



US007084531B2

(12) **United States Patent**
Bruwer

(10) **Patent No.:** **US 7,084,531 B2**

(45) **Date of Patent:** **Aug. 1, 2006**

(54) **INTELLIGENT ELECTRICAL DEVICES**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 127 days.

(21) Appl. No.: **10/873,190**

(22) Filed: **Jun. 23, 2004**

(65) **Prior Publication Data**

US 2004/0227409 A1 Nov. 18, 2004

Related U.S. Application Data

(63) Continuation of application No. 09/806,860, filed as application No. PCT/ZA99/00107 on Oct. 8, 1999, now Pat. No. 6,984,900, which is a continuation-in-part of application No. 09/169,395, filed on Oct. 9, 1998, now Pat. No. 6,249,089.

(51) **Int. Cl.**
H01H 3/26 (2006.01)

(52) **U.S. Cl.** **307/140; 307/112**

(58) **Field of Classification Search** **307/140, 307/112**

See application file for complete search history.

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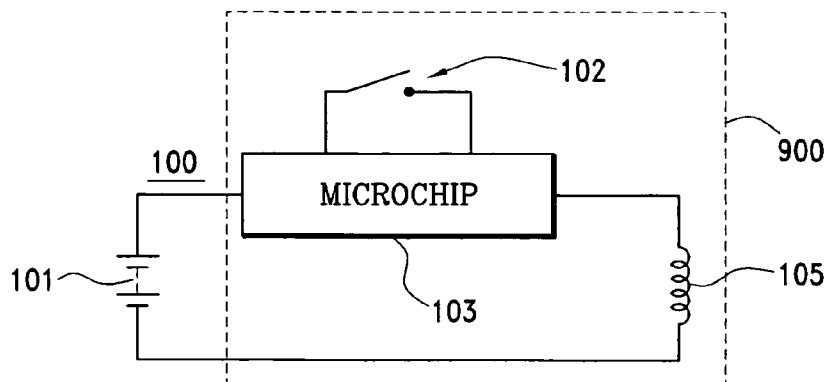
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(57) **ABSTRACT**

An electronic circuit for use with an exhaustible power source and load such as a light bulb, a radio or motor, includes a microchip with an input that transmits a signal to the microchip when the load is activated or deactivated. The input does not form a serial link between the power source and the load. The power switch, by on/off switching, controls energy flow from the power source to the load. The electronic circuit has an automatic delayed shut-off function for the load and, a find-in-the-dark indicator and a power source level indicator which are active when the load is not energized and the power source is not being charged. The input to the microchip acts as an activation/deactivation user interface. The microchip allows the user to select specific functions based on the time duration of activation signals, the time duration between activation signals and the number of activation signals at the input.

