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Description

Technical Field

The subject matter of the invention is a micro-processor controlled timer, which is continuously programmed in real time by actuation of a manual power switch (stand-by mode) and which on request can replace the function of the manual power switch (simulation mode).

Related Application

This application is a continuation of the Swiss Application No. 5 141/83-3, filed September 22, 1983 and entitled "Relais électrique à séquence temporelle cyclique autoprogrammable".

Background and Summary of Invention

The present invention relates to power switches with built-in programmable timers of the type which has its most important commercial application as a control for energizing and de-energizing of electrical appliances used in homes and offices, which emit acoustic or luminous energy, thus simulating the presence of persons, when these are in fact absent. A deterrent effect is thus achieved on intruders, although certain aspects of the invention have a more general application. In such a commercial application, the present invention will form an electric power switch, of the type to be connected in series with a power cord of the appliance and incorporated in the housing of the appliance itself or in its miniaturized version just connected as a mobile switch at the two ends of the power cord carrying the power from the plug to the appliance.

The utilization of mechanical and electro-mechanical timers for similar purposes is known since long time. These devices have small dimensions and are easily programmed by users without any technical knowledge. Their main drawback lies in the limited amount of on/off sequences which can be programmed during a cycle, which usually covers a time period of a day or a multiple thereof. So it is difficult to have more than 100 on/off sequences per cycle, and the minimum delay between two adjacent sequences is also limited by the precision with which mechanical markers can be machined and visually seen as distinct. A further drawback of this type of timers lies in their limited lifelength, due to wear of mobile mechanical parts.

Consequently in the last ten years, novel electronic means for enacting the timer function have been proposed.

For example, international patent application WO 81/02808 discloses a lighting circuit timer which can be programmed automatically. This may be achieved in real time over the first twenty four hours after a 30 minute "play period" by actuating a power switch to turn the light circuit on and off in a normal manner. The "play period" is for the purpose of preventing the real time program mode from being "locked-in" until the light circuit is energized for at least one-half hour.

It is an object of the present invention to

provide an electric power switch incorporating a selfprogrammable control timer which performs a better simulation of the presence of persons than the timer disclosed by the above-mentioned international patent application.

This is achieved by continuously refreshing, when the timer is in its programming mode, the content of the memory storing the sequences of on/off power switchings.

More precisely, the power switch of the present invention, which is operated manually by a toggle or button, comprises a pair of power input terminals, a pair of load device connecting terminals, power switch means connected between said power input terminals and said load device connecting terminals, an auxiliary commutator with at least two stable positions, for selecting the operating modes "stand-by" or "simulation", and a built-in electronic selfprogrammed control timer which, in the "stand-by" mode of operation, stores in a memory, over a given period of time, the sequences of on/off power switchings controlled by said manual toggle or button and which, in the "simulation" mode of operation, controls said power switch means in such a way as to replay, during said time period, the sequences of on/off power switchings with their corresponding time intervals as stored in said memory and, at the end of a time period, automatically restarts a new one according to the same schedule of stored on/off sequences until, by command of said commutator, the operation mode is changed from "simulation" back to "stand-by". This power switch is characterized in that the sequences of on/off power switchings are stored by the timer in the "stand-by" mode of operation over a gliding period of time.

In a refined version of the electric power switch according to the invention, the commutator has a third stable position "fail safe stand-by", whereby if the user does not activate the manual toggle within a certain period of time since the last manual operation thereof, the switch automatically, and without any action from the outside, goes over to the "simulation" mode and stays in that mode until the manual toggle is operated again.

In accordance with another feature of the present invention, any dysfunction of the electric power switch which is detected by a special self-check program stored in a suitable memory of the microprocessor gives rise to a coded alarm signal in the form of a characteristic train of very frequent on/off sequences of the power energizing the appliance, thus alerting the user that something is wrong.

Since the use of electronic memories in the timer portion of the electric power switch allows the storing of a very large number of on/off sequences during one cycle, the preferred cycle duration is of one week or a multiple thereof. This has the advantage that the changing pattern of on/off sequences during workdays and weekends is simulated properly when the electric power switch is in the "simulation" mode. In accordance

with another feature of the Present invention, the microprocessor checks at regular intervals the content of each day section of the stored program of on/off sequences and in case it finds a one day section which is empty (e.g. has not a predetermined minimum amount of on/off sequences), it replaces said one day section with another which is available in the stored program, having a large number of on/off sequences.

