-activated switch 226 for connecting or disconnecting the wires 222a, 222b. In a variety of forms, the switch 226 may be a momentary-contact switch with a timed-shut off (including a push-button switch or a motion-activated switch such as a mercury switch), or, in the simplest form, the switch 226 may be a two-position switch such as a toggle or rocker switch, as is illustrated above as toggle member 52, each of the wires 222a, 222b having switch terminals 230a and 230b, respectively (the switch terminals 230a and 230b analogous to switch terminals 52a and 52b, discussed above).

[0109] Accordingly, the switch 226 of the cable assembly 200, when used with an electrical device, may be co-located with the electrical device. For instance, a cellular phone typically has a AC to DC power charger having a cable extending from a charger body, a DC connector for connecting with a power input to the cellular phone being at the end of the cable. A user may plug the phone charger into the cable assembly 200, and the charger connector may be co-located with the switch 226 so that the charger cable and cable assembly cable 220 run alongside each other. In some forms, additional components may be provided for holding the cables together. In some forms, the switch 226 or a portion of the cable assembly 200 proximate thereto may include a clip or other component for securing the switch 226 with the DC connector, as will readily be recognized.

[0110] Turning now to Fig. 14, a diagram of a first form of a circuit 240 is depicted for the cable assembly 200. As can be seen, the circuit 240 includes first and second inputs 242a and 242b corresponding to the prongs 208 and corresponding to "+" and "-" electrodes. The input rating for the circuit 240 is, in the present form, 120-240 volts AC as is known in the art, though this may be different such as for countries other than the United States. The circuit 240 includes first and second outputs 250a and 250b corresponding to the openings 214 and secondary power outlet 216 for electrical connection with the plug (not shown) of the electrical device cord or charger or the like.

[0111] As can be seen, the inputs 242a and 242b are electrically connected or connectable to the outputs 250a and 250b, respectively. The input 242a is directly wired to output 250a via wire 254; however, the input 242b is connected to wire 222a having switch terminal 230a, while output 250b is connected to wire 222b having switch terminal 230b. Accordingly, the switch 226 may be used to connect or disconnect switch terminal 230a with switch terminal 230b and, hence, to connect input 242b with output 250b. It should be noted that a power-limiting device in the form of a fuse 260 is provided in-line with the switch 226.

[0112] Turning now to Fig. 15, a diagram of a second form of a circuit 280 for the cable assembly 200 is depicted. Like circuit 240, a pair of inputs 282a and 282b are provided corresponding to the prongs 208, and a pair of outputs 284a and 284b are provided corresponding to openings 214 and secondary power outlet 216 for electrical connection with the plug of the electrical device cord or charger or the like. The input 282a is directly connected to output 284a via wire 286, as well as directly connected to an input 288 of a non-isolated DC power supply 290 (including a transformer, as will be recognized).

[0113] The circuit 280 includes a representative form for allowing momentary contact or activation of the switch 226 by the user to connect the power from the power source to the secondary power outlet 216 and the electrical device connected thereto. The input 282b is connectable to the output 284b across the switch 226. Again, it should be noted that the wires 222a and 222b include the switch terminals 230a and 230b and extend through the cable 220 for connection/disconnection via the switch 226. Within the cable assembly plug body 206 is a sub-circuit 300 that is activated by the switch 226.

[0114] The sub-circuit 300 includes the input 288 and a second input 302 so that, upon momentary connection via the switch 226, the power supply 290 receives input AC power. The power supply 290 provides output DC power to a control 304 including a timer and relay circuit.

[0115] Upon connection and activation of the power supply 290 and the control 304, a power-on relay coil, referred to herein for simplicity as the on-coil 306, physically shifts a relay contact 308 to a closed position across contact terminals 308a and 308b thereof. In the closed position, the relay contact 308 connects the input 282b with the output 284b, thus providing electrical power to an electrical device connected at the secondary power outlet 216.

[0116] The timer of the control 304 is also activated by the at least momentary connection of the switch 226. After a predetermined time, the timer serves to notify the control 304 to activate a power-off relay coil, referred to herein for simplicity as the off coil 310, which physically shifts the relay contact 308 to an open position, as is illustrated in Fig. 15. It should be noted that a secondary relay 316 is provided and is opened and closed in a manner corresponding to the position of the relay contact 308 so that, while the relay contact 308 is in the closed position, the relay 316 provides power to the power supply 290 and the control 304. In some forms, the relay contact 308 and relay 316 may be combined, as will be readily recognized. In simple forms, the predetermined time for the time may be selected as a manufacturing or programming step corresponding to a designated use for the cable assembly 200, while in more complex forms the predetermined time may be programmed or selected by a user depending on a desired application of the cable assembly 200.

[0117] In a form of the circuit 280 shown in Fig. 16, the circuit 280 is adapted to additionally or alternatively sense a level of current through an output and automatically shut off when the current drops below a predetermined level. As can be seen, a current sense element 340 is provided across points 341 and 343, in which case there is no connection between points 341 and other than through the current sense element 340. Preferably, the current sense element 340 is connected with the control 304 so that the circuit 280 is shut off in the same manner as described above by the off coil 310 opening the relay 308.

[0118] In one preferred embodiment, the control 304 ignores a low current level from the current sense element 340 for a predetermined period of time. It is not uncommon for batteries, at the beginning of a charge cycle, to draw a low amperage current. By providing an initial period of time from the push button starting of switch 226 in which a low current through the current sense element 340 is ignored, the circuit 280 remains closed until for a sufficient period to allow the current to rise. Otherwise, the low current may cause the current sense element 340 to provide an indication to the control 304 to open the circuit 280 via the off coil 310.

[0119] While in some forms a current threshold (below which the circuit 280 is shut down) is predetermined, the threshold may also be adjustable. For instance, a switch or knob is provided that may be used to select a current level, this selection being made prior to connection with the electronic device such as a cell phone and its charger. Alternatively, the circuit 280 may be adapted to sample current to the electronic device when in the idle state, and internally storing a set-point (such as storing a set-point as a threshold in the control 304).

[0120] It should be noted that, while it is preferred to use the above described timer feature in conjunction with the current sensing feature, either could be used separately and independently of the other. In greater detail, the timer feature of circuit 280 as illustrated in Fig. 16 may be simplified by eliminating a requirement that the circuit 280 open after a predetermined period of time, instead relying on the current sense element 340 alone. Additionally, in some forms, the initial period during which a low current is ignored would not be necessary.

[0121] While the invention has been described with respect to specific examples including presently preferred modes of carrying out the invention, those skilled in the art will appreciate that there are numerous variations and permutations of the above described systems and techniques that fall within the spirit and scope of the invention as set forth in the appended claims.

WHAT IS CLAIMED IS:

1. A power device for supplying power to a portable rechargeable electronic device, the power device comprising:

a first portion for receiving electrical input power from a source;

a second portion for delivering electrical output power to the electronic device;

a connector located on the second portion and removably connectable with the electronic device; and

a switch assembly located remote from the first portion, wherein the switch assembly is operable for connection and disconnection of the output power.

2. The power device of Claim 1, wherein the switch assembly includes a member movable to and between first and second positions corresponding to respective "on" and "off" states, wherein the power device receives the input power in the "on" state, and the power device draws no input power in the "off" state.

3. The power device of Claim 1 further comprising:

a third portion including the switch; and

a cable extending between the first and third portions,

wherein the second portion is operable to provide output power to the electrical device.

4. The power device of claim 1 wherein the first portion includes a plug having a plug body and a first and second side, the first side having prongs for electrical connection with the power source in the form of a power outlet, the second side having a secondary power outlet for receiving prongs of the electrical device for delivering electrical power thereto.

5. The power device of claim 4 wherein the switch may be secured with a portion of the electrical device.

6. The power device of claim 5 wherein the electrical device includes a power cord including a connector for removable connection from the electrical device, and wherein the switch may be secured with the connector.

7. The power device of claim 1 wherein the switch is a two-position user-actuated switch.

8. The power device of claim 1 wherein the switch assembly member is a throw.

9. The power device or claim 8 wherein the throw is a toggle or rocker throw.

10. The power device of claim 1 wherein the switch assembly member is a

sheath longitudinally movable to and between the first and second positions.

11. The power device of Claim 1, wherein the switch assembly is user-actuated.

12. The power device of claim 11 wherein the switch is user-actuated by a momentary connection across switch terminals thereof.

13. The power device of claim 12 further including a timer, wherein actuation of the switch allows power to be provided to the second portion for a predetermined time, and the timer effects disconnection of the power after the predetermined time.

14. The power device of claim 13 further including a current sense element, wherein the power in the power device is disconnected when a current level through the current sense element is below a threshold level.