73 Claims, 6 Drawing Sheets



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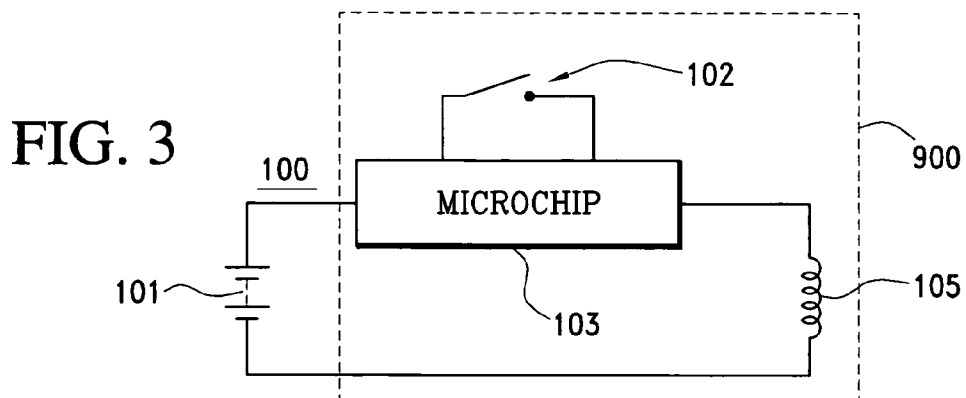
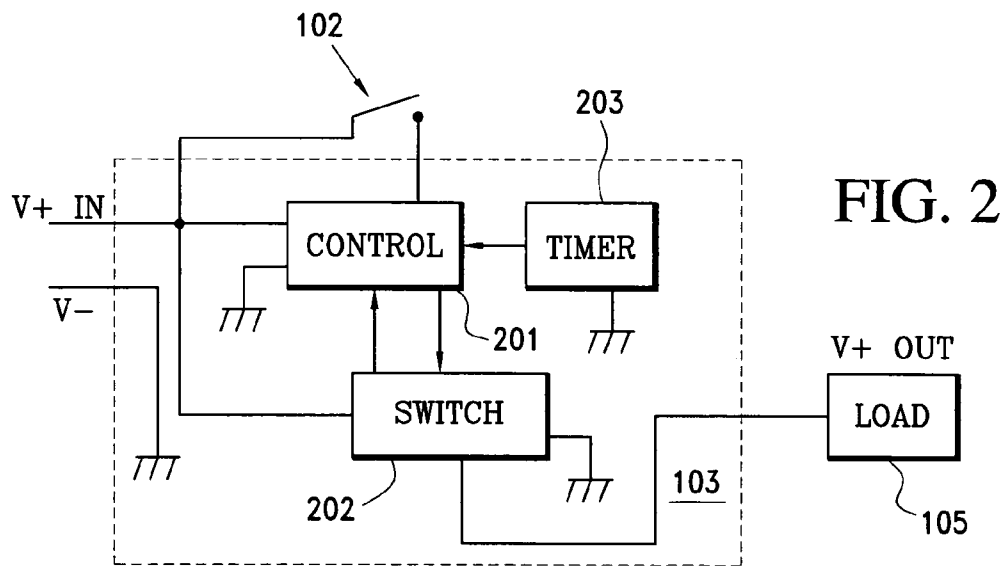
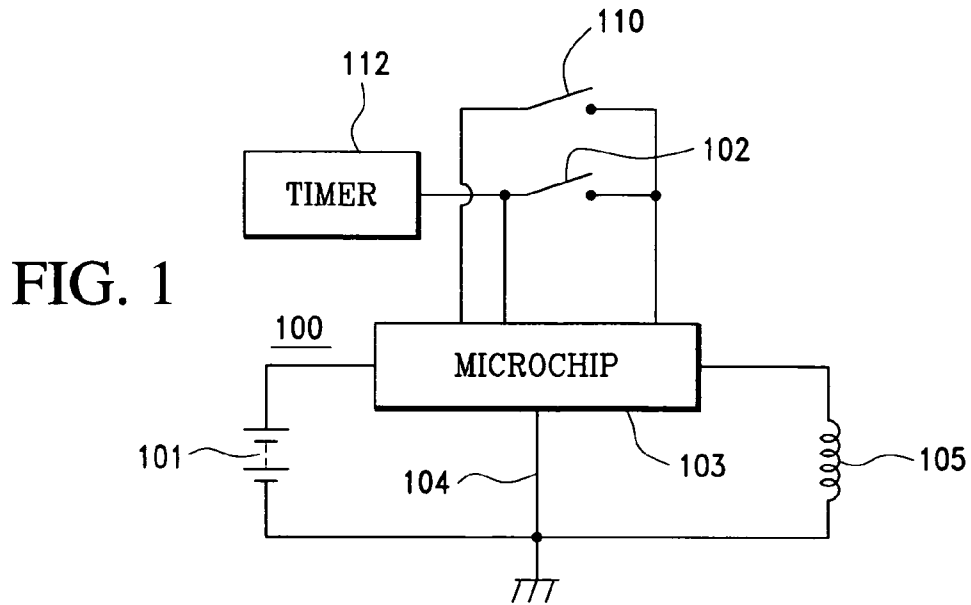
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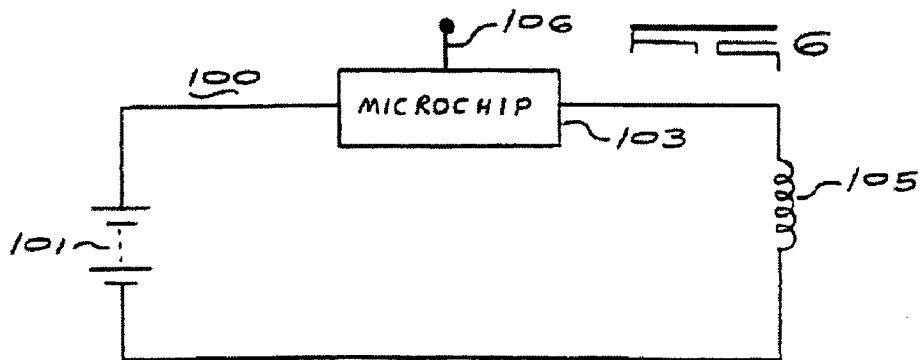
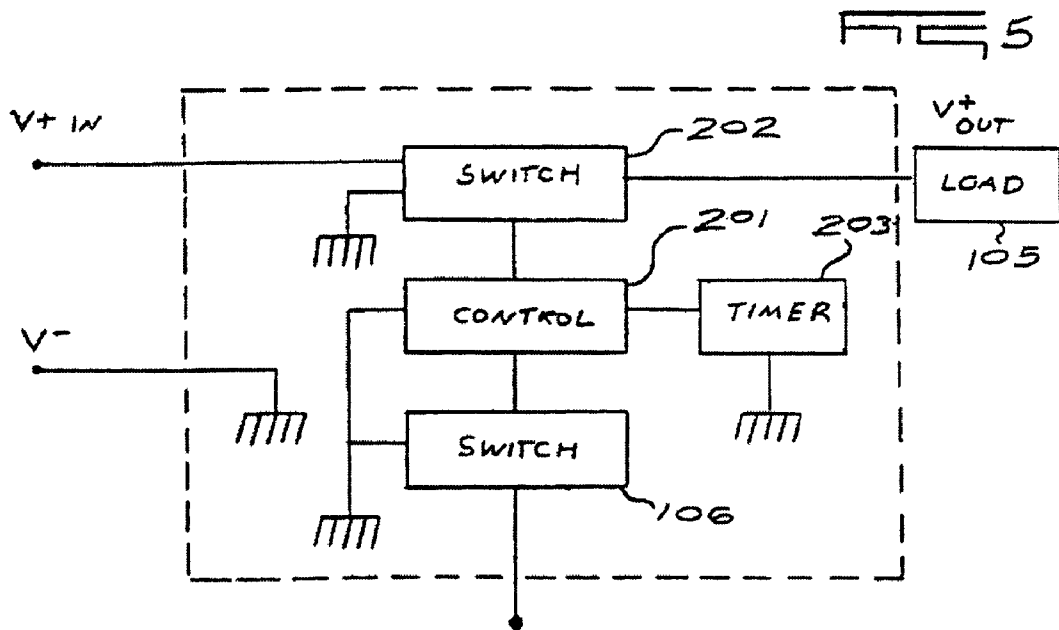
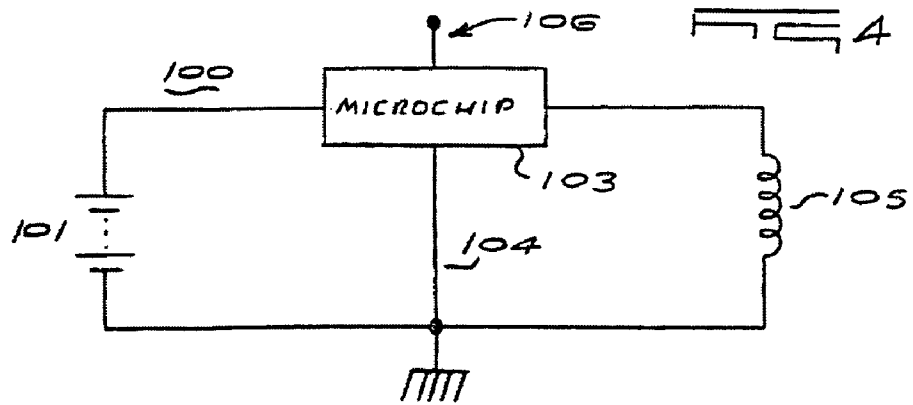
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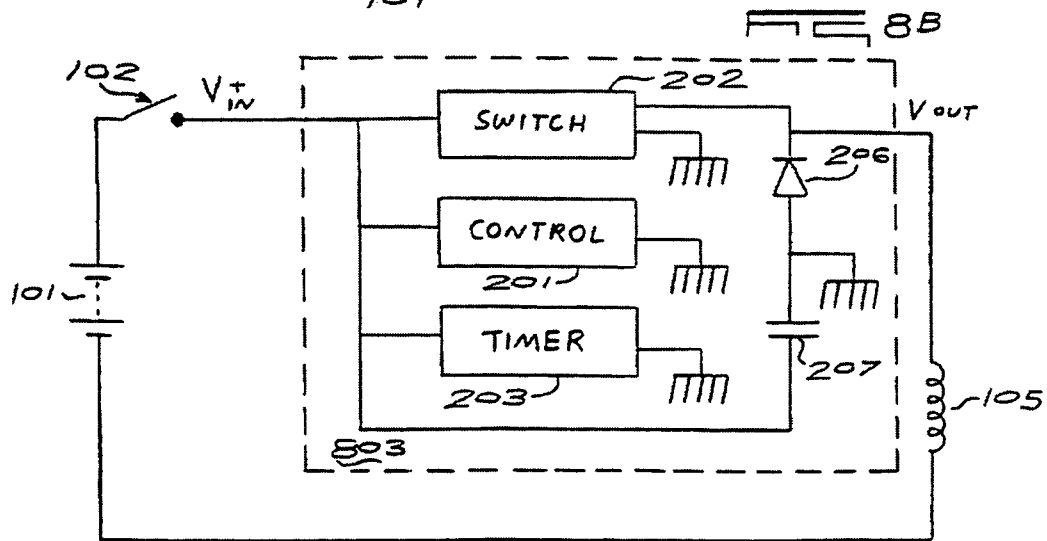
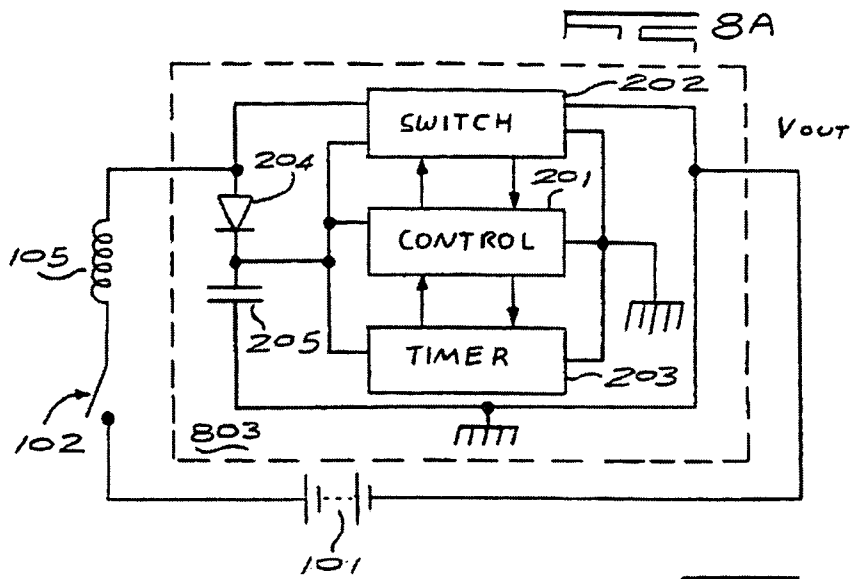