This last feature of the invention is particularly useful when installing the electric power switch for the first time, since then, if no particular provisions have been taken, the stored program controlling the timer portion of the electric power switch is completely empty, e.g. all the one day portions of it are empty. After a one day period of use of the electric power switch in the "stand-by" mode, all the empty one-day sections of the stored program will then automatically be filled with the pattern of on/off sequences of the first day, allowing the user to set the electric power switch into the "simulation" mode even though said switch was not in use in the "stand-by" mode for the full length of a recording cycle.

Accordingly no special initialization of the timer has to be performed upon the first time of use, which again is very useful and acceptable for technically unskilled users, the only requirement being to use the electric power switch in the "stand-by" mode at least for one day.

Since power failures of short duration (less than 5 minutes) are quite frequent, the critical parts of the timer portion of the electric power switch are protected against loss of power by voltage supplied by a small rechargeable battery or a lithium battery, which is provided in the low voltage supply part of the electric power switch. In particular the electronic memory holding the stored program of on/off sequences and the clock are fed by the emergency battery in case of power failure. If the voltage of the emergency battery falls below a certain proper value, the microprocessor, according to another feature of the present invention, detects it and signals it to the user by generating a train of frequent on/off sequences of the power energizing the appliance. This allows the user of either changing the emergency battery or waiting until the battery has been recharged, before setting the electric power switch into the "simulation" mode.

According to another feature of the present invention, in case that the electric power switch has been disconnected from the power outlet for a very long period of time, the appliance it controls not being used or having been inadvertently disconnected by children or other unaware people, the electric power needed to keep the clock and the memory with the stored on/off sequences going is supplied under the day by a photovoltaic cell which charges the emergency battery with the current generated by conversion of daylight, so as to compensate also for the loss of charge of the battery during the night period.

A preferred version of such a photovoltaic cell is an amorphous silicon solar cell, which is

mounted on the same side of the container where also the main toggle is located, so as to get maximum light exposure during the day.

When in the same building more than one electric power switch according to the present invention are installed, it might be useful to control from a central point the setting of said switches into the "simulation" mode or back into the "stand-by" mode. To achieve this and according to another feature of the present invention, the microprocessor is provided with a special decoder circuit, which decodes high frequency signals which are sent along the power lines from a suitable central unit which is operated by the user when leaving or coming back from a prolonged absence. So when a coded high frequency signal is sent along the power lines, each electric power switch goes simultaneously into the "simulation" mode, but each of said switch has a different program of on/off sequences, which simulate e.g. the activity of a person moving from one room to the other. Furthermore and according to another feature of the present invention, the electric power switches are provided with a coded high frequency signal emitting circuit, which sends alarms signal into the power line, in case that the manual toggle is activated when the electric power switches are operating in the "simulation" mode. Since by definition during the "simulation" mode nobody should be in the building, if there is a change of the status of any of the toggles an intruder has penetrated into the building: in this case the coded high frequency signals emitted by the corresponding electric power switch are received and decoded by the central unit, which can then take proper action, e.g. alerting the police over the phone line or energizing an acoustic alarm horn.

In the case where high security is required, the electric power switch is provided according to another feature of the present invention with a voice recognition electronic device, which is speaker dependent and connected to a small microphone, mounted on a suitable face of the container so as to be exposed optimally to the mouth of the user, who is entitled to operate it. At the time of first installation of the said switch, the authorized user can teach the voice recognition device by spelling e.g. the words "stand-by" and "simulation" when the commutator is in the corresponding position and having a special auxiliary button for the "teach" function depressed with his hand. After that, the access to the commutator is rendered difficult to unauthorized persons, by sealing it e.g. with a lid or any other physical means hampering access and the electric power switch is incorporated into the electrical apparatus which it controls, having only the side with the toggle and the microphone exposed to the outside. With this particular set-up only the authorized user is able to commute the electric power switch from the "stand-by" into the "simulation" mode and vice versa.