15. The power device of claim 14 wherein a predetermined delay period is provided, wherein the power in the power device remains connected for the delay period subsequent to actuation of the switch.

16. The power device of claim 11 further including a current sense element, wherein the power in the power device is disconnected when a current level through the current sense element is below a threshold level.

17. The power device of claim 1 further including a cable extending between the first portion and the second portion, the cable including a first pair of wires for delivering power to the electronic device and a second pair of wires for communicating with the switch assembly, and wherein the first portion includes:

first and second prongs for electrical communication with a receptacle of a power outlet;

circuitry electrically connected to the prongs and to the cable for changing the input power to the output power; and

a housing from which the prongs and cable extend, the circuitry disposed within the housing.

18. The power device of claim 17 wherein the second pair of wires is connected such that when the switch assembly is operating for disconnection of the output power, the switch assembly disconnects at least one of the first and second prongs from at least a portion of the circuitry to prevent power from being drawn by the power device.

19. The power device of claim 17 wherein the switch assembly is located proximate the second portion and connector thereof.

20. A cable assembly for a power device having electrical circuitry for supplying output power to an electronic device comprising:

a first sub-cable including:

a switch; and

a pair of switch wires electrically connectable via the switch;

a second sub-cable including:

a pair of output wires, each of the wires connected with output power from the power device, and each of the output wires electrically connected with a connector for transmitting output power to the electronic device,

wherein the switch is operable to open and close the electrical circuitry, the electrical circuitry drawing substantially no power when open.

21. The cable assembly of claim 20 wherein the first and second sub-cables are encased by a single jacket.

22. The cable assembly of claim 20 wherein the first and second sub-cables are joined by a bridge.

23. The cable assembly of claim 20 wherein the switch disconnects power from an input terminal of the power device electrically connected to a power source.

24. The cable assembly of claim 23 wherein the switch disconnects the input terminal in the form of a plug prong of the power device from the power device electrical circuitry.

25. The cable assembly of claim 20 wherein the first and second sub-cables are substantially joined in parallel to extend a length from a housing of the power device in which the electrical circuitry is disposed to a switch assembly including the switch.

26. The cable assembly of claim 25 wherein the second sub-cable extends from the switch assembly to the connector.

27. The cable assembly of claim 25 wherein the output wires extend from the switch assembly to the connector.

28. The cable assembly of claim 20 wherein the switch is a functional switch.

29. The cable assembly of claim 20 wherein the switch is remotely located from the electrical circuitry.

30. The cable assembly of claim 20 wherein the power device is a step down AC to DC converter, and the switch cuts input AC power to the power device electrical circuitry.

31. The cable assembly of claim 20 wherein the switch is moveable between first and second positions corresponding to open and close the electrically circuitry.

32. The cable assembly of claim 20 wherein the cable assembly is elongated and

flexible, the power device includes input prongs for receiving input power from a power source and includes a housing within which the electrical circuitry is generally disposed, and the switch is located remotely from the housing.

33. A power device for supplying power to a portable rechargeable electronic device, the power device comprising:

a first portion for receiving electrical input power from a source, the input having an input voltage;

a second portion for delivering electrical output power to the electronic device, the output power having an output voltage;

circuitry for converting the input voltage to the output voltage and for determining an "off" state of the circuitry;

a connector located on the second portion and removably connectable with the electronic device; and

a switch assembly having powered terminals to change the circuitry to an "on" state, wherein the circuitry automatically turns the circuitry to the "off" state, the circuitry drawing no power when in the "off" state.

34. The power device of Claim 33 wherein the switch assembly is responsive to movement of at least a movable portion thereof to electrically connect the powered terminals and to provide an output signal to activate the circuitry to the "on" state.

35. The power device of claim 34 wherein the switch assembly movable portion is biased to a first position and is movable to a second position by force applied by the user to change the circuitry to the "off" state.

36. The power device of claim 35 wherein cessation of the force permitting the movable portion to return to the first position.

37. The power device of claim 34 wherein the switch assembly movable portion is a pushbutton spring-biased to a first position and is movable to a second position by force applied by the user, the pushbutton in the second position electrically connecting the terminals to produce the output signal, the output signal being a momentary signal from a momentary connection of the terminals, and releasing the pushbutton permits return thereof to the first position.

38. The power device of claim 34 wherein the switch assembly movable portion is an orientation-dependent switch.

39. The power device of claim 34 wherein the switch assembly movable portion is a motion-sensing switch.

40. The power device of claim 33 wherein the circuitry includes a timer programmed with a predetermined time period, the timer providing a timer signal to the circuitry at the conclusion of the time period, and wherein the circuitry automatically changes to the “off” state in response to the timer signal.

41. The power device of claim 33 wherein the circuitry includes a power sensing portion programmed with a predetermined threshold power level, wherein the circuitry automatically changes to the “off” state in response to the output power being at or below the threshold power level.

42. The power device of claim 33 wherein the circuitry includes a latching relay that is closed in response to the switch assembly changing the circuitry to the “on” state, the latching relay being opened in response to the output power being at or below a threshold power level to change the circuitry to the “off” state.

43. The power device of claim 33 wherein the circuitry includes a solid state switch element that opens in response to the output power being at or below a threshold power level to change the circuitry to the “off” state.