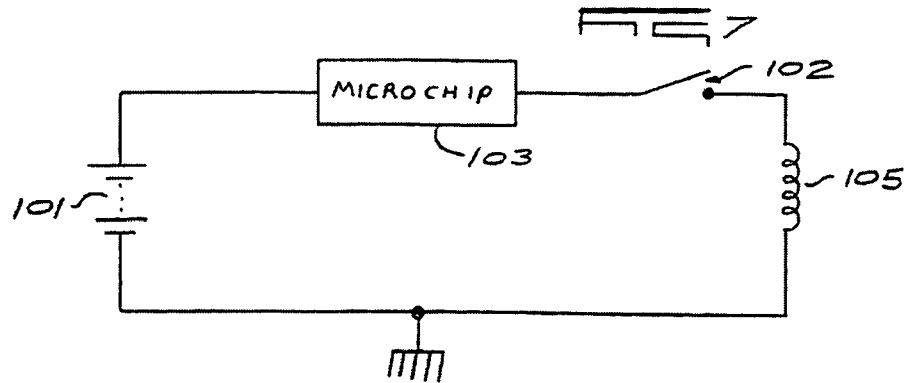
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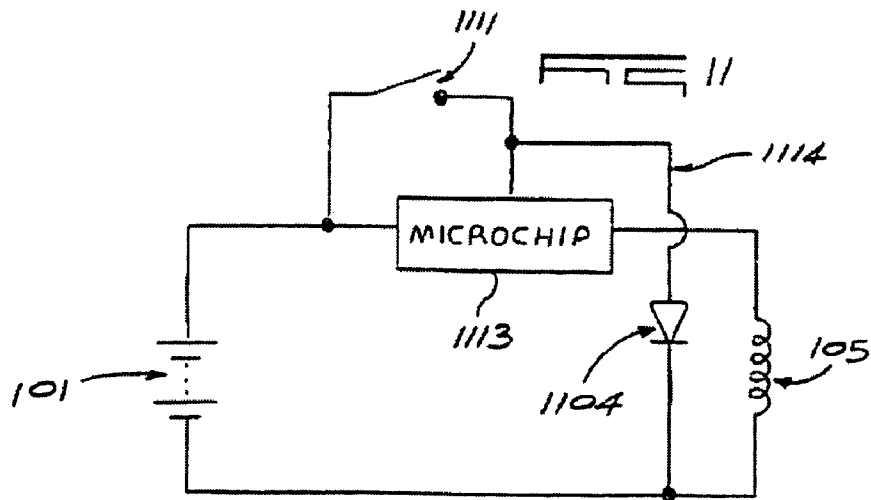
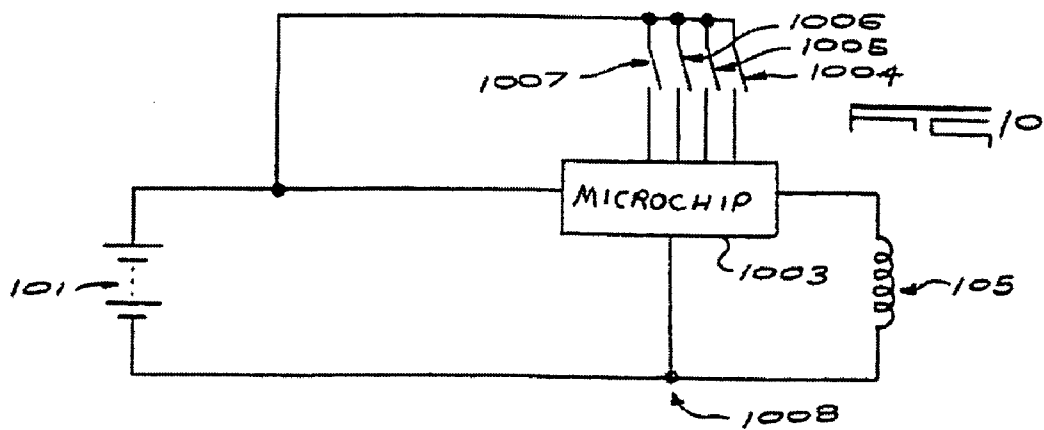
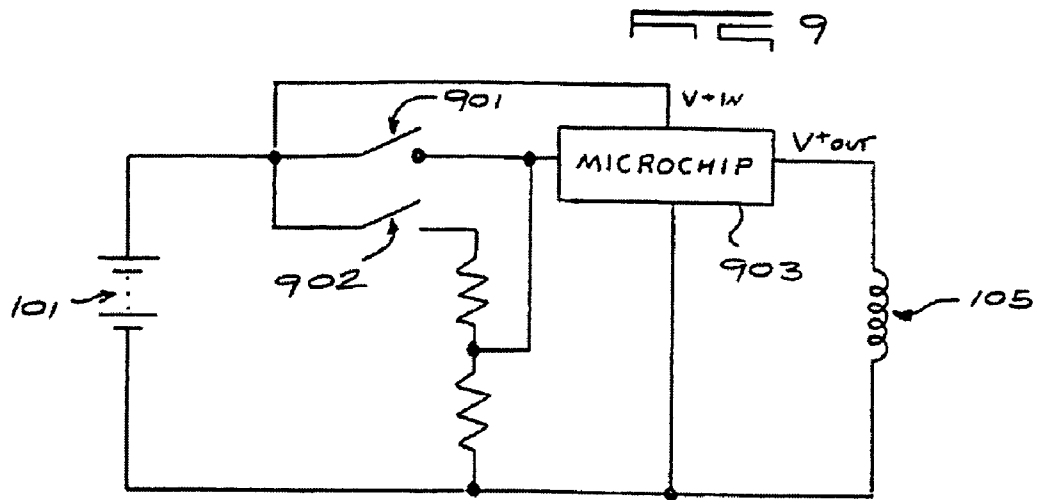
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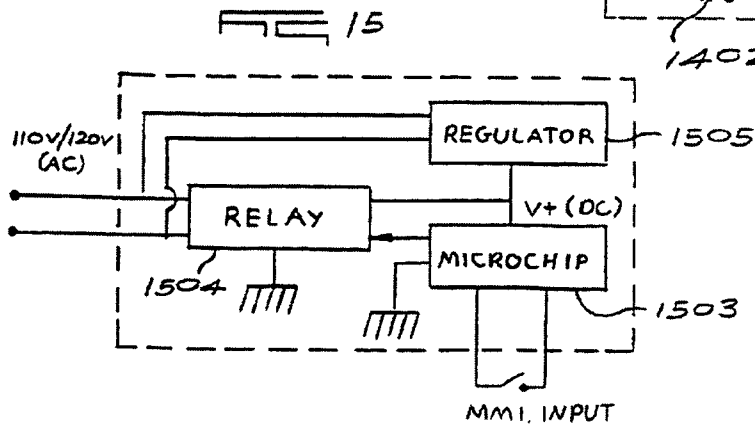
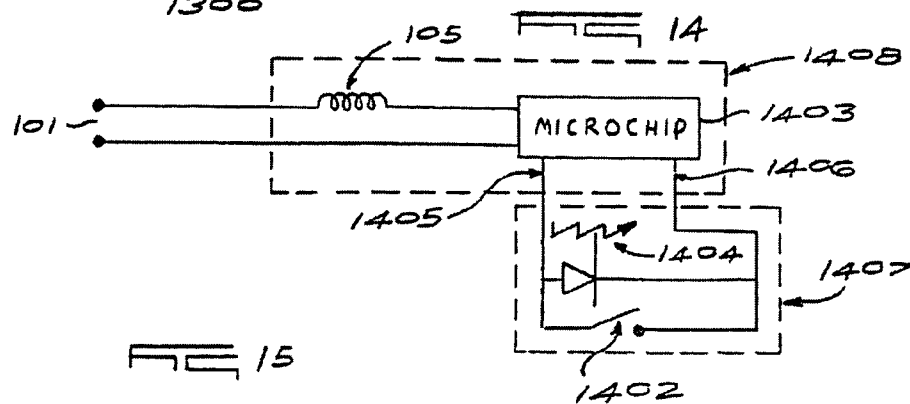
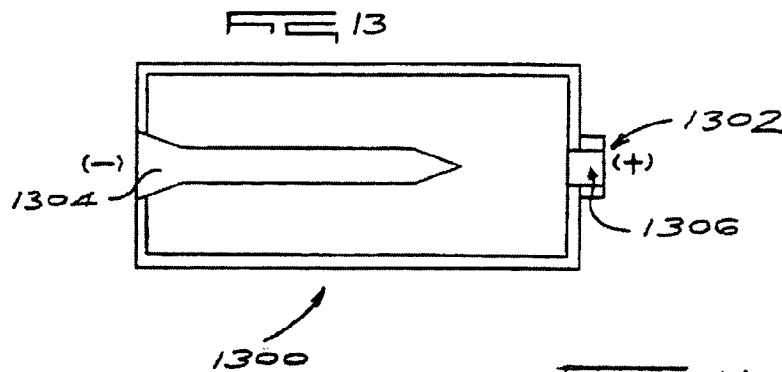
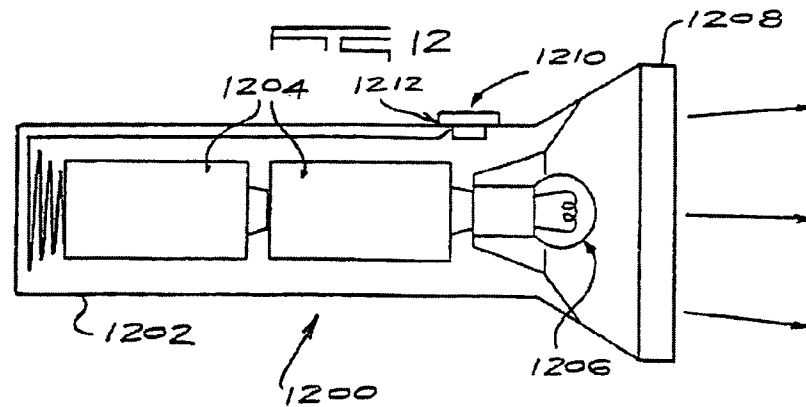
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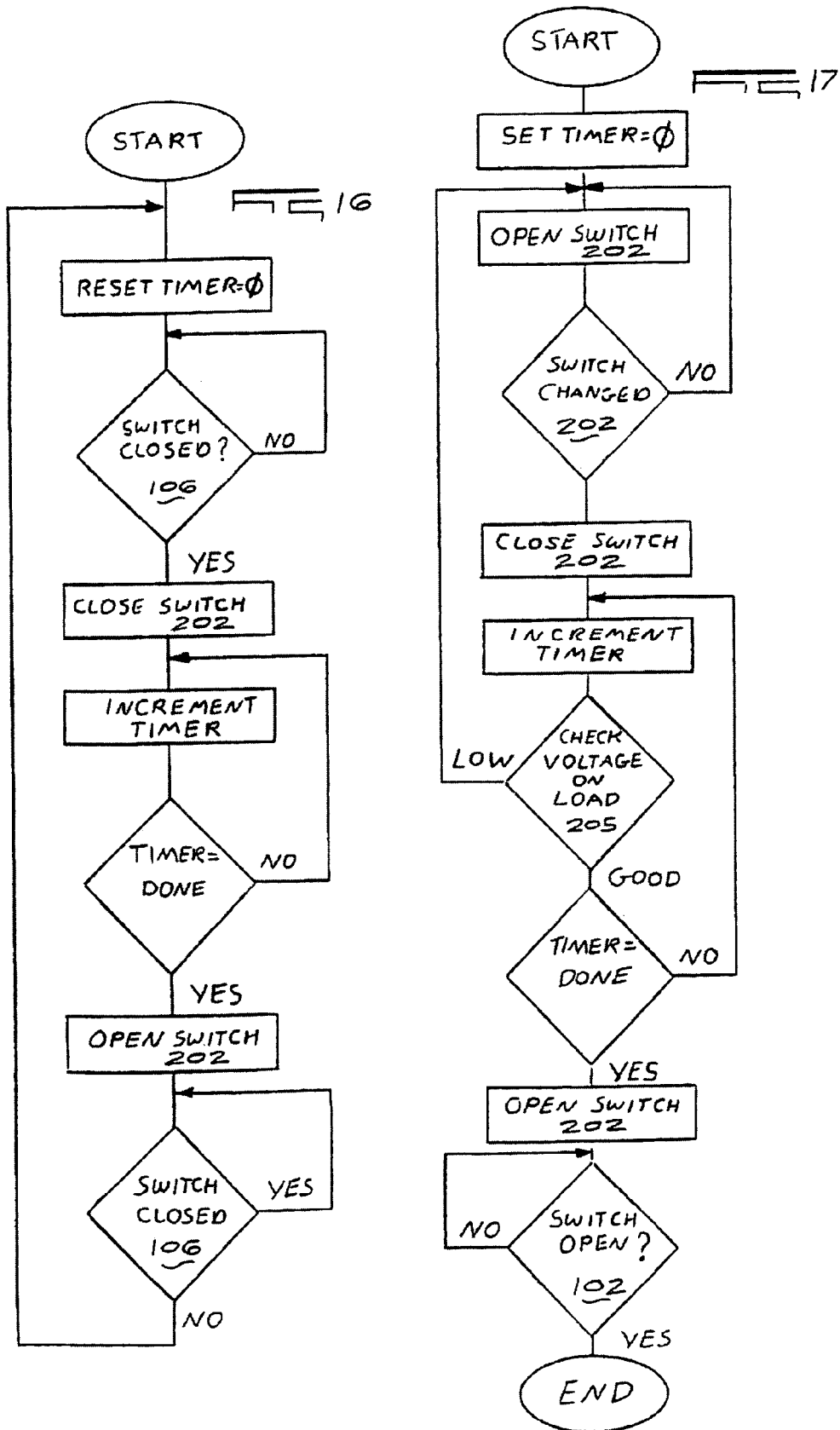