Furthermore it might be useful for the user to have a feed-back, that the electric power switch is

properly operating in the "simulation" mode, when the order to do it is either entered by action on the commutator S or by other previously described means. According to another feature of the invention, such an immediate feedback signal is generated by having after a short delay upon the change of mode a predetermined sequence of few on/off or off/on switches of the power, which end after 10 to 30 seconds, signalling to the user that the microprocessor is working properly. In opposition to this and as already said before, if there is some dysfunction of the electric power switch, the sequences of on/off power switches keep steadily going for as long as the user is taking appropriate action to eliminate said dysfunction.

A further check that the electric power switch according to the present invention is in the "simulation" mode can be achieved by disabling the toggle in the "simulation" mode, that is either disconnecting from the power the input of the manual switch operated by the toggle or by suppressing any action that the toggle operated switch might have on the operation of the microprocessor. This feature of the present invention is especially useful in buildings, where security guards performs regular tours, checking the status of electrical apparatus: when operating the toggle they notice no change in the energized status of the apparatus, they have the proof that the electrical power switch is in the "simulation" mode.

When the appliance or apparatus which is controlled by the electric power switch needs a variable power input according to the user's wishes, it might be useful, according to another feature of the present invention, to incorporate the power regulating means into the electric power switch in such a way, that the microprocessor is storing the on/off sequences and the level of power allowed during the "on" state into said memory during the "stand-by" mode and replays then during the "simulation" mode both the on/off sequences and the level of electric power allowed, as they were stored during the immediately preceding cycle in, the "stand-by" mode. The same considerations apply to appliances or apparatus which need for their operation DC voltage supply, in which case the AC/DC converter may be incorporated into the electric power switch, having the added benefit that DC power can be directly supplied to the electronic control timer, if provisions are made in order to have an output of the AC/DC converter with the suitable DC voltage (in most cases 5 V).

The above and other advantages and features of the invention will become apparent upon making reference to the specification to follow, the claims and the drawings.

Description of drawings

Fig. 1 is a perspective view of an electric power switch, connected between the ends of the electric power carrying cord, which supplies power to the appliance or apparatus which is turned on or

off by manual operation of a toggle mounted in the housing of the electric power switch, as long as the commutator on the side of the housing is set, in the "stand-by" position. If said commutator is set in the "simulation" position, the electric power switch is then operated automatically by the built-in electronic control timer, housed in said housing and protected from external influences, which might impair its correct operation.

Fig. 1a is a perspective view of an electric power switch and its remote manual operated toggle or button, which is connected to the electric power switch by additional wirings incorporated into the special portion of the power cord between the electric power switch and the remote toggle or button. The normal power cord is connected at one end at the appropriate side of the electric power switch and at the other end at the appropriate side of the remote toggle's or button's housing.

Fig. 1b is a perspective view of an electric power switch and its remote manual operated toggle or button together with the remote stand-by/simulation commutator, both of which are connected to the electric power switch by suitable wirings in a special cord, whereas the ends of the electric power cord are directly connected at the appropriate sides of the electric power switch.

Fig. 2 is a box diagram of the basic control elements of the electronic control timer and of the power switching means according to an embodiment of the present invention, where said power switching means have an air gap when in the "off" state and where both the toggle or button and the stand-by/simulation commutator are mounted in the same housing as the electric power switch.

Fig. 3 is a box diagram of the basic control elements of the electronic control timer and of the power switching means according to another embodiment of the present invention, where the toggle or button as well as the stand-by/simulation commutator are housed in an auxiliary housing, as apparent from Fig. 1b, and where said power switching means are of the solidstate type, like ignition controlled rectifiers and the like.

Description of First Exemplary Form of the Invention

Referring now to Fig. 1, Fig. 1a and Fig. 1b, there is shown an electric power switch housed in a housing B, connected between the ends of power carrying cord V (plug side) and W (appliance input). The manually operated toggle or button I is housed in B, as depicted on Fig. 1 or in a remote auxiliary housing Ba connected to the power cord as depicted in Fig. 1a, or finally in an auxiliary remote housing Bb together with the stand-by/simulation commutator S, as depicted in Fig. 1b.