44. The power device of claim 33 wherein the switch assembly is located remote from the first portion.

45. The power device of claim 33 wherein the switch assembly is located proximate the second portion.

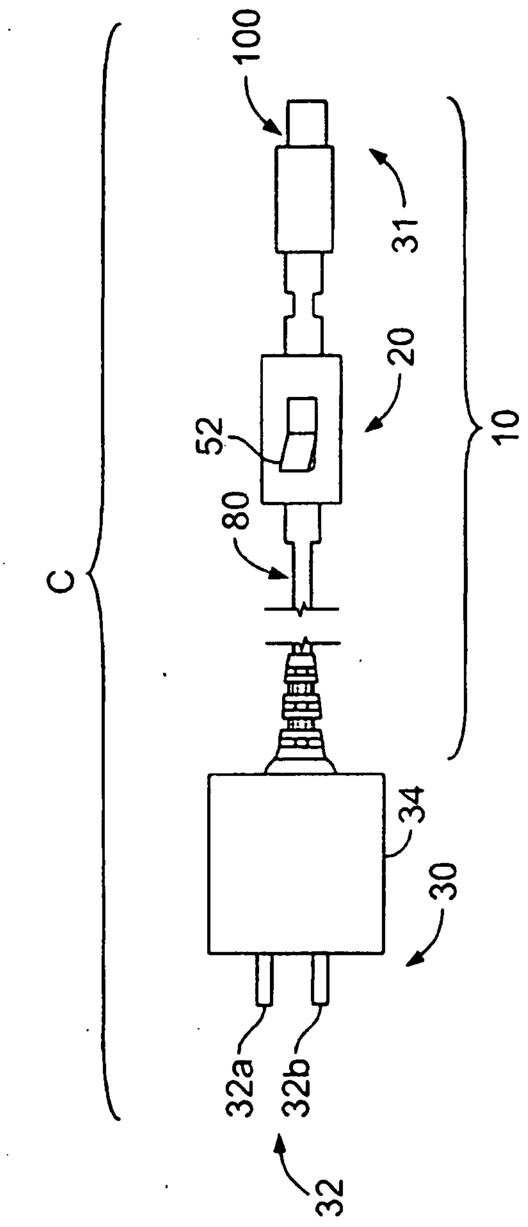

FIG. 1

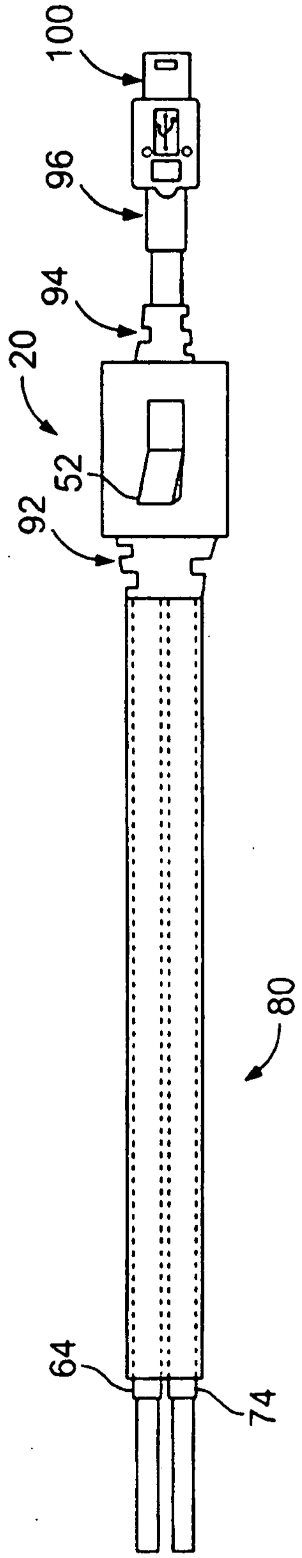

FIG. 2

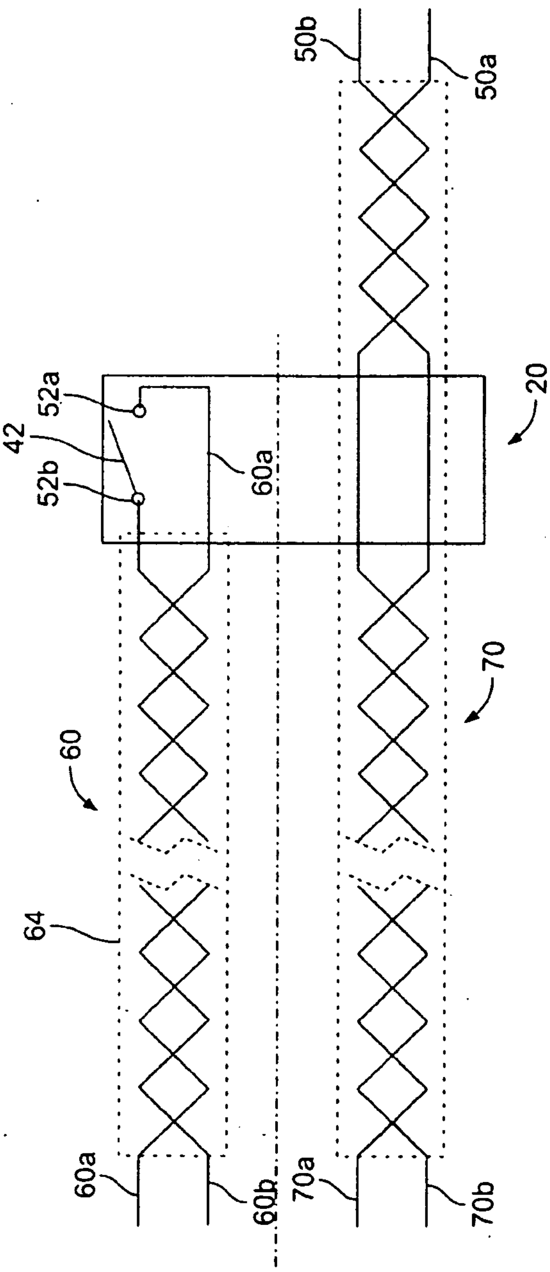

FIG. 3

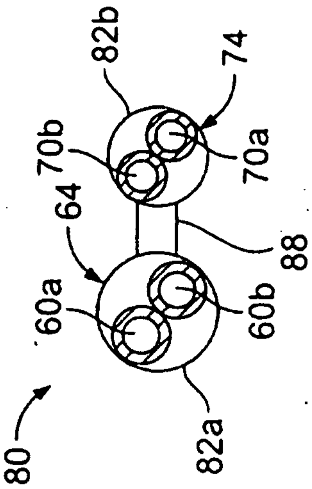

FIG. 5B

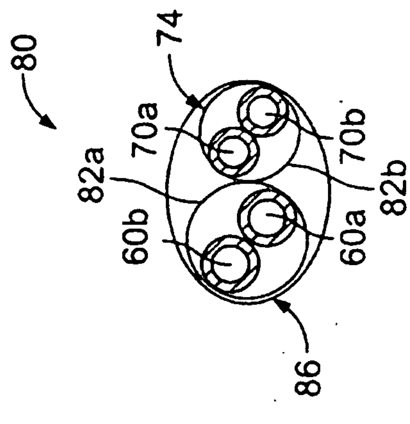

FIG. 5A

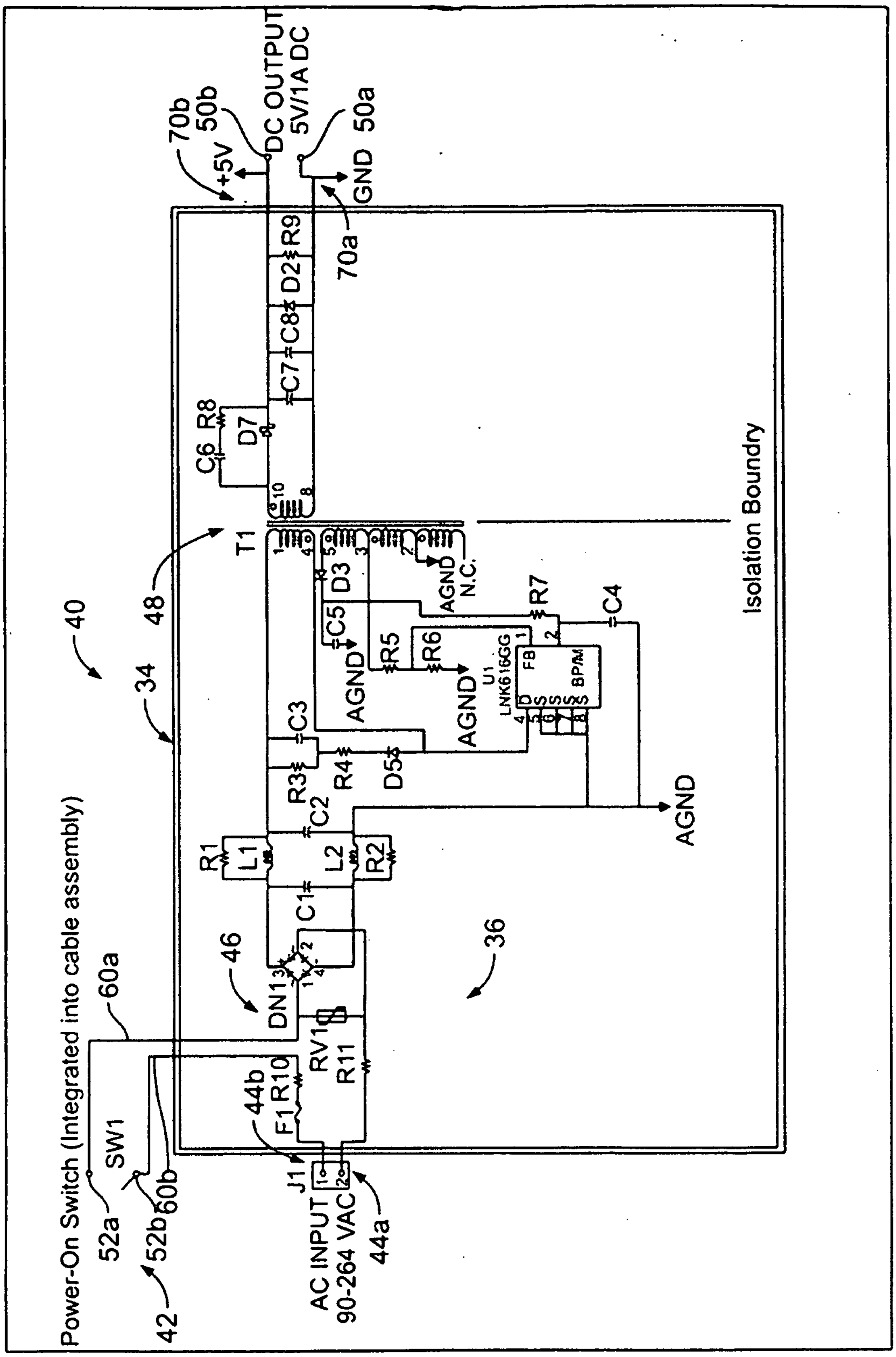
DC OUTPUT
5V/1A DC
70b
50b
+5V
GND
50a
70a
R9
D2
C8
C7
R8
C6
D7
T1
48
40
34
Isolation Boundry
D3
C5
AGND
N.C.
R7
C4
R5
R6
U1
LNK616GG
FB
BP/M
C3
R3
R4
D5
C2
R1
L1
L2
R2
C1
46
DN1
36
RV1
R10
R11
F1
44b
J1
AC INPUT
90-264 VAC
44a
SW1
60a
60b
52a
52b
42
Power-On Switch (Integrated into cable assembly)