INTELLIGENT ELECTRICAL DEVICES

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a Continuation of U.S. application Ser. No. 09/806,860, filed Jul. 2, 2001, now U.S. Pat. No. 6,984,900, which is a U.S. National Stage of International Application No. PCT/ZA99/00107, filed Oct. 8, 1999, which is a Continuation-in-Part of U.S. application Ser. No. 09/169,395, filed Oct. 9, 1998, now U.S. Pat. No. 6,249,089.

FIELD OF THE INVENTION

The present invention relates to new intelligent electrical current switching devices and more particularly, to microchip controlled electrical current switching devices. The invention further relates, in one embodiment, to intelligent batteries having embedded therein a microchip for use with a variety of electrical devices to add heretofore unknown functionality to existing electrical devices. The invention also relates, according to another embodiment, to intelligent hand-held electronic devices, and in a preferred embodiment to hand-held light sources, and more particularly, to flashlights. According to one embodiment of the present invention, the invention relates to intelligent hand-held flashlights having microchip controlled switches wherein said switches can be programmed to perform a variety of functions including, for example, turning the flashlight off after a pre-determined time interval, blinking, or dimming, etc. According to a still further embodiment, the invention relates to low current switches controlled by microchips of the present invention for use in building lighting systems.

BACKGROUND OF THE INVENTION

In conventional flashlights, manually-operated mechanical switches function to turn the flashlight "on" and "off." When turned "on," battery power is applied through the closed switch to a light bulb; the amount of power then consumed depends on how long the switch is closed. In the typical flashlight, the effective life of the battery is only a few hours at most. Should the operator, after using the flashlight to find his/her way in the dark or for any other purpose, then fail to turn it off, the batteries will, in a very short time, become exhausted. Should the flashlight be left in a turned-on and exhausted condition for a prolonged period, the batteries may then leak and exude corrosive electrolyte that is damaging to the contact which engages the battery terminal as well as the casing of the flashlight.

When the flashlight is designed for use by a young child the likelihood is greater that the flashlight will be mishandled, because a young child is prone to be careless and forgets to turn the flashlight "off" after it has served its purpose. Because of this, a flashlight may be left "on" for days, if not weeks, and as a result of internal corrosion may no longer be in working order when the exhausted batteries are replaced.

Flashlights designed for young children are sometimes in a lantern format, with a casing made of strong plastic material that is virtually unbreakable, the light bulb being mounted within a reflector at the front end of the casing and being covered by a lens from which a light beam is projected. A U-shaped handle is attached to the upper end of the casing, with mechanical on-off slide switch being mounted on the handle, so that a child grasping the handle can readily manipulate the slide actuator with his/her thumb.

With a switch of this type on top of a flashlight handle, when the slide actuator is pushed forward by the thumb, the switch "mechanically" closes the circuit and the flashlight is turned "on" and remains "on" until the slide actuator is pulled back to the "off" position and the circuit is opened. It is this type of switch in the hands of a child that is most likely to be inadvertently left "on."

To avoid this problem, many flashlights include, in addition to a slide switch, a push button switch which keeps the flashlight turned on only when finger pressure is applied to the push button. It is difficult for a young child who wishes, say to illuminate a dark corner in the basement of his home for about 30 seconds, to keep a push button depressed for this period. It is therefore more likely that the child will actuate the slide switch to its permanently-on position, for this requires only a monetary finger motion.

It is known to provide a flashlight with a delayed action switch which automatically turns off after a pre-determined interval. The Mallory U.S. Pat. No. 3,535,282 discloses a flashlight that is automatically turned off by a delayed action mechanical switch assembly that includes a compression spring housed in a bellows having a leaky valve, so that when a switch is turned on manually, this action serves to mechanically compress the bellows which after a pre-determined interval acts to turn off the switch.

A similar delayed action is obtained in a flashlight for children marketed by Playskool Company, this delayed action being realized by a resistance-capacitance timing network which applies a bias to a solid-state transistor switch after 30 seconds or so to cut off the transistor and shut off the flashlight. Also included in the prior art, is a flashlight previously sold by Fisher-Price using an electronic timing circuit to simply turn off the flashlight after about 20 minutes.

It is also known, e.g. as disclosed in U.S. Pat. No. 4,875,147, to provide a mechanical switch assembly for a flashlight which includes a suction cup as a delayed action element whereby the flashlight, when momentarily actuated by an operator, functions to connect a battery power supply to a light bulb, and which maintains this connection for a pre-determined interval determined by the memory characteristics of the suction cup, after which the connection is automatically broken.

U.S. Pat. No. 5,138,538 discloses a flashlight having the usual components of a battery, and on-off mechanical switch, a bulb, and a hand-held housing, to which there is added a timing means and a circuit-breaking means responsive to the timing means for cutting off the flow of current to the bulb, which further has a by-pass means, preferably child-proof, to direct electric current to the light bulb regardless of the state of the timing means. The patent also provides for the operation of the device may be further enhanced by making the by-pass means a mechanical switch connected so as to leave it in series with the mechanical on-off switch. Furthermore, the patent discloses a lock or other "child-proofing" mechanism may be provided to ensure that the by-pass is disabled when the flashlight is switched off.

Most conventional flashlights, like those described above, are actuated by mechanical push or slide button-type switches requiring, of course, mechanical implementation by an operator. Over time, the switch suffers "wear and tear" which impairs operation of the flashlight as a result of, for example, repeated activations by the operator and/or due to the fact that the switch has been left "on" for a prolonged period of time. In addition, such mechanical switches are vulnerable to the effects of corrosion and oxidation and can

cause said switches to deteriorate and to become non-functioning. In addition, these prior art devices having these mechanical switches are generally "dumb," i.e. they do not provide the user with convenient, reliable, and affordable functionalities which today's consumers now demand and expect.

The prior art switches typically provide two basic functions in prior art flashlights. First, the mechanical switches act as actual conductors for completing power circuits and providing current during operation of the devices. Depending upon the type of bulb and wiring employed, the intensity of electrical current which must be conducted by the switch is generally quite high leading to, after prolonged use, failure. Second, these mechanical switches must function as an interface between the device and its operator, i.e. the man-machine-interface ("MMI") and necessarily requires repeated mechanical activations of the switch which over time mechanically deteriorate.

Also, currently the electrical switches used in buildings/houses for control of lighting systems are of the conventional type of switches which must conduct, i.e. close the circuit, upon command, thus also providing the MMI. These prior art switches suffer from the same disadvantages as the switches described above in relation to portable electronic devices, like flashlights. Moreover, the switches are relatively dumb in most cases and do not provide the user with a variety of functions, e.g. but not limited to timing means to enable a user, for example, a shop owner or home owner to designate a predetermined shut off or turn on point in time.

There is a need for inexpensive, reliable, and simple intelligent electronic devices which provide increased functionality and energy conservation.

SUMMARY OF THE INVENTION

According to one embodiment of the present invention, there is provided a microchip controlled switch to manage both the current conducting functions and the MMI functions in an electronic device, such as a flashlight, on a low current basis i.e. without the MMI device having to conduct or switch high current. According to one aspect of the invention, the MMI functions are controlled by very low current signals, using touch pads, or carbon coated membrane type switches. These low current signal switches of the present invention can be smaller, more reliable, less costly, easier to seal and less vulnerable to the effects of corrosion and oxidation. Moreover, since the switch is a solid state component, it is, according to the present invention, possible to control the functions of the device in an intelligent manner by the same microchip which provides the MMI functions. Thus, by practicing the teachings of the present invention, more reliable, intelligent, and efficient electrical devices can be obtained which are cheaper and easier to manufacture than prior art devices.

According to another embodiment of the invention, there is provided a microchip which can be embedded in a battery that will lend intelligence to the battery and thus, the device it is inserted into, so that many functions, including but not limited to, delayed switching, dimming, automatic shut off, and intermittent activation may be inexpensively realized in an existing (non intelligent) product, for example a prior art flashlight.

According to a further embodiment, the invention provides a power saving microchip which, when operatively associated with an electronic device, will adjust the average electric current through a current switch, provide an on and

off sequence which, for example, but not limited to, in the case of a flashlight, can be determined by an operator and may represent either a flash code sequence or a simple on/off oscillation, provide an indication of battery strength, and/or provide a gradual oscillating current flow to lengthen the life of the operating switch and the power source.

According to one embodiment of the invention, an intelligent flashlight, having a microchip controlled switch is provided comprising a microchip for controlling the on/off function and at least one other function of the flashlight. According to a further embodiment of the invention, an intelligent flashlight having a microchip controlled switch is provided comprising an input means for sending activating/deactivating signals to the microchip, and a microchip for controlling the on/off function and at least one other function of the flashlight. According to a further embodiment of the invention, there is provided an intelligent flashlight having a microchip controlled switch comprising an input means for selecting one function of the flashlight, a microchip for controlling at least the on/off function and one other function of the flashlight, wherein the microchip control circuit may further comprise a control-reset means, a clock means, a current switch, and/or any one or combination of the same.

According to another embodiment of the invention, there is provided a battery for use with an electrical device comprising a microchip embedded in the battery. According to still a further embodiment of the invention, a battery for use with an electronic device is provided comprising a microchip embedded in the battery wherein said microchip is adapted such that an input means external to the microchip can select the on/off function and at least one other function of the electronic device.

According to one embodiment of the present invention, there is provided an intelligent battery for use with an electronic device, the battery having positive and negative terminal ends and comprising a microchip embedded in the battery, preferably in the positive terminal end, for controlling on/off functions and at least one other function of the electronic device.