The stand-by/simulation commutator S is housed in B, as depicted in Fig. 1 and Fig. 1a, in such a way that it is accessible to manual operation from the user, when the housing B is

mounted or incorporated in an appliance or apparatus, which is controlled by the electric power switch. In the case that this shall not be possible for practical reasons, the commutator S is then incorporated into the auxiliary remote housing Bb, as earlier mentioned and as depicted in Fig. 1b.

The commutator S has in the present example two distinct positions "stand-by" and "simulation", which are visually indicated by appropriate signs on the housings B or Bb, so that the user can check in which mode of operation the electric power switch is set. If more modes of operations are available, like the e.g. "remote control" mode, then the commutator S shall have additional stable and visually indicated positions, so as to indicate to the user, in which mode the electric power switch is operating.

In each of the examples of Fig. 1, 1a and 1b, use of the electric power switch according to the present invention is straightforward: as long as the commutator S is in the "stand-by" position, the turning on and off of the appliance or apparatus controlled by it is performed by the user by manual operation of toggle or button I, as it is widely used in common electric power switches. When the user wants to operate the electric power switch during his absence, he just has to set the commutator S in the "simulation" position before leaving. From that moment on, the built-in electronic timer will take over the operation of the electric power switch according to the schedule of on/off switching sequences which has been stored in the immediately preceding cycle during the "stand-by" mode of operation. To get back to the "stand-by" mode of operation, the user has only to set the commutator S in the "stand-by" position again. Similar considerations apply, if the commutator S has more than two stable positions, since they are visually apparent and indicated to the user.

Description of the main elements of the electric power switch

Coming now to Fig. 2, there is shown two AC power lines V1 and V2 on the input side of the electric power switch housed in B, which are connected to the DC low voltage power supply Y, to the terminals of an electromechanical relay C and of a contactor mechanically operated by the toggle or button I. At the output side there are two AC power lines W1 and W2, connected at the corresponding terminals of the relay C and of the contactor mechanically operated by I as well as to connected to a voltage sensing detector D, which transforms the AC voltage into a suitable DC low voltage signal compatible with the input levels of the microprocessor P. These power lines W1 and W2 bring the power to the appliance or apparatus A. If A needs a 3-phase power feed, the electromechanical relay C and the contactor mechanically operated by I are changed accordingly, whereas the low voltage power supply Y and the detector D can be fed by only two phases, or by a phase and the common.

The low voltage DC power supply Y has a rechargeable battery or a lithium battery or other suitable DC electric power storage means, which allow it to feed appropriate electric DC power to the clock H and the memory M of the electronic control timer, in case that a power failure on the lines V1 and V2 occurs. The microprocessor P, which manages all the functions of the electronic control timer, is connected to the detector D and to an output interface unit T, which commands the relay C. The three elements P, D and T are fed by low voltage DC power from a separate line of Y, which is not protected against mains power failure on the lines V1 and V2.

The microprocessor P is further connected to the clock H, from where it gets the appropriate timing signals, and to the memory M, in which are stored the sequences of on/off power switchings detected and stored during one cycle in the "stand-by" mode and continuously refreshed as long as the electric power switch stays in the "stand-by" mode, said sequences being entered into the memory M by the microprocessor P according to corresponding input signals coming from detector D concerning presence or absence of AC voltage on the lines W1 and W2. The contact of commutator S is also connected to P in such a way that e.g. when said contact is on the "0" digital voltage level, the microprocessor P is forced to operate in the "stand-by" mode, whereas if said contact is on the "1" digital voltage level, P is forced to operate in the "simulation" mode.

The operating software which is necessary to operate the microprocessor P according to the present invention is stored in ROM or EPROM memories, which are incorporated in the same chip as the microprocessor P. When P is forced to operate in the "simulation" mode by having the contact of commutator S on the "1" digital voltage level, the microprocessor P reads the content of memory M, which in this case is no longer refreshed by the output of detector D, and transforms said content into timed commands, which over the output of the output interface unit T are causing relay C to turn on and off the electric power on lines W1 and W2 according to the schedule stored in M and within the timing precision of the minimum sampling time of the microprocessor P. This action goes on continuously, in the sense that when the content of one cycle has been read, the microprocessor P starts reading at the beginning of the cycle again and indefinitely, unless the commutator S is brought back by the user in the "stand-by" position.