FIG. 4

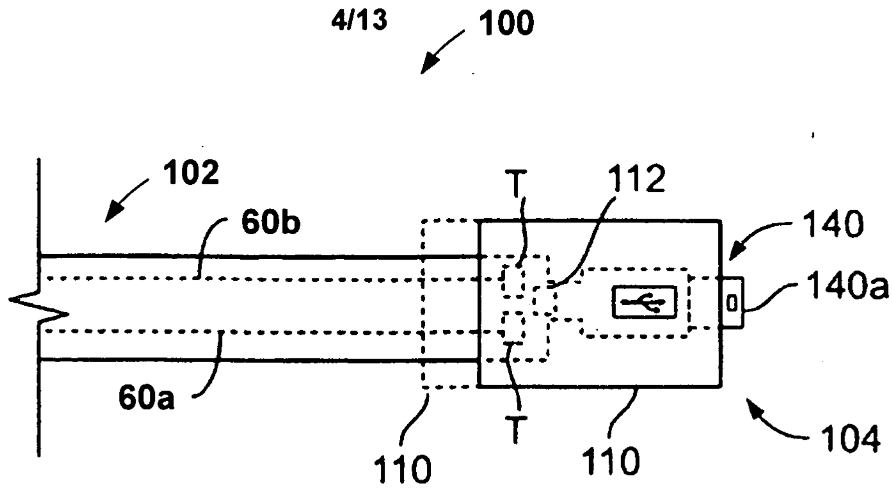
100
102
60b
T
112
140
140a
60a
T
110
110
104

FIG. 6

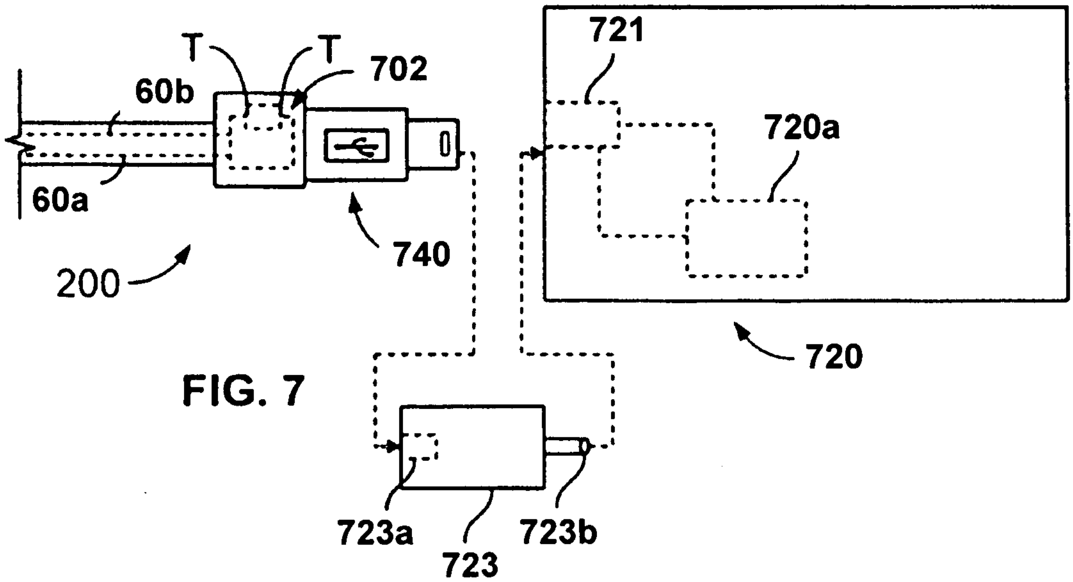
T
T
702
60b
60a
740
200
721
720a
720
723a
723
723b

FIG. 7

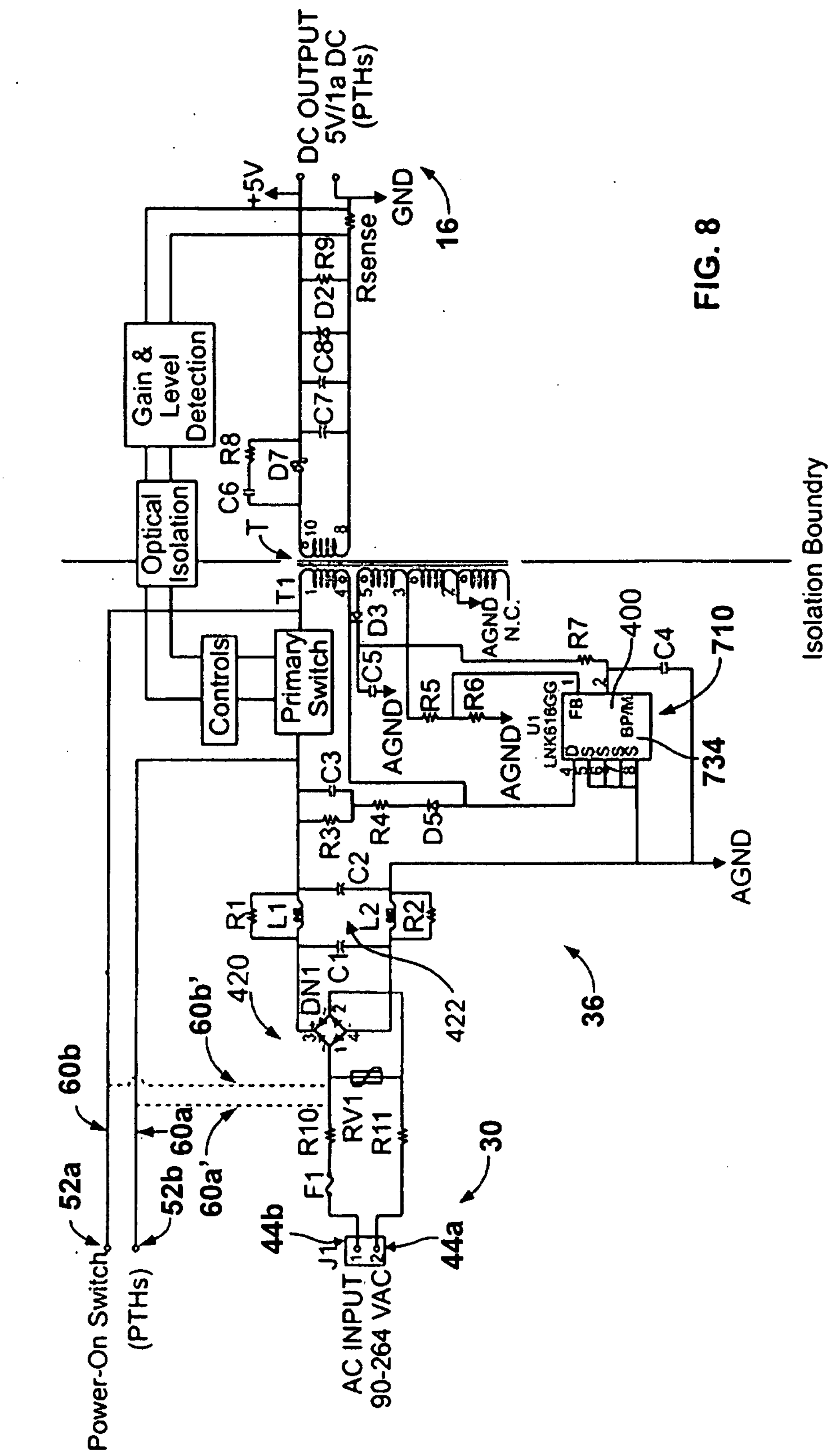
DC OUTPUT
5V/1a DC
(PTHs)
+5V
GND
16
Rsense
R9
D2
C8
C7
Gain &
Level
Detection
R8
D7
C6
T
10
8
Optical
Isolation
Isolation Boundry
T1
Controls
Primary
Switch
D3
C5
AGND
N.C.
R5
R6
R7
400
C4
710
U1
LNK616GG
FB
BP/M
D
S
734
AGND
C3
R3
R4
D5
C2
R1
L1
L2
R2
C1
DN1
420
422
36
60b'
60b
52a
Power-On Switch
(PTHs)
52b
60a
60a'
R10
RV1
R11
F1
30
44b
J1
44a
AC INPUT
90-264 VAC