According to another embodiment of the invention, there is provided a portable microchip device for use in serial connection with a power source, e.g. an exhaustible power source, and an electronic device powered by said source wherein said electronic device has an input means for activating and deactivating said power source, and said microchip comprising a means for controlling the on/off function and at least one other function of the electronic device upon receipt of a signal from said input means through said power source.

According to a still further embodiment of the invention, there is provided a microchip adapted to control lighting in buildings. According to this embodiment, the normal switch on the wall that currently functions as both a power-switch, i.e. conduction of electricity, and MMI can be eliminated, thus eliminating the normal high voltage and high current dangerous wiring to the switch and from the switch to the load or light. Utilizing the present invention, these switches can be replaced with connecting means suitable for low current DC requirements.

According to another embodiment, the present invention is directed to a battery comprising an energy storage section, a processor, e.g. a microchip and first and second terminal ends. The first terminal end being connected to the energy storage section, the second terminal end being connected to the processor, and the processor being connected to the second terminal end and the energy storage section. The

5

processor controls the connection of the second terminal end to the energy storage section.

According to another embodiment, the present invention provides an electronic apparatus which includes an electrical device, comprising a power supply, an activating/deactivating means, and a processor. The activating/deactivating means is connected to the processor and the processor is connected to the power supply. The processor controls the on/off function of the device and at least one other function of the device in response to signals received from the activation/deactivation means.

The present invention, according to a still further embodiment, provides a flashlight comprising a light source, an energy storage means, a switch means, and a processor means. The switch means being in communication with the processor means and the processor means being in communication with the energy storage means which is ultimately in communication with the light source. The processor controls the activation/deactivation of the light source and, in some embodiments, further functions of the flashlight, in response to signals received from the switch means.

While the present invention is primarily described in this application with respect to either a flashlight or a battery therefore, the embodiments discussed herein should not be considered limitative of the invention, and many other variations of the use of the intelligent devices of the present invention will be obvious to one of ordinary skill in the art.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic of a device having a microchip controlled push button or sliding type input activation/deactivation switch according to one embodiment of the present invention;

FIG. 2 is a block diagram of a microchip for use in association with a push button or sliding input activation/deactivation switch according to one embodiment of the invention;

FIG. 3 is a schematic of a second type of intelligent device having a microchip controlled push button or sliding type input activation/deactivation switch according to another embodiment of the invention;

FIG. 4 is a schematic of a device having a microchip controlled touch pad or carbon coated membrane activation/deactivation switch according to a still further embodiment of the invention;

FIG. 5 is a block diagram of a microchip for use in association with a touch pad or carbon coated membrane activation/deactivation switch according to one embodiment of the invention;

FIG. 6 is a schematic of a second type of device having a microchip controlled touch pad or carbon coated membrane activation/deactivation switch according to one embodiment of the invention;

FIG. 7 is a schematic of a battery having embedded therein a microchip according to a further embodiment of the invention;

FIG. 8A is a block diagram of a microchip for use in a battery according to one embodiment of the present invention;

FIG. 8B is a block diagram of a second type of microchip for use in a battery according to another embodiment of the present invention;

FIG. 9 is a schematic of a device having a microchip controlled switch according to one embodiment of the invention;

6

FIG. 10 is a schematic of a device having a microchip controlled switch according to one embodiment of the invention;

FIG. 11 is a schematic of a device having a microchip controlled switch according to one embodiment of the present invention;

FIG. 12 is a schematic of a flashlight having therein a microchip controlled switch according to one embodiment of the present invention;

FIG. 13 illustrates a possible position, according to one embodiment of the present invention of a microchip in a battery;

FIG. 14 is a schematic of one embodiment of the present invention of a low current switching device suitable for lighting systems in buildings;

FIG. 15 is a block diagram of one embodiment of the present invention, i.e. microchip 1403 of FIG. 14;

FIG. 16 is a flow diagram for a microchip as shown in FIGS. 4 and 5 for a delayed shut off function embodiment of one embodiment of the present invention; and

FIG. 17 is a flow diagram for a microchip as shown in FIGS. 7 and 8a for a delayed shut off function embodiment of one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

According to one embodiment or aspect of the present invention, and referring to FIG. 1, a schematic depiction of main circuit 100 of an electronic device, for example, a flashlight, is provided, wherein the device has a microchip 103 and a microchip controlled input activator/deactivator 102, for example, a push button or sliding switch. Main circuit 100 of the device is powered by a current supplied by power source 101. Power source 101 may be any power source, e.g. a DC battery, as is well known to those of ordinary skill in the art. While the following discussion is limited to specific electronic devices, that is flashlights, it is to be understood that the following description is equally applicable to other electronic devices including portable radios, toys, for example but not limited to battery operated cars, boats, planes, and/or other electrically powered toys.

Referring to FIG. 1, when an operator activates input push button or sliding command switch 102 to the "on" position, the microchip 103 receives a signal. Switch 102 is a direct electrical input to microchip 103. Microchip 103 is grounded by grounding means 104. Microchip 103 is in series between power source 101 and load 105. Microchip 103 also transfers sufficient power through means of a current switch (not shown in FIG. 1) to load 105 which can be, for example, a resistor-type bulb in the case of a flashlight to provide illumination.

The microchip 103, and other microchips of the present invention, can have its/their intelligence embedded in combinational or sequential logic, a PLA or ROM type structure feeding into a state machine or a true microcontroller type structure. The memory for the above will normally be non-volatile, but should there be a need for selectable options, EE or flash memory structures may be used.

The structure and operational parameters of such a microchip 103 are explained in greater detail below with respect to FIG. 2. As shown in FIG. 1, power is supplied to microchip 103 by power source 101. When an operator activates input switch 102 to the "on" position it represents a command which is communicated to microchip 103. Input means 102 requires very low current in preferred embodiments. In one embodiment of the invention, microchip

control/reset means **201** simply allows the current switch **202** to pass current provided from power source **101** to load **105** in an unimpeded manner when the MMI switch **102** is activated, and, in the case of a flashlight, illumination is obtained. It is important to recognize, however, that it is control circuit **201** which activates current switch **202** upon acting on an input from MMI switch **102**. Unlike heretofore known prior art devices, activating switch **102** does not conduct current to load **105**, but is only a command input mechanism which can, according to the invention, operate on very low current. For example, according to the invention, touch sensor input or carbon coated membrane type switch devices are preferred.

If, for example, an emergency notification function is desired, the flashlight may be designed to alternately flash on and off every second. First, the operator activates input **102** into the appropriate position to indicate such a function is desired. During the "on" segment of the flashing routine, control/reset means **201** commands current switch **202** to close and let current flow through to load **105**, thereby causing, in the case of a flashlight, the bulb to illuminate. Simultaneously, control/reset means **201** uses the timing means **203** as a clock for timing. After control/reset means **201** determines one second has elapsed, control/reset means **201** instructs current switch **202** to open and interrupt the current flow through to load **105**, and bulb illumination is discontinued. It is important to note that both control/reset means **201** and current switch **202** are still active and fully powered; however, current delivery is now latent with respect to load **105**. When another second has elapsed, a command is passed from control/reset means **201** which again allows current to be delivered through current switch **202** to load **105**, and in the case of a flashlight, bulb illumination is immediately resumed. The device continues an alternating current delivery routine until either the operator switches the setting of the activating input switch **102** to the "off" position, or until the conditions pre-programmed into the microchip, e.g. into the control/reset means **201**, are satisfied and current delivery is permanently discontinued.

Similar operating routines can be employed to generate other conspicuous flashing functions such as the generation of the universal distress signal S.O.S. in Morse code. Again, such a function would require that the microchip, e.g. control/reset means **201**, be pre-programmed with the appropriate code for creating such a signal, and to permit current transmission from switch **202** to load **105** in accordance with the code with the assistance of timing means **203**. For example, it may be desirable to have an S.O.S. sequence wherein flashes representing each individual letter are separated by time intervals ranging from one-half ($\frac{1}{2}$) second to one (1) full second, while the interval between each letter in the code comprises two (2) full seconds. After a certain number of repetitions of the routine, again determined by the operator or as pre-programmed within the microchip, e.g. within the control/reset means **201**, the signal is discontinued.

As shown in FIG. 3, it is possible to remove grounding means **104** from main circuit **100**. However, it is then necessary to intermittently provide an alternative power source for microchip **103** and to create a virtual ground reference level. A suitable microchip **103** for this configuration is described in greater detail below with respect to FIGS. 8A and 8B.

Referring now to FIG. 4, utilizing the circuits in the microchip of some embodiments of the present invention, carbon coated membrane or touch pad type switches are preferred. Carbon coated membrane switches and touch pad

switches have many advantages over conventional high current switches, such as those currently used in flashlights. According to the present invention, carbon coated membrane type switches, low current type switches, and touch pad type switches can be used which may be smaller, less costly, easier to seal, and less vulnerable to corrosion and oxidation than conventional switches which also transfer energy or current to the load. Moreover, according to one embodiment of the present invention, carbon coated membrane type switches, touch pad switches, or low current type switches can be formed structurally integral with the product, for example, with the casing of a flashlight.

A block diagram showing microchip **103** for use, in accordance with one embodiment of the present invention, in association with a carbon coated membrane, a touch pad switch, or a low current type switch **106** is now explained in greater detail in respect to FIG. 5. According to this one embodiment of the present invention, current switch **202** is powered directly by grounded power source **101**. However, output of current from current switch **202** to load **105** is dependent on control/reset means **201**. When an operator depresses touch pad **106**, carbon coated membrane switch **106** or low current type switch **106**, control/reset means **201** allows current switch **202** to flow current through to load **105**. However, in more intelligent applications according to certain embodiments of the present invention, control/reset means **201** will coordinate, based on clock and/or timing means **203**, to execute timing routines similar to those described above such as, but not limited to, intermittent flashing, the flashing of a conspicuous pattern such as Morse code, dimming functions, battery maintenance, battery strength/level, etc.