If a short power failure occurs on lines V1 and V2, the clock H and the content of memory M are thereby not concerned, being fed automatically by the rechargeable batteries of Y, so that when the mains power comes back, P picks up the content of M at the correct location as instructed by the timing signals of H and continues playing back the on/off switching sequences on C, as if there was no mains failure at all.

As an illustration of this first example, an electric power switch has been built, having as microprocessor P a 8-bit integrated circuit of the 8751 Intel type, as memory M a 16 kbits integrated circuit of the HM6116LP Hitachi type and as a timing unit for the clock H incorporated into the 8751 type processor a 12 Mhz quartz resonator. The cycle time was one week and the processor 8751 did sample every minute the output of detector D, transferring it into the memory HM6116LP during the "stand-by" mode. In this particular case only $60 \times 24 \times 7 = 10'080$ bits of the memory HM6116LP were needed in order to fully cover storage of a whole recoding cycle of 168 hours.

It is now apparent to persons skilled in the field of electronic controls using microprocessors, that further features of the present invention can be implemented by adding suitable inputs to the microprocessor P, by connecting it with other suitable electronic units, by introducing more complex instructions in the operating software which runs the microprocessor P or by a combination of all these said means. When the contactor mechanically operated by the toggle or button I is spatially separated from housing B, it is apparent to persons skilled in electricity that the wirings connecting the auxiliary housing Ba or Bb to housing B of Fig. 1a or Fig. 1b includes the lines V1, V2, W1, W2 in both cases, with the addition of three wirings (contact input to P, "0" and "1" digital voltage levels) to the terminals of commutator S in the Fig. 1b.

Description of a Second Exemplary Form of Invention

From the user's standpoint, all what was said in the foregoing description of first exemplary form of the invention still applies. Referring now to the Fig. 3, there is shown a housing B, containing the earlier described building elements Y, H, M, P and T, with the exception of relay C and of detector D, no longer needed, and with the addition of suitable ignition controlled silicon rectifiers or power transistors X, acting as power switching means. In a separate auxiliary housing Bb there are contacts connecting suitable inputs of P to the "0" or "1" digital voltage level, the first of said contacts being activated by the toggle I, the other ones being activated by commutator S in such a way, that the three commands "stand-by", "fail-safe stand-by" and "simulation" are univocally transmitted to P when commutator S is in the corresponding position.

As long as S is in the "stand-by" position, changes of status level of the contact operated by the toggle I are stored by P into the memory M and at the same time they enable or disable thru the output interface unit T the ignition of X, thus effectively turning on or off the power on lines W1 and W2, as requested by manual operation of toggle I. If the commutator S is positioned on "simulation", the input coming from the contact operated by I is disabled and P starts reading the content of M and accordingly enabling or disab-

ing thru T the ignition of X, thus replaying the sequences of on/off power switchings commanded by operation of I during the cycle immediately preceding the transition from "stand-by" to the "simulation" mode.

If the commutator S is positioned as to force P into the "fail-safe stand-by" mode, as long as the changes of status of the contact operated by I follow each other within a predetermined lapse of time, they are stored into M and at the same time they enable or disable thru T the ignition of X, as it always is in the "stand-by" mode. Once the toggle I is not operated for a lapse of time longer than said predetermined lapse (e.g. one day), the microprocessor P automatically goes over into the "simulation" mode, but the input of the contact operated by I is not disabled, allowing the microprocessor P to revert to the "stand-by" mode as soon as I is operated again.

As an illustration of this second exemplary form of the invention, an electric power switch was built having as P an integrated circuit of the 40C49 type, as memory M an integrated circuit of the HM6116LP type backed by auxiliary integrated circuits 74C373 and 27C16 and as power switching means X a triac of the 2N6073A type. Said illustration was fitted into a housing B with dimensions less than $10 \times 5 \times 2$ cm., including rechargeable batteries of the NiCd type for a nominal voltage of 5 volts DC.