FIG. 8

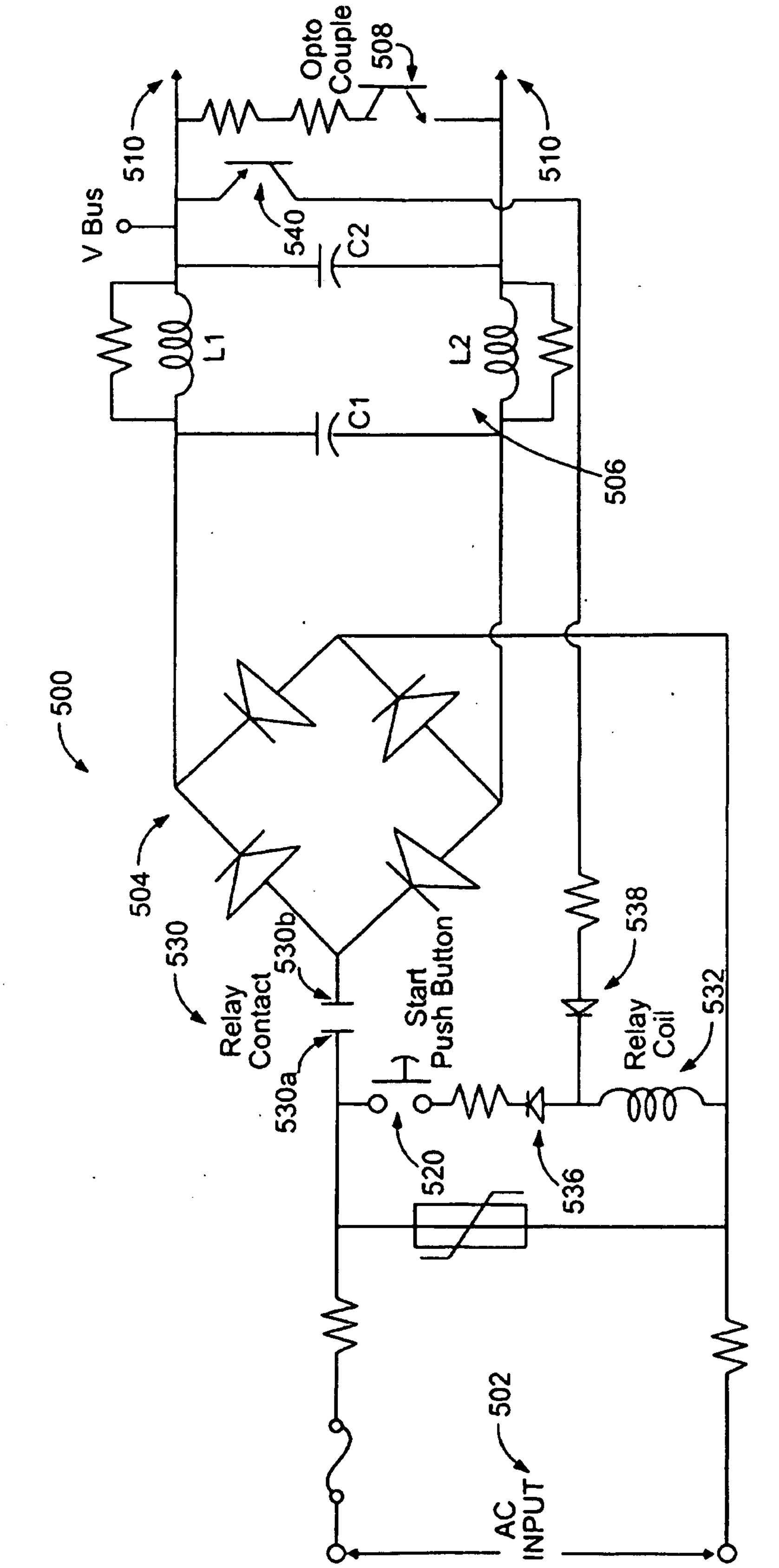
V Bus
510
510
Opto
Couple
508
540
C2
L1
L2
C1
506
500
504
530
Relay
Contact
530b
530a
Start
Push Button
520
536
538
Relay
Coil
532
502
AC
INPUT

FIG. 9

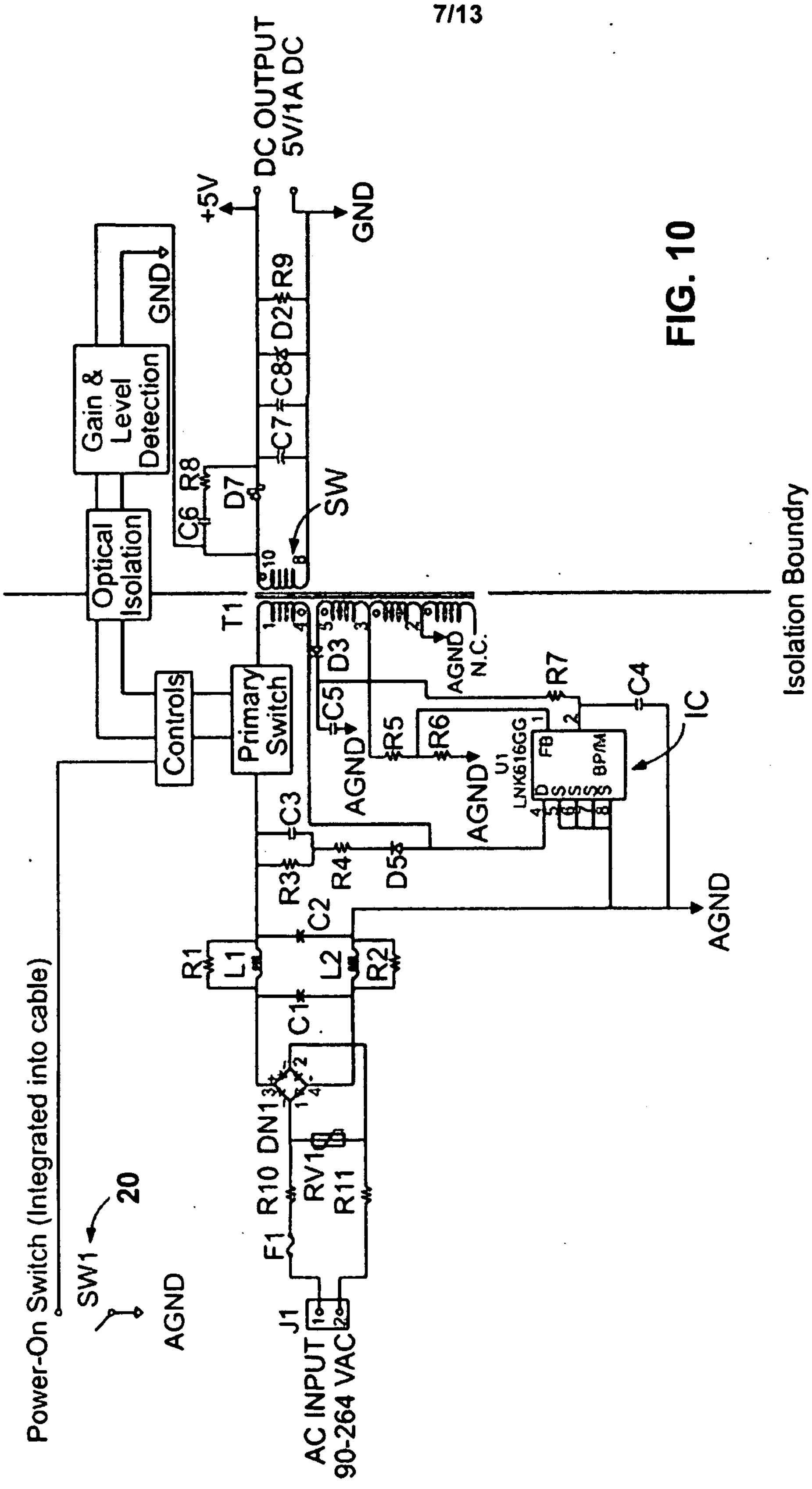
DC OUTPUT
5V/1A DC
+5V
GND
Gain &
Level
Detection
GND
C6
R8
D7
C7
C8
D2
R9
SW
10
8
Optical
Isolation
Isolation Boundry
T1
Controls
Primary
Switch
D3
AGND
N.C.
R7
C4
C5
R5
R6
AGND
U1
LNK616GG
FB
BP/M
D
S
IC
C3
R3
R4
D5
AGND
C2
R1
L1
L2
R2
C1
DN1
R10
RV1
R11
F1
J1
AC INPUT
90-264 VAC
Power-On Switch (Integrated into cable)
SW1
20
AGND