FIG. 16 is a flow diagram for a microchip **103** as shown in FIGS. 4 and 5 and provides a delayed shutoff function. The flow sequence commences at START when the power source **101** is connected to the microchip **103**, as shown in FIG. 4. The sequence of operation is substantially self-explanatory and is not further elaborated herein.

As shown in FIG. 6, grounding means **104** can be removed from the system as a matter of design choice. A more detailed description of a suitable microchip **103** for this type of configuration is provided below with respect to FIGS. 8A and 8B.

Referring to FIG. 7, certain embodiments of the present invention also provide for a battery having a microchip embedded for use in association with an electronic device. As shown, direct current is provided to microchip **103** by power source **101**. When activating input switch **102** is closed, current is complete and power is transferred to load **105** at the direction of microchip **103**. Microchip **103** embedded in the battery can have any number of intelligent functions pre-programmed therein, such as, for example but not limited to, battery strength monitoring, recharging, adjustment of average current through a current switch, intermittent power delivery sequences, and so on. Examples of suitable microchips **103** for this type of application are discussed below with reference to FIGS. 8A and 8B.

FIGS. 8A and 8B are block diagrams of two different further embodiments of the present invention. Microchip **803** is especially suitable for applications wherein microchip **803** is not grounded through the body of the electrical device or where a ground cannot otherwise be established because of design considerations. This embodiment is useful to provide sufficient operating power to the microchip and can be achieved by periodically opening and closing current switch **202** when activation input switch **102** is closed. For example, referring to FIG. 8A, when input switch **102** is

closed but current switch **202** does not conduct (that is, the switch is open and does not allow current to flow to load **105**), then voltage drop over load **105** is zero and in the case of a flashlight, no illumination is provided from the bulb. Instead, the full voltage drop is over current switch **202** and in parallel with the diode **204** and capacitor **205**. Once capacitor **205** becomes fully charged, current switch **202** can close and circuit **103** will be powered by capacitor **205**. When circuit **803** is adequately powered, it functions in a manner identical to the circuits described previously with respect to the functions provided by control/reset means **201** and timing means **203**.

When the charging capacitor **205** starts to become depleted, control/reset means **201** will recognize this state and reopen the current switch **203**, thus briefly prohibiting the flow of current to load **105**, in order to remove the voltage drop from load **105** and allow capacitor **205** to recharge and begin a new cycle. In a flashlight application, the time period wherein current flow from current switch **202** is discontinued can be such that the dead period of the light is not easily or not at all detectable by the human eye. In the case of a high current usage load, such as a flashlight, it means the ratio of the capacitance of the capacitor having to power the microchip and the current consumption of the microchip, must be such that the capacitor can power the microchip for a long time relative to the charging time (**202** open). This will enable the flashlight's "off" time to be short and the "on" time to be long, thus not creating a detectable or intrusive switching of the flashlight to the user.

FIG. **17** is a flow diagram for a microchip as shown in FIGS. **7** and **8** which also provides a delayed shutoff function. The flow diagram is substantially self-explanatory and the flow sequence commences at START when closure of the switch **102** takes place from an open position.

According to another embodiment of the present invention, e.g. in relation to another product of low current consumption, such as a FM radio, the designer may opt for a capacitive (reservoir) device externally to the microchip (see FIG. **11**). In this case, the electrical device may function for a time longer than the time required for charging the capacitor (**205**, **207**) which is when the current switch (**202**) is open and not conducting current.

According to another embodiment of the present invention, an output may be provided to indicate a condition, e.g. a battery is in good or bad condition. It may also be suitable to assist in locating a device, e.g. but not limited to a flashlight, in the dark. This may be a separate output pin or may be, according to another embodiment, shared with the MMI switch input. (See FIG. **11**) This output or indicator may be a LED. Referring to FIG. **11**, indicator/output device **1104** may, for example, be an LED. When microchip **1113** pulls the line **1114** to high, the LED **1104** shines. LED **1104** may also shine when switch **1111** is closed by the user. However, since that is only a momentary closure, this should not create a problem.

According to a further specific embodiment of the invention, referring to FIG. **11**, microchip **1113** can activate the LED **1104** for a short time, e.g. every 100 milliseconds, every 10 seconds. This indication will let potential users know the device is in a good state of functionality and will enable fast location of the device in the dark, e.g. in times of emergency. The low duty cycle will also prevent unnecessary battery depletion.

With an alternative embodiment of the present invention, FIG. **8B** illustrates the charging and discharging of capacitor

207 to provide power to circuit **803**, wherein the diode and capacitor structure establishes a ground reference for circuit **803**.

Each of the embodiments explained with respect to FIGS. **8A** and **8B** are suitable for use, according to the present invention, depending upon the application. Indeed, the embodiments shown in FIGS. **8A** and **8B** can be directly embedded into a battery and/or can be separately constructed in another portable structure, e.g. but not limited to, in the shape of a disc, about the size of a quarter, to be inserted at the end of the battery between the output means or positive terminal of the battery and the current receiving structure of the electronic device. As described, the embodiments shown in FIGS. **8A** and **8B** can be utilized with the prior art high current switches currently being utilized in simple non-intelligent electronic devices, for example flashlights, radios and toys. For example, in the case of a portable simple radio without any intelligence, an automatic shut "off" may be achieved by using the intelligent battery or portable microchip of the present invention having a timing function to automatically shut off the radio after a given period of time, i.e. after the user is asleep.

The architecture of the two embodiments of the present invention shown in FIGS. **8A** and **8B** provide certain advantages over the simple dumb architecture in current simple electrical devices, for example, flashlights. Due to the unique design of the microchips, as shown in FIGS. **8A** and **8B**, after the device (into which the microchip is incorporated) is shut off the micro chip remains powered for an additional period of time which allows for said microchip to thus receive additional commands, for example, a second "on" activation within a given period after a first "on" and "off" activation, may be programmed into the microchip (control/reset means) to indicate a power reduction or dimming function or any other function as desired by the designer of said device. This is accomplished by the inventive designs of the present invention without having to utilize substantial energy from what are typically small exhaustible power sources, e.g. DC batteries in the case of flashlights.

According to some embodiments of the present invention, more intelligent devices include many other useful functions pre-programmed within the microchip, e.g. in control/reset means **201** and may, e.g. be assisted by a timing means **203**. Referring to FIG. **2**, commands can be entered through switch **102** in several different ways. First, various time sequences of closed and open activations may represent different commands. For example, but not limited to, a single closure may instruct microchip **103** to activate current switch **202** continuously for a pre-determined length of time. Alternatively, two successive closures may instruct the microchip **103** to intermittently activate current switch **202** for a pre-determined length of time and sequence, for example, a S.O.S. sequence.

Secondly, referring to FIG. **9**, commands may be communicated to microchip **903** through the use of various voltages recognizable by microchip **903** to represent various commands. For example, but not limited to, according to one embodiment of the present invention, it may include multiple activating switches **901** and **902** connecting different voltages to the command input structure of microchip **903**.

Thirdly, referring to FIG. **10**, commands may be communicated to microchip **1103** through the use of multiple specific switches (**1004**, **1005**, **1006**, **1007**) which when activated either singularly or in combination is/are recognizable by microchip **1103** as representing various different commands.

11

As can be seen by FIG. 9, switch 901 and 902 and in FIG. 10, switches 1004, 1005, 1006, and 1007, power or ground may be used as a command reference voltage level. For example, the switches in FIG. 10 may be connected to another ground instead of point 1008 depending on the internal structure of the microchip.

The control/reset means included in the inventive microchips of the present invention may and in some instances, depending upon the application, should in addition to the many possible user functions described above, include means for adjusting the average current over a switch and/or a means for providing a gradual "on"/"off" current flow, so that the operator does not appreciably perceive the increase and decrease in light provided by the device. These features allow for an ongoing variable level of lighting as desired by an operator, and may also lengthen the life span of the activation switch, the bulb, and the power source. Moreover, several functions can now be added to an existing device, like a flashlight, through the use of a battery having embedded therein a microchip according to the present invention.

In another embodiment of the invention, the microchip is adapted to control lighting in buildings. The normal switch on the wall that currently functions as both a power-switch and MMI can be replaced by a low current switching device like a membrane switch, touch pad or carbon coated switching device. Since very low currents are required by the MMI switch (device) that replaces the normal wall mounted (A/C) switch, it is possible to replace the normal high voltage/current (dangerous) wiring to the switch and from the switch to the lead (light), with connectivity means suitable to the new low current DC requirements. As such, in the case of normal A/C wiring (110V/220V), the dangerous wiring can now be restricted to the roof or ceiling and all switches (MMI's) can inherently be safe. This may make the expensive and regulated safety piping required for the wiring of electricity to wall switches redundant.

In a specific embodiment, the traditional wiring between the light and the wall switch is replaced by flexible current conducting tape that can be taped from the roof and down the wall to the required location. In another embodiment, the connections can be made by current conducting paint or similar substances. In both cases above, it can be painted over with normal paint to conceal it. This makes changing the location of a wall switch or the addition of another switch very easy.

The microchip according to the present invention can be located in the power fitting of the light. The microchip having the low current (MMI) input and a power switch to block or transfer the energy to the load (light, fan, air conditioner). It reacts to the inputs received to activate or disable, or control other functions, of whatever device it is controlling.

The microchip may be adapted to contain the high current/voltage switch or control an external switching device or relay. The microchip may also, as in the other embodiments discussed, have some intelligence to control functions like dimming, delayed shut off, timed activation/deactivation, timed cycles, flashing sequences and gradual on/off switching. The microchip may also be adopted, as in a specific flashlight embodiment discussed, to provide a location/emergency signal for lighting/flashing an LED.