It is now apparent to persons skilled in the field of electronic controls using microprocessors, that further features of the present invention can be implemented by adding suitable inputs to P, by connecting to P suitable signal processing units, such as high frequency signal receiver or emitter and the like, by introducing more complex instructions sets in the operating software of P, such as routines for periodically checking the content of 24-hours segments of M and for replacing empty segments with other available segments having more than predetermined number of on/off sequences, or such as routines for commanding coded on/off sequences of power switchings on the lines W1, W2 by acting on ignition of X, if specific information about the status of the electric power switch or of its elements and detected by suitable means affecting P, has to be indicated to the user.

Furthermore a solar cell fed electronic unit can be connected to Y in order to keep its rechargeable batteries at operating voltage, taking into account that said, batteries have to continuously feed DC power to the clock H and to the memory M also during nighttime, in case of prolonged disconnection of the power on lines V1, V2. By adding a voltage sensing electronic unit into Y, which sends appropriate alarm signals to P if the batteries voltage is lower than a predetermined limit, a routine of the operating software of P is activated, whereby P commands coded sequences of on/off switchings to X, thus signalling to the user that batteries have to be replaced or checked.

It is also apparent to skilled persons, that if

power switching means are required, which in the "off" state have an open air gap, the solid state switches in X are replaced by an electro-mechanical relay, which is controlled by a suitable output interface unit in T.

The practical applications of the electric power switch according to the present invention are of different nature and can be found in fields as diverse as medical patient care, biology, intelligence and military, feeding of animals, security of goods and persons and the like, where operation of electrical apparatus should continue if the user consciously or unconsciously is prevented to directly and manually operate said toggle or button.

A preferred application of the electric power switch according to the present invention is the control of illumination sources in houses and offices, like electrical lamps or motor-driven window-shutters and the like.

By now it should be apparent that the present invention allows to build extremely user friendly and ever-ready electric power switches, which do not require any special programming of on/off schedule by the user other than the regular use of the electric power switch in the "stand-by" mode for at least a short period of its chosen cycle time, which if necessary can be extended to encompass the change of seasons over a whole year (52 weeks), if a memory M of sufficient capacity (e.g. 64 kbits or 256 kbits RAM's) is used.

It should be understood that numerous modifications may be made with reference to the exemplary forms of the invention as described in this patent application, without deviating from the broader aspects of the present invention.

Claims

1. An electric power switch operated manually by a toggle or button, comprising a pair of power input terminals, a pair of load device connecting terminals, power switch means connected between said power input terminals and said load device connecting terminals, an auxiliary commutator with at least two stable positions for selecting the operating modes "stand-by" or "simulation", and a built-in electronic selfprogrammed control timer which, in the "stand-by" mode of operation, stores in a memory, over a given period of time, the sequences of on/off power switchings controlled by said manual toggle or button and which, in the "simulation" mode of operation, controls said power switch means in such a way as to replay, during said time period, the sequences of on/off power switchings with their corresponding time intervals as stored in said memory and, at the end of a time period, automatically restarts a new one according to the same schedule of stored on/off sequences until, by command of said commutator, the operation mode is changed from "simulation" back to "stand-by", characterized in that the sequences of on/off power switchings

are stored by the timer in the "stand-by" mode of operation over a gliding period of time.

2. The electric power switch of claim 1, wherein said toggle or button for manual operation is spatially separated from the body of the switch and connected thereto with suitable wiring for carrying the on/off command to said power switch means.

3. The electric power switch of claim 1 or 2, wherein the duration of said gliding period of time is 168 hours or a integer multiple thereof.

4. The electric power switch of any of the preceding claims, wherein said commutator has another stable position for a "fail-safe stand-by" mode, different from the "stand-by" and the "simulation" positions, such as, when the commutator is in said "fail-safe stand-by" position, the switch automatically moves from the initial "stand-by" into the "simulation" mode if said toggle or button is not manually operated for a time exceeding a predetermined duration corresponding to a multiple of hours or days, and automatically reverts back to the "stand-by" mode of operation as soon as said toggle or button is operated again.

5. The electric power switch of any of the preceding claims, wherein predetermined coded sequences of on/off power switchings controlled by said timer are used as indicator means for the feed-back to the user of information relating to the change of mode of operation or to some dysfunction of failed components of the switch itself.