FIG. 10

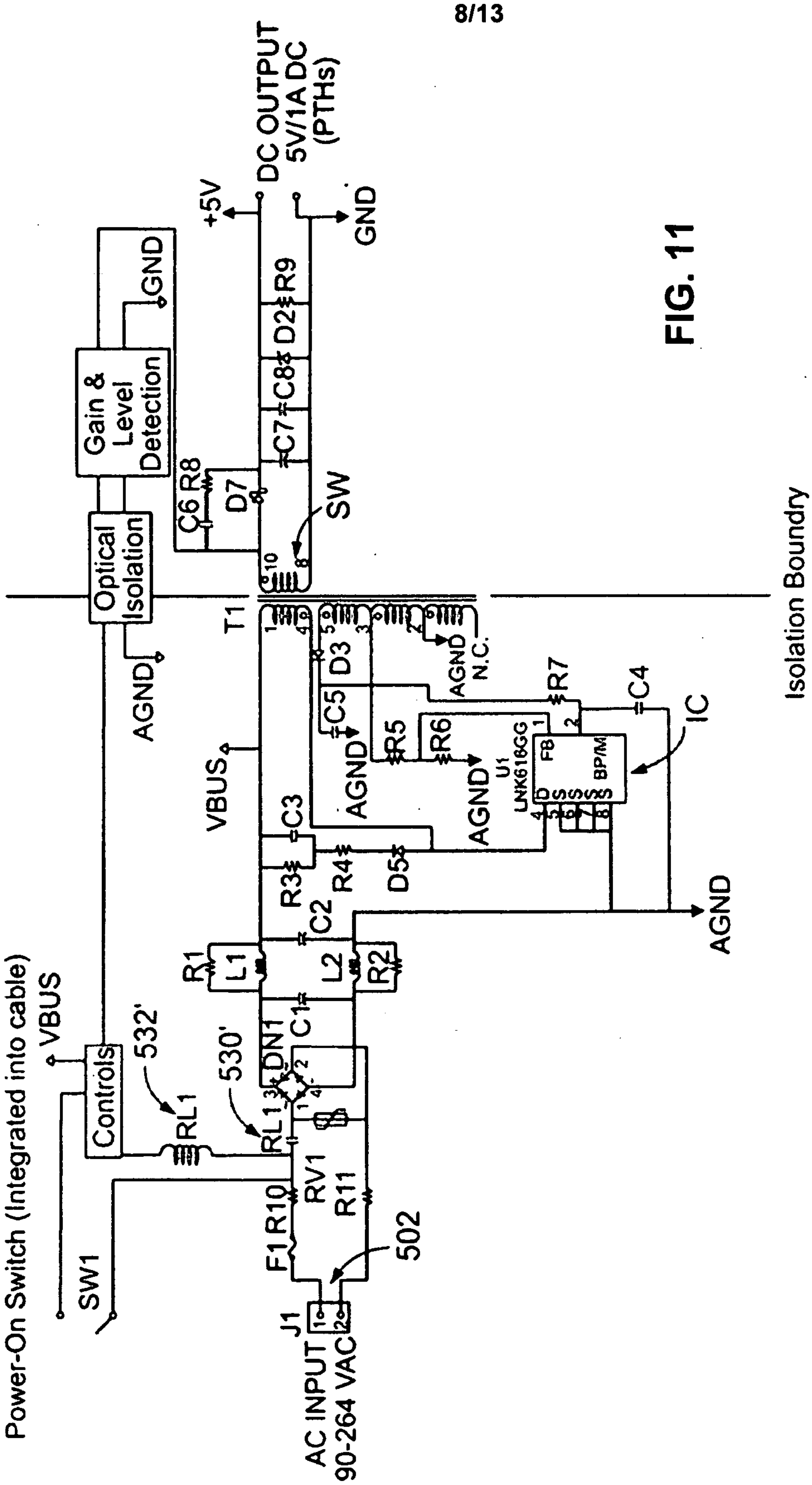
DC OUTPUT
5V/1A DC
(PTHs)
+5V
GND
Gain &
Level
Detection
Optical
Isolation
C6 R8
D7
C7
C8
D2
R9
SW
10
8
T1
Isolation Boundry
AGND
VBUS
C5
D3
R5
R6
AGND
N.C.
R7
C4
IC
U1
LNK616GG
FB
BP/M
D
S
C3
R3
R4
D5
AGND
C2
R1
L1
L2
R2
C1
DN1
530'
532'
RL1
Controls
VBUS
Power-On Switch (Integrated into cable)
SW1
RV1
R10
R11
F1
502
J1
AC INPUT
90-264 VAC

FIG. 11

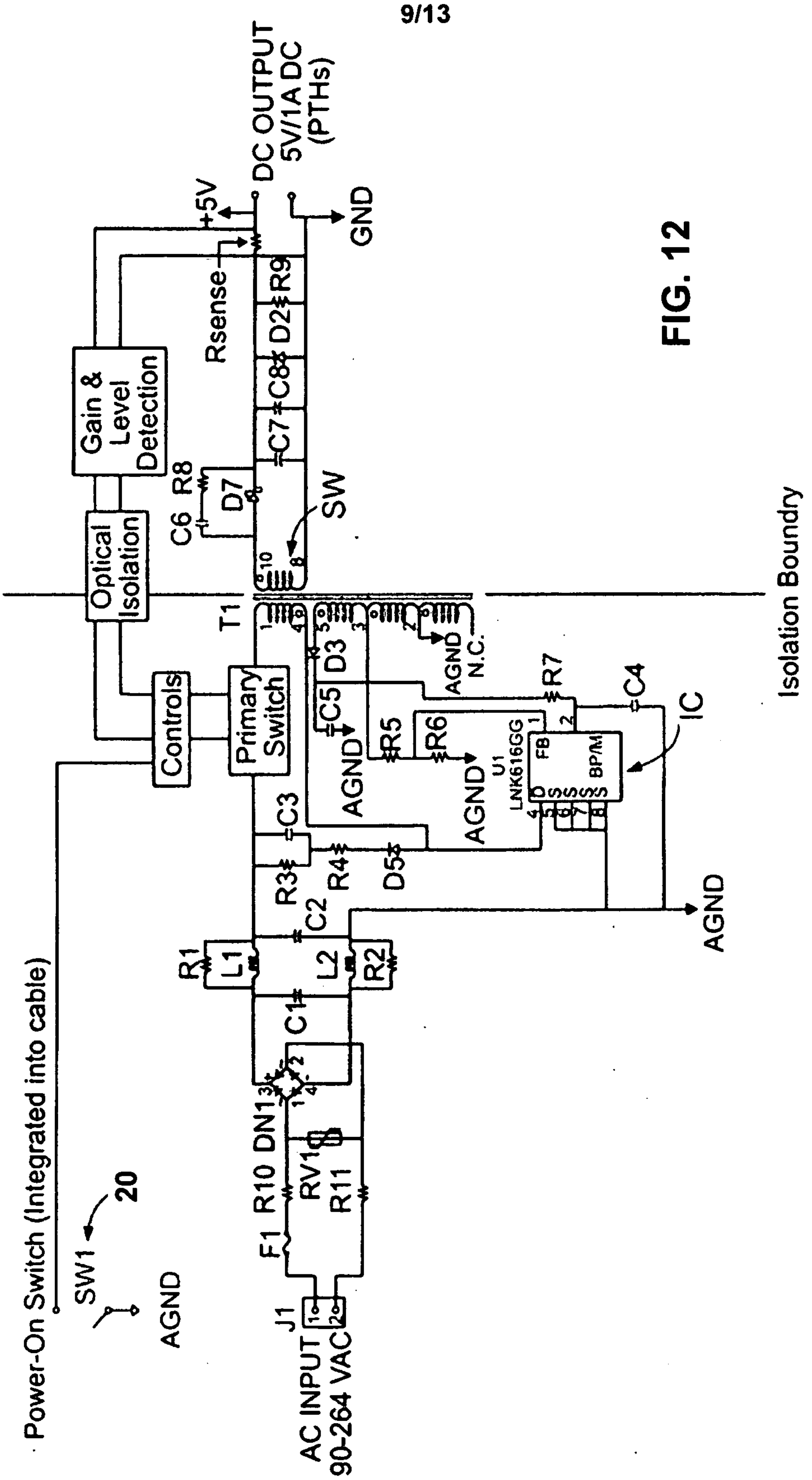
DC OUTPUT
5V/1A DC
(PTHs)
+5V
GND
Rsense
R9
D2
C8
C7
Gain &
Level
Detection
R8
D7
C6
SW
Optical
Isolation
Isolation Boundry
T1
D3
AGND
N.C.
R7
C4
C5
R5
R6
IC
U1
LNK616GG
FB
BP/M
D
S
Controls
Primary
Switch
AGND
C3
R3
R4
D5
C2
AGND
R1
L1
L2
R2
C1
DN1
R10
RV1
R11
F1
J1
AC INPUT
90-264 VAC
Power-On Switch (Integrated into cable)
SW1
20
AGND