FIG. 12 shows a flashlight 1200 with a housing 1202, batteries 1204, a bulb 1206, a reflector and lens 1208, a switch 1210 and a microchip 1212. The flashlight has a conventional appearance but its operation is based on the microchip 1212 controlling the operation of the switch 1210, as described hereinbefore.

12

FIG. 13 illustrates that a battery 1300 with positive and negative terminals 1302 and 1304 respectively, and of substantially conventional shape and size, can be fabricated with an integral microchip 1306, of the type described hereinbefore. Alternatively the microchip can be mounted to the battery, for example by being inserted into a preformed cavity. As the microchip is inserted into the cavity it makes contact with the positive and negative terminals on the battery. The microchip also carries external terminals so that when the battery is inserted into an appliance (not shown) it makes direct contact with corresponding terminals on the appliance so that the microchip is automatically connected in circuit.

The power input 101 in FIG. 14 may be DC (e.g. 12V) as is commonly used for some lights or A/C (110V or 240V). The device shown as 1403 may be monolithic or be a multichip unit having a relay (solid state or mechanical), a regulator (e.g.: 110 AC volt to 12V DC) and a microchip as discussed in this application.

In a specific embodiment, Ic pin 1406 can normally be high and a closure of input means 1402, e.g. any of the low current switching devices described above, can be detected as Ic pin 1405 also goes too high. To flash the LED 1404 the microchip will reverse the polarities so that Ic pin 1405 becomes high with regards to Ic pin 1406. During this time, it may not be possible to monitor the closure of the input 1402 switch and the LED 1404 may not shine should the input 1402 be closed. In another embodiment, microchip 1403 is able to detect closure of input 1402 before reversing the voltage polarity as discussed and if it detects closure, it does not proceed with reversing the polarity.

Reference 1407 denotes an MMI wall unit, and reference 1408 denotes a high voltage roof unit.

In FIG. 15, microchip 1503 does not contain a current switch (e.g. switch 102) as shown in FIG. 2. However, if desired the regulator and relay can be integrated into a single monolithic microchip 1503. In case of a 12V (DC) local voltage this may be done in any event unless the current/power considerations is too high to make it practical.

In another embodiment, the microchips 1403 and 1503 are adapted to receive commands not only via the MMI input but also over the load power (electricity) wiring. This would allow a central controller to send out various commands to various power points, controlled by a microchip according to this invention, by using address information of specific microchips or using global (to all) commands.

Referring again to FIG. 1, and this being done purely for the sake of example, the microchip 103 is activated by sliding or activating a switch 102. It is apparent that different switches can be provided for different functions of the microchip. However, in order to enhance the user-friendliness of the device, a single switch may be capable of controlling different functions of an appliance such as a flashlight to which the microchip is mounted.

Assume for the sake of example that the switch 102 is used to turn the microchip on in the sense that a flashlight is turned on. A switch 110 may then be used at any time to turn the flashlight off, by appropriately controlling operation of the microchip. This is a conventional approach to controlling operation of the microchip. As an alternative the operation of the switch 102 can be sensed by means of a timing device 112. The timing device is started when the switch 102 is closed and after a short time period, say on the order of 5 seconds or less, which is measured by the timing device, the mode or function of the switch 102 changes so that, upon further actuation of the switch 102, the switch duplicates the function of the switch 110 which can therefore be dispensed

with. Thus, initially the switch **102** functions as an on-switch while, a short period after its actuation, the switch **102** functions as an off-switch. It follows that with minor modifications to the circuitry of the microchip a single switch can exhibit multi-mode capabilities with the different modes being distinguished from each other or being exhibited on a time basis or, if necessary, on any other basis.

Multimode capabilities can for example be incorporated in a microchip wherein the function of a switch is also linked to time. In this sense the word "function" means the action which ensues or results upon the detection of the closure of the switch. For example a single switch may, from an off state of a flashlight, enable (a) the switching on of the flashlight and (b) the selection of one of a number of various modes like dimming level, flashing rate/sequence etc. when the switch is closed a number of times.

If however a certain time is allowed to pass (say five seconds) without any further closure of the switch taking place (indicating a mode has been selected), the function resulting from the next closure may be changed. Thus instead of selecting another mode, the closure may be interpreted as an "off" command.

In other words a sequence of switch closures within five seconds of each other will continue to step the microchip through a number of predefined modes. However should at any stage a time of more than five seconds elapse between consecutive presses or closures of the switch then the next switch operation will switch the flashlight off rather than stepping the microchip to another mode.

Clearly these characteristics are not confined to the use of the chip with a flashlight for the chip can be used with other applications to vary the mode of operation thereof in an analogous way. Thus, for the flashlight, the function of the switch will affect the operation of the flashlight in a manner which is dependent on the time period between successive actuations of the switch. More generally, in any electrical device which is controlled by means of the microchip the operation of the device will be regulated by the function which is exhibited by a switch which is in communication with the microchip. The switch function in turn is dependent on the duration of a time period between successive operations of the switch.

Other modes can also be exhibited by a single switch. For example, depending on requirement, a switch can be used for on and off operation, for initiating the transmission of an emergency signal, for initiating the gradual dimming of a flashlight or the like. The scope of the invention is not limited in this regard.

While the preferred embodiments of the present invention have been described in detail, it will be appreciated by those of ordinary skill in the art that changes and modifications may be made to said embodiments without, however, departing from the spirit and scope of the present invention as claimed.

The invention claimed is:

1. A flashlight for use with an exhaustible power source, comprising:

a light source;

a first circuit for conducting power from said power source to activate the light source;

a switch, wherein the switch is not a serial element of the first circuit, and wherein the switch is a user interface;

a microchip having a first input coupled to the switch;

wherein the microchip is capable of controlling the activation and the deactivation of the light source in response to a first signal from the switch received through said first input, such that in a first operating

mode the microchip causes the light source to turn off after a predetermined time interval passes following receipt of an activation signal from the switch; and wherein the microchip, in response to at least a second signal from the switch through said first input, is capable of causing the light source to operate in at least a second operating mode, in which a different level of power is supplied to the light source, than in the first operating mode, such that the light is illuminated in the second operating mode with a brightness level that is different than when illuminated in the first operating mode.

2. The flashlight of claim **1**, wherein the microchip is also capable of controlling the flow of power to the light source such that in a further operating mode the microchip causes the light source to flash a visible code sequence.

3. The flashlight of claim **1**, further comprising a casing and wherein the microchip, the switch, the light source and the power source are all attached to and/or enclosed in the casing, with the switch being the only user interface for activation, deactivation and changing operating modes.

4. The flashlight of claim **3**, wherein the microchip is always supplied with power if a good power source is properly installed.

5. The flashlight of claim **4**, wherein the microchip is capable of causing the light source to flash in a manner that is easily visible to the human eye.

6. The flashlight of claim **4**, wherein the microchip is further configured to control the light source to indicate the strength of one or more batteries associated with the flashlight.

7. The flashlight of claim **3**, wherein the flashlight has an off mode; and

wherein the microchip is further capable of causing the light source to change from one of the operating modes to the off mode if the time period between a switch operation when selecting the operating mode and a subsequent activation of the switch, is more than a predetermined period of time.

8. The flashlight of claim **7**, wherein the microchip is further capable of causing the light source to indicate the strength of one or more batteries associated with the flashlight.

9. The flashlight of claim **1**, wherein the microchip is further configured to control the light source to indicate the strength of one or more batteries associated with the flashlight.

10. The flashlight of claim **1**, wherein the microchip is capable of controlling the flow of power to the light source to gradually vary the brightness, such that the gradual change in brightness is not easily visible to the user.

11. The flashlight of claim **10**, wherein the microchip is further configured to control the light source to indicate the strength of one or more batteries associated with the flashlight.

12. The flashlight of claim **1**, wherein the microchip is further capable of allowing a user to gradually vary the power to the light source in response to at least a signal received through the switch.

13. The flashlight of claim **1**, wherein the microchip is further capable of providing a find-in-the-dark indication by controlling an indicator.

14. The flashlight of claim **1**, further comprising an exhaustible power source that supplies power to the light source under control of the microchip.

15. The flashlight of claim **1**, further comprising a casing and wherein the light source, switch, and microchip are each coupled to and/or enclosed in the casing.

15

16. A method of controlling a flashlight for use with an exhaustible power source comprising a light source and a push button switch that serves as a user interface but does not form a part of a path for supplying power from the power source to operate the light source, the method comprising:

receiving a signal from the switch on a first input of a microchip, wherein the microchip is capable of activating and deactivating the light source in response to at least a first signal received through said first input; causing, under control of the microchip, the flow of power to the light source to be varied in response to at least a signal received on the first input and further operate such that in a first operating mode the microchip causes the light source to turn off after a predetermined time interval following receipt of an activation signal from the switch on said first input; and

causing, under control of the microchip and in response to a second signal from the switch, the light source to operate in at least a second operating mode in which a different level of power is supplied to the light source than in the first operating mode in order to provide a different level of illumination than in the first operating mode.

17. The method of claim 16, further comprising controlling, using the microchip, the flow of current from the power source to the light source such that in a third operating mode the light source flashes a code sequence.

18. The method of claim 17, further comprising indicating, under control of the microchip, the strength of one or more batteries associated with the flashlight.

19. The method of claim 16, further comprising causing, under control of the microchip, the light source to flash in a manner that is not easily visible to the human eye.

20. The method of claim 19, further comprising indicating, under control of the microchip, the strength of one or more batteries associated with the flashlight.

21. The method of claim 19, wherein the flashlight has an off mode; and the method further comprises causing, under control of the microchip, the light source to change from one of the operating modes to the off mode if the time period between the selection of the operating mode with the switch and a subsequent actuation of the switch is more than a predetermined period of time.

22. The method of claim 16, further comprising controlling, using the microchip, the flow of power to the light source such that in a third operating mode the light source flashes in a manner that is visible to the human eye.