6. The electric power switch of any of the preceding claims, wherein the operating system of the microprocessor controlling said timer contains a routine program, such as, every 24 hours, the content of said memory is checked and, if 24 hours segments are found, which contain a number of on/off sequences lower than a predetermined limit, the content of said segments is cancelled and replaced with the content of other 24 hours segments present in said memory and having a number of on/off sequences larger than said predetermined limit.

7. The electric power switch of any of the preceding claims, wherein the change from the "stand-by" to the "simulation" mode of operation and viceversa is activated by a built-in high frequency signal decoder which picks signals from the power line and transforms them into commands for the timer if said commutator is positioned on a position "remote control", which is different from said "stand-by" and "simulation" positions.

8. The electric power switch of claim 7, wherein the information necessary for decoding said signals on the power line is contained in a non-volatile semiconductor memory of the EEPROM or NOVRAM type.

9. The electric power switch of any of claims 1 to 6, wherein the change from the "stand-by" to the "simulation" mode of operation is activated by a built-in voice recognition electronic unit which transforms acoustic information received

power switching means are required, which in the "off" state have an open air gap, the solid state switches in X are replaced by an electro-mechanical relay, which is controlled by a suitable output interface unit in T.

The practical applications of the electric power switch according to the present invention are of different nature and can be found in fields as diverse as medical patient care, biology, intelligence and military, feeding of animals, security of goods and persons and the like, where operation of electrical apparatus should continue if the user consciously or unconsciously is prevented to directly and manually operate said toggle or button.

A preferred application of the electric power switch according to the present invention is the control of illumination sources in houses and offices, like electrical lamps or motor-driven window-shutters and the like.

By now it should be apparent that the present invention allows to build extremely user friendly and ever-ready electric power switches, which do not require any special programming of on/off schedule by the user other than the regular use of the electric power switch in the "stand-by" mode for at least a short period of its chosen cycle time, which if necessary can be extended to encompass the change of seasons over a whole year (52 weeks); if a memory M of sufficient capacity (e.g. 64 kbits or 256 kbits RAM's) is used.

It should be understood that numerous modifications may be made with reference to the exemplary forms of the invention as described in this patent application, without deviating from the broader aspects of the present invention.

Claims

1. An electric power switch operated manually by a toggle or button, comprising a pair of power input terminals, a pair of load device connecting terminals, power switch means connected between said power input terminals and said load device connecting terminals, an auxiliary commutator with at least two stable positions for selecting the operating modes "stand-by" or "simulation", and a built-in electronic selfprogrammed control timer which, in the "stand-by" mode of operation, stores in a memory, over a given period of time, the sequences of on/off power switchings controlled by said manual toggle or button and which, in the "simulation" mode of operation, controls said power switch means in such a way as to replay, during said time period, the sequences of on/off power switchings with their corresponding time intervals as stored in said memory and, at the end of a time period, automatically restarts a new one according to the same schedule of stored on/off sequences until, by command of said commutator, the operation mode is changed from "simulation" back to "stand-by", characterized in that the sequences of on/off power switchings

are stored by the timer in the "stand-by" mode of operation over a gliding period of time.

2. The electric power switch of claim 1, wherein said toggle or button for manual operation is spatially separated from the body of the switch and connected thereto with suitable wiring for carrying the on/off command to said power switch means.

3. The electric power switch of claim 1 or 2, wherein the duration of said gliding period of time is 168 hours or a integer multiple thereof.

4. The electric power switch of any of the preceding claims, wherein said commutator has another stable position for a "fail-safe stand-by" mode, different from the "stand-by" and the "simulation" positions, such as, when the commutator is in said "fail-safe stand-by" position, the switch automatically moves from the initial "stand-by" into the "simulation" mode if said toggle or button is not manually operated for a time exceeding a predetermined duration corresponding to a multiple of hours or days, and automatically reverts back to the "stand-by" mode of operation as soon as said toggle or button is operated again.

5. The electric power switch of any of the preceding claims, wherein predetermined coded sequences of on/off power switchings controlled by said timer are used as indicator means for the feed-back to the user of information relating to the change of mode of operation or to some dysfunction of failed components of the switch itself.

6. The electric power switch of any of the preceding claims, wherein the operating system of the microprocessor controlling said timer contains a routine program, such as, every 24 hours, the content of said memory is checked and, if 24 hours segments are found, which contain a number of on/off sequences lower than a predetermined limit, the content of said segments is cancelled and replaced with the content of other 24 hours segments present in said memory and having a number of on/off sequences larger than said predetermined limit.