FIG. 12

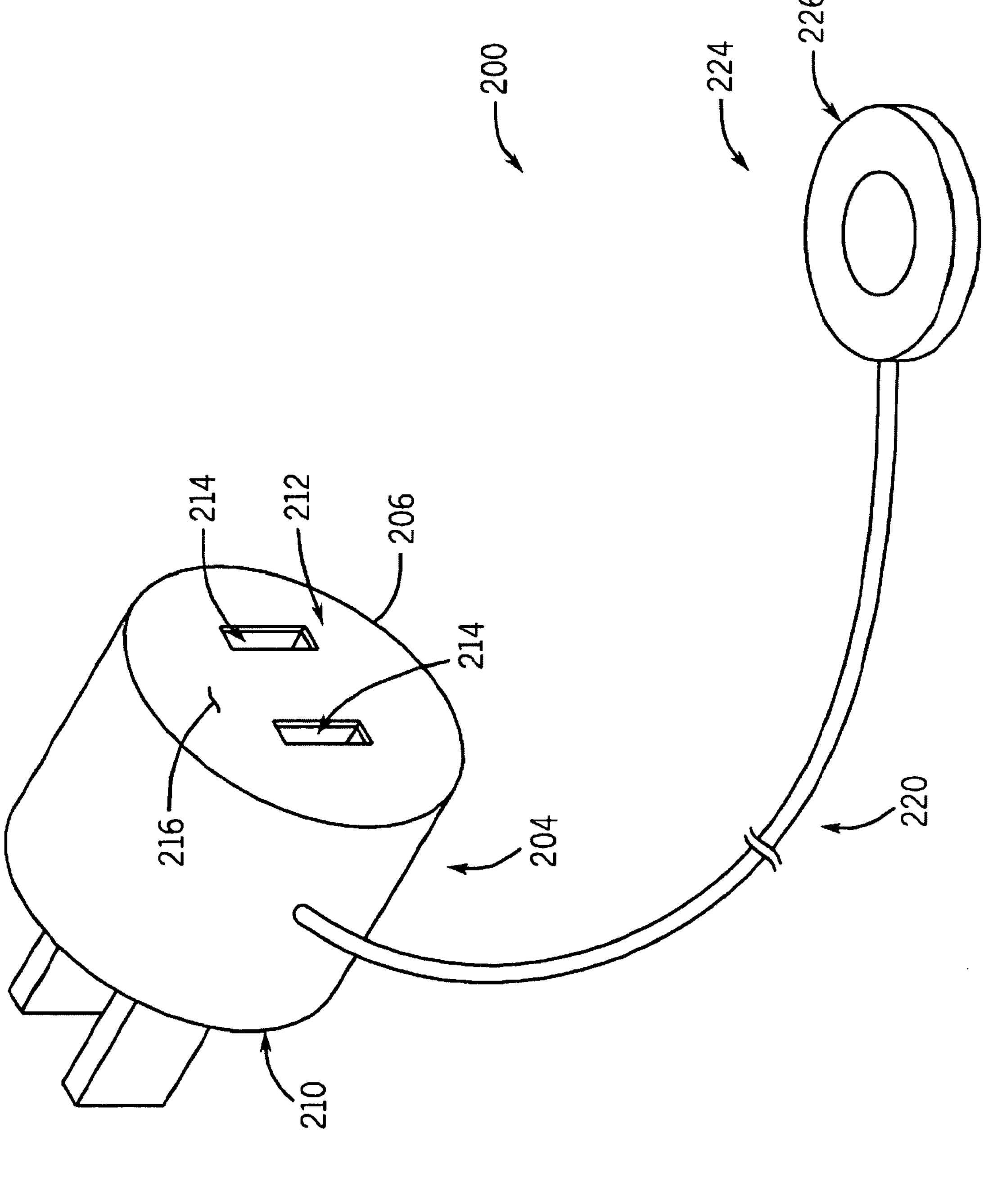

FIG. 13

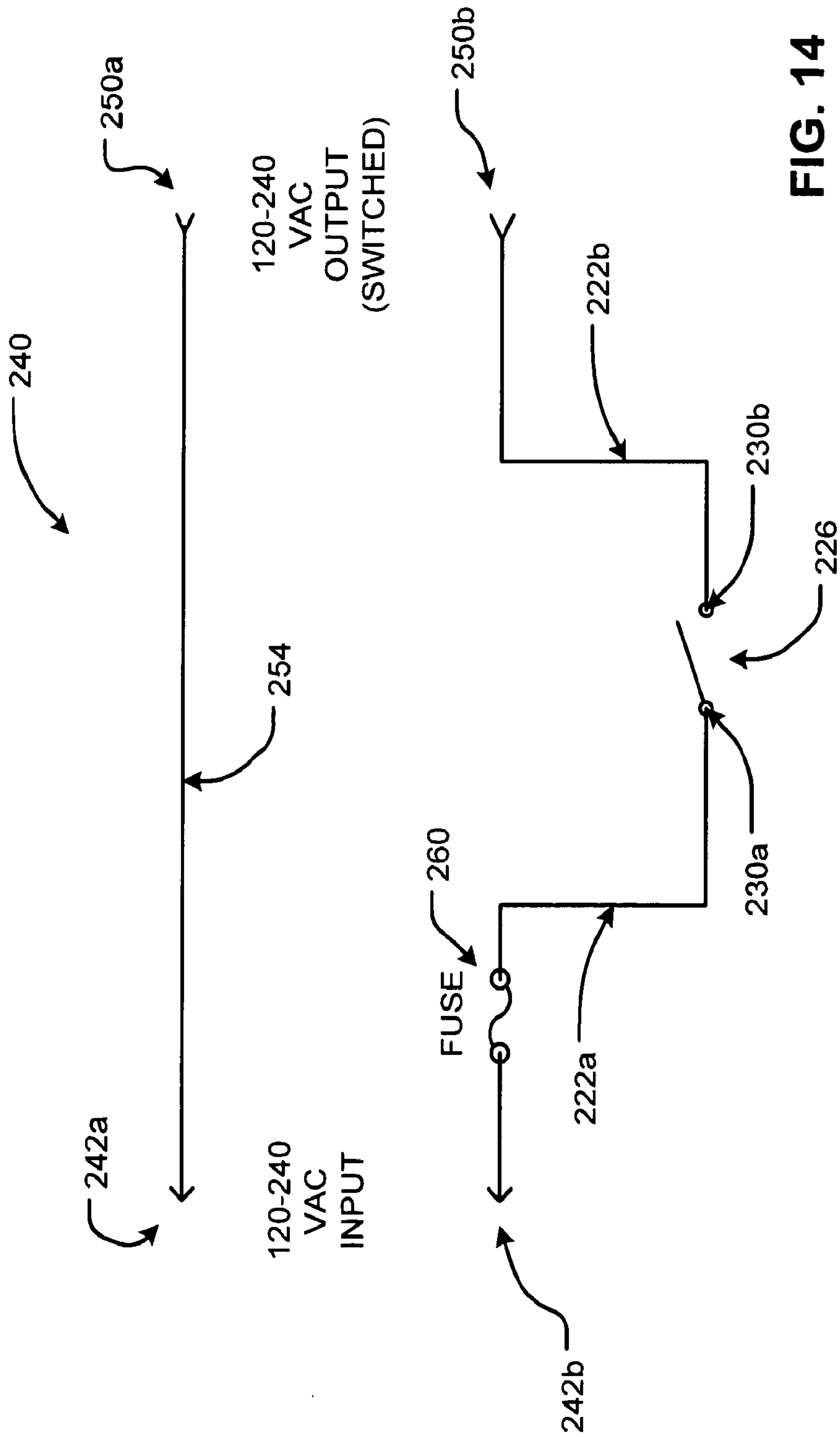
240
250a
120-240
VAC
OUTPUT
(SWITCHED)
250b
222b
230b
226
254
260
FUSE
230a
222a
242a
120-240
VAC
INPUT
242b