23. The method of claim 22, further comprising a configuration wherein the microchip is always powered if a good power source is correct installed in the flashlight.

24. The method of claim 23, further comprising causing, under control of the microchip, the light source to flash in a manner that is not easily visible to the human eye.

25. The method of claim 16, further comprising indicating, under control of the microchip, the strength of one or more batteries associated with the flashlight.

26. The method of claim 16, further comprising causing, under control of the microchip, the light source to gradually vary in brightness in response to a user action.

27. The method of claim 16 wherein the flashlight has an off mode; and the method further comprises causing, under control of the microchip, the light source to change from one of the operating modes either to the off mode or to another one of the operating modes in response to a switch actuation, based on the time period elapsed since the selection of a currently active operating mode.

16

28. A flashlight for use with an exhaustible power supply, comprising:

a light source;
a first circuit for conducting power from said power source to activate the light source;

a switch, wherein the switch is not a serial element of the first circuit, and wherein the switch is a user interface;
a microchip having a first input coupled to the switch, wherein the microchip is capable of controlling the activation, deactivation and at least one other function of the light source in response to at least a signal received through said first input; and

wherein the microchip is further configured to provide a find-in-the-dark function by activating an indicator that is active when the light source has not been activated by the user, said indicator also being controlled to give an indication of the switch operation and/or an indication of the remaining power level of the power supply.

29. The flashlight of claim 28, further comprising a casing, wherein the light source, the switch, the indicator and the microchip are each coupled to the casing and/or enclosed in the casing.

30. The flashlight of claim 28, wherein the microchip is further capable of causing the light source to change from one operating mode either to another operating mode or to an off mode, in response to the passage of time between the activation of an operating mode using the switch and a subsequent operation of the switch.

31. The flashlight of claim 28, wherein the microchip is further configured to select an off mode if the time period between an operation of the switch when selecting a mode and a next operation of the switch is more than a predetermined period of time.

32. The flashlight of claim 31, wherein the microchip is further configured to provide an automatic delayed shut-off function in response to an activation command received through said first input from said switch.

33. The flashlight of claim 28, wherein the microchip is further configured to provide an automatic delayed shut-off function in response to an activation command from said switch.

34. The flashlight of claim 28, wherein the microchip is further configured to allow a user to gradually vary the power supplied to the light source.

35. The flashlight of claim 28, wherein the switch comprises a touch sensor or touch pad.

36. A lighting unit for use with an exhaustible power supply, comprising:

a light source;
a first circuit for conducting power from said power source to activate the light source;

a switch, wherein the switch is not a serial element of the first circuit, and wherein the switch is a user interface;
a microchip having a first input coupled to the switch, wherein the microchip is capable of controlling the activation and deactivation of the light source in response to at least a signal received through said first input;

wherein the light source has a plurality of operating modes including at least a first operating mode and a second operating mode with an adjusted power level supplied to the light source, and wherein the user selects an operating mode from said plurality of modes through the said switch connected to said first input, and wherein the second operating mode provides a different level of illumination when compared with the first operating mode; and

17

wherein the microchip is further configured to gradually vary the power to the light source based on the time period of switch actuation, such that the gradual change in power is not easily visible to the user.

37. The lighting unit in accordance with claim 36 configured to have a casing and wherein the microchip, the switch and the light source are each attached to and/or enclosed in the casing.

38. The lighting unit of claim 37, wherein the switch comprises a touch sensor or touch pad.

39. The lighting unit of claim 37, wherein the microchip is further configured to provide an automatic delayed shut-off function in response to an activation command from said switch received through said first input.

40. The lighting unit of claim 37, wherein the microchip is further capable of causing the light source to change from one operating mode either to another one of the plurality of operating modes or to an off mode, in response to the passage of time between the activation of an operating mode by operating the switch and a subsequent operation of the switch.

41. The lighting unit of claim 40, wherein the microchip is further configured to provide an automatic delayed shut-off function in response to an activation command from said switch.

42. The lighting unit of claim 40, wherein the microchip is further configured to have an address and to receive at least one command from a controller that contains at least an address.

43. The lighting unit in accordance with claim 36 configured to be a flashlight, wherein the microchip is further capable of causing the light source to indicate the strength of one or more batteries associated with the exhaustible power supply.

44. The lighting unit of claim 43, wherein the microchip is further configured to provide an automatic delayed shut-off function in response to an activation command from said switch.

45. The lighting unit of claim 44, wherein the microchip is further configured to have an address and to receive at least one command from a controller that contains at least an address.

46. The lighting unit in accordance with claim 36, wherein the microchip is further configured to be capable of selecting an off mode if the time period between an operation of the switch when selecting an operating mode and a next operation of the switch is more than a predetermined period of time.

47. The lighting unit of claim 46, wherein the microchip is further configured to provide an automatic delayed shut-off function in response to an activation command from said switch.

48. The lighting unit of claim 47, wherein the microchip is further configured to have an address and to receive at least one command that contains at least an address from a controller.

49. The lighting unit of claim 36, wherein the microchip is further configured to provide an automatic delayed shut-off function in response to an activation command from said switch.

50. The lighting unit of claim 49, wherein the switch comprises a touch sensor.

51. The lighting unit of claim 36, wherein the microchip is further configured to have an address and to receive at least one command from a controller that contains at least an address.

18

52. A flashlight for use with an exhaustible power supply, comprising:

a light source;
a first circuit for conducting power from said power source to operate the light source;

a switch, wherein the switch is a serial element of said first circuit, and wherein the switch is a user interface;

a microchip having a first input coupled to the switch, wherein the microchip is capable of controlling the activation and deactivation of the light source;

wherein the light source has a plurality of modes including at least an off mode; and

wherein the microchip is further configured to provide a shut off function if the time period of switch actuation was longer than a certain predefined period of time and to provide another of the plurality of modes if the time period of switch actuation was less than a certain predefined period of time.

53. The flashlight of claim 52, wherein the microchip is capable of controlling the flow of power to the light source such that a visible flashing function is selected based on the time period of switch actuation.

54. The flashlight of claim 52, wherein the microchip is further capable of causing the light source to indicate the strength of one or more batteries associated with the exhaustible power supply.

55. The flashlight of claim 52, wherein the microchip is further configured to provide an automatic delayed shut-off function in response to an activation command from said switch.

56. The flashlight of claim 52, wherein the switch comprises a touch sensor.

57. A lighting unit for use with an exhaustible power source, comprising:

a light source;
a first circuit for conducting power from said power source to operate the light source;

a switch, wherein the switch is not a serial element of said first circuit, and wherein the switch is a user interface;
a microchip having a first input connected to the switch, wherein the microchip is capable of controlling the activation and deactivation of the light source in response to a signal received from said switch through said input;

wherein the light source has a plurality of user-selectable operating modes controlled by said microchip, and said operating modes selected by signals received at least from said switch through said first input;

wherein the microchip is further capable of causing the light source to change from an active operating mode, that is one of the plurality of operating modes, to an off mode, if the time period between a switch operation during the selection of the active operating mode and the next activation of the switch is longer than a predetermined period of time;

wherein the microchip is further capable of causing the light source to change from an active operating mode, that is one of the plurality of operating modes, to another one of the plurality of operating modes, if the time period between a switch operation during the selection of the active operating mode and the next activation of the switch is not longer than a predetermined period of time; and

wherein the light source has an operating mode in which the microchip causes an adjustment of the average current supplied to the light source by means of an intermittent power delivery sequence from said power

source, such that any dead period of power when the power source is disconnected from said light source, is not easily visible to the human eye.

58. The lighting unit of claim 57 configured to be a flashlight, wherein the microchip is capable of controlling the flow of power to the light source such that in a flashing mode comprising one of the plurality of operating modes the microchip causes the light source to flash in a manner visible to the human eye.

59. The lighting unit of claim 57 configured to be a flashlight, wherein the microchip is configured to control a find-in-the-dark indicator that is active when the light source is not activated by the user.

60. The lighting unit of claim 57 configured to be a flashlight, wherein the microchip is further capable of causing the light source to indicate the strength of one or more batteries associated with the exhaustible power supply.

61. The lighting unit of claim 57, wherein the microchip is further configured to

enable a user to gradually vary the power supplied to the light source such that the gradual change in brightness is not easily visible and whereby operating mode selected is based on the time of switch actuation.

62. The lighting unit of claim 61, wherein the microchip is further configured to have an address and to receive at least one command that contains at least an address from a controller.

63. The lighting unit of claim 61, wherein the microchip is further configured to provide an automatic delayed shut-off function in response to an activation command from said switch.

64. The lighting unit of claim 63, wherein the microchip is further configured to have an address and to receive at least one command that contains at least an address from a controller.

65. The lighting unit of claim 64, wherein the switch comprises a touch sensor or touch pad.

66. The lighting unit of claim 63, wherein the switch comprises a touch sensor or touch pad.

67. The lighting unit of claim 66, further comprising a casing, wherein the light source, switch, and microchip are each coupled to the casing and/or enclosed in the casing.

68. The lighting unit of claim 63, further comprising a casing, wherein the light source, switch, and microchip are each coupled to the casing and/or enclosed in the casing.

69. The lighting unit of claim 68, wherein the microchip is further configured to control a find-in-the-dark indicator that is active when the light source is not activated.

70. The lighting unit of claim 57, wherein the switch comprises a touch sensor or a touch pad.

71. The lighting unit of claim 57, wherein the microchip is further configured to have an address and to receive at least one command that contains at least an address from a controller.

72. The lighting unit of claim 57, wherein the microchip is further configured to provide an automatic delayed shut-off function in response to an activation command from said switch.

73. The lighting unit of claim 57, further comprising a casing, wherein the light source, switch, and microchip are all coupled to the casing and/or enclosed in the casing.

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