FIG. 14

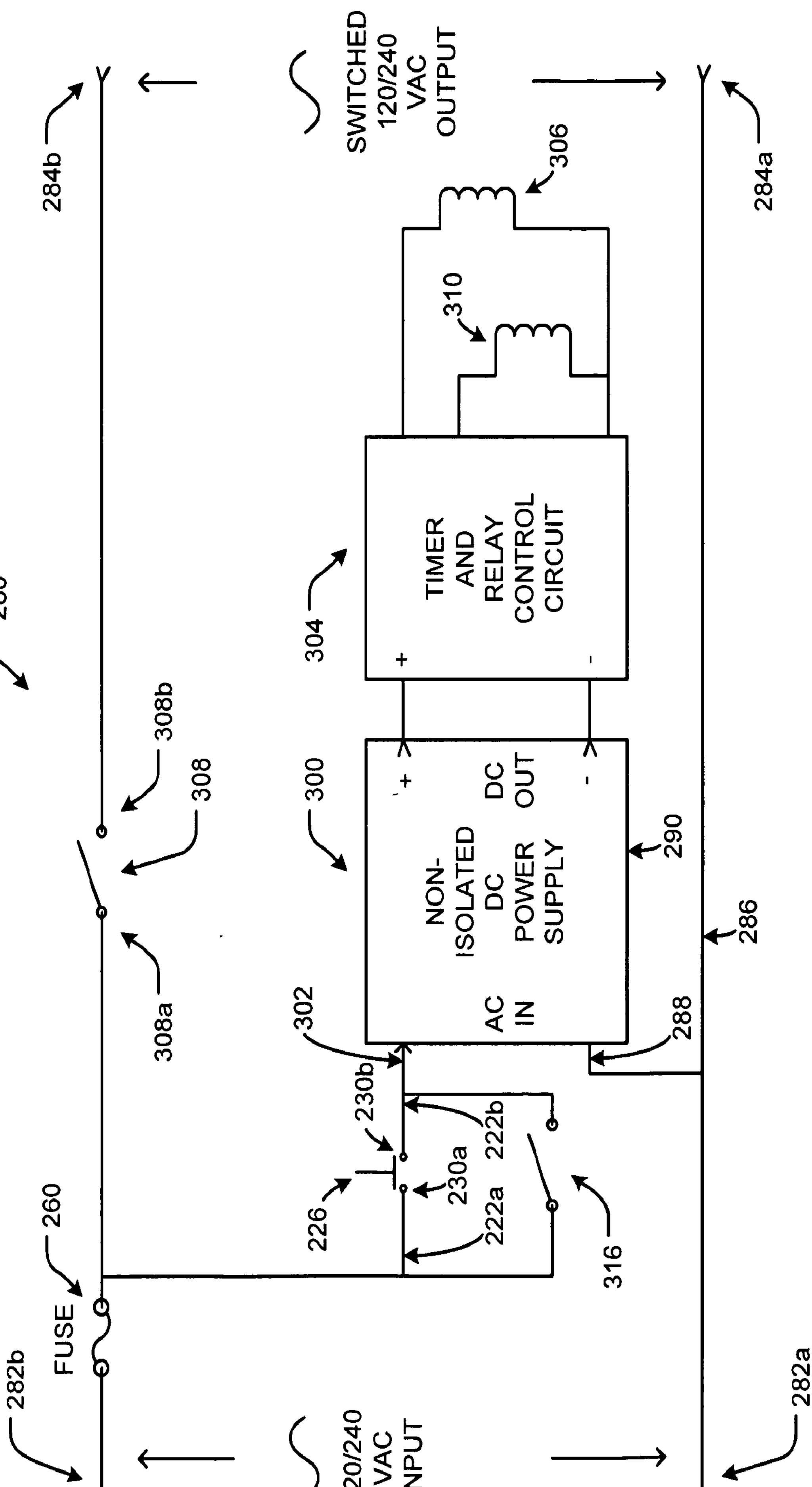
280
SWITCHED 120/240 VAC OUTPUT
284b
284a
306
310
TIMER AND RELAY CONTROL CIRCUIT
304
+
-
NON-ISOLATED DC POWER SUPPLY
AC IN
DC OUT
300
290
286
288
302
308b
308
308a
FUSE
260
230b
222b
230a
222a
226
316
282b
282a
120/240 VAC INPUT

FIG. 15

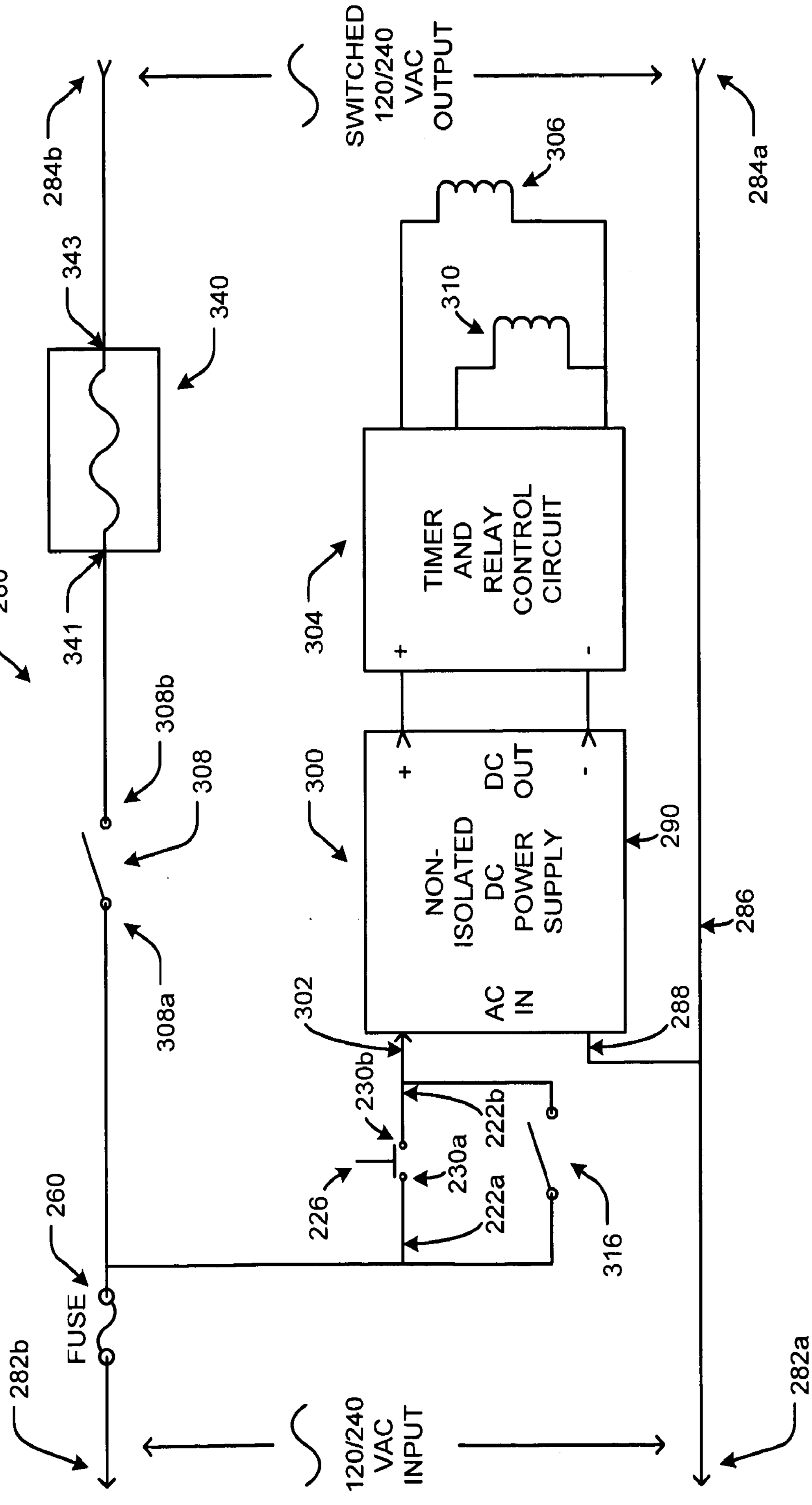
SWITCHED
120/240
VAC
OUTPUT
284b
284a
343
340
306
310
TIMER
AND
RELAY
CONTROL
CIRCUIT
+
-
280
341
304
308b
308
300
NON-
ISOLATED
DC
POWER
SUPPLY
DC
OUT
AC
IN
290
286
308a
302
288
230b
222b
230a
222a
226
260
316
FUSE
282b
282a
120/240
VAC
INPUT

FIG. 16

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 09/45325

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - H02J 7/16 (2009.01)
USPC - 320/162
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - H02J 7/16 (2009.01)
USPC - 320/162

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
IPC(8) - H02J 7/16 (2009.01) (text search)
USPC - 320/107, 114, 137, 152, 156, 157, 162; 439/617, 620.21 (text search)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PubWEST(USPT,PGPB,EPAB,JPAB); Internet search via Google Web and Google Scholar search engines. Search Terms Used: charge portable mobile plug prong outlet cord battery circuit switch bridge diode transformer LED button pushbutton AC/DC power current connector plug recharge blade standard outlet wall 120

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 2007/0164704 A1 (McGinley et al.) 19 July 2007 (19.07.2007) para. [0003] through [0040], Fig. 1-3	1-12, 17-39, 44 and 45 --- 13-16 and 40-43
Y	US 7,101,226 B1 (Gilliland) 05 September 2006 (05.09.2006) col. 2 ln. 52-56, col. 5 ln. 11 to col. 6 ln. 3, Fig. 2, 11a, 11b	13-16 and 40-43
A	US 2006/0292905 A1 (Gilliland) 28 December 2006 (28.12.2006) entire document	1-45
A	US 2007/0141894 A1 (McGinley et al.) 21 June 2007 (21.06.2007) entire document	1-45

☐ Further documents are listed in the continuation of Box C. ☐

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"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 July 2009 (15.07.2009)	27 JUL 2009

Name and mailing address of the ISA/US	Authorized officer:
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774