7. The electric power switch of any of the preceding claims, wherein the change from the "stand-by" to the "simulation" mode of operation and viceversa is activated by a built-in high frequency signal decoder which picks signals from the power line and transforms them into commands for the timer if said commutator is positioned on a position "remote control", which is different from said "stand-by" and "simulation" positions.

8. The electric power switch of claim 7, wherein the information necessary for decoding said signals on the power line is contained in a non-volatile semiconductor memory of the EEPROM or NOVRAM type.

9. The electric power switch of any of claims 1 to 6, wherein the change from the "stand-by" to the "simulation" mode of operation is activated by a built-in voice recognition electronic unit which transforms acoustic information received



by a built-in microphone into commands for said timer if said commutator is positioned on a "remote control" position which is different from said "stand-by" and "simulation" positions.

10. The electric power switch of any of the preceding claims, wherein a high-frequency signal emitting device is built-in and emits alarm signals on the power line if said toggle or button is operated when the electric power switch is in the "simulation" mode of operation.

11. The electric power switch of any of the preceding claims, wherein a photovoltaic device is attached on a suitable face of the housing of the switch for the purpose of under daylight generating a DC current of suitable power for charging the rechargeable battery which is incorporated in the power supply unit feeding the clock and the memory of said timer.

12. The electronic power switch of any of the preceding claims, wherein said power switch means are ignition controlled rectifiers which are ignited by a built-in AC-phase sensitive electronic control unit in such a way that, by manual operation of a suitable knob, the user is able to control the amount of electric power going through the switch in the "on" state.

13. The electric power switch of any of the preceding claims, wherein, during the mode of operation "simulation" and during a period of time when said power switch is in the "on" state, any manual operation of said toggle or button is disabled, so that it does not provoke a change from the "on" state into the "off" state of the switch, thus signalling to the user that the switch is in the "simulation" operation mode.

14. The electric power switch of any of the preceding claims, wherein there is provided on a face of the housing containing the switch a digital display for displaying the daytime and the date as derived by signals coming from a microprocessor which manages said timer and wherein there are provided additional mechanical means for allowing the user to set the display at the actual time and date when first taking the switch in use.

15. The electric power switch of any of the preceding claims, wherein said memory is a magnetic non-volatile memory of the "bubble" type with a storage capacity in excess of 100 kilobits.

Patentansprüche

1. Elektrischer Leistungsschalter, der von Hand aus durch einen Hebel oder Knopf betätigt wird, mit einem Paar von Stromeingangsanschlüssen, einem Paar von Verbraucheranschlüssen, einem Leistungsschalter zwischen den Stromeingangsanschlüssen und den Verbraucheranschlüssen, einem Hilfsumschalter mit wenigstens zwei stabilen Positionen zum Auswählen der Betriebsarten "Bereitschaft" oder "Simulation" und mit einem eingebauten elektronischen selbstprogrammierenden Zeitgeber, der im Betriebszustand "Bereitschaft" über eine gegebene Zeitspanne, die Folgen von An-/Aus-Schaltungen, die durch den

Handhebel oder Knopf gesteuert werden, in einem Speicher speichert und der in der Betriebsart "Simulation" den Leistungsschalter so steuert, daß er während der gegebenen Zeitspanne die Folge von An-/Aus-Schaltungen mit ihren entsprechenden Zeitabständen, wie sie im Speicher gespeichert sind, ablaufen läßt und der am Ende einer Zeitspanne automatisch eine neue gemäß dem gleichen Schema von gespeicherten An-/Aus-Folgen beginnt, bis durch Befehl des Umschalters die Betriebsart von "Simulation" zurück in "Bereitschaft" geändert wird, dadurch gekennzeichnet, daß die Folgen von An-/Aus-Leistungs-Schaltungen durch den Zeitgeber in der Betriebsart "Bereitschaft" über eine Gleitzeit-spanne gespeichert werden.

2. Elektrischer Leistungsschalter nach Anspruch 1, bei dem der Hebel oder Knopf zur Betätigung von Hand aus räumlich vom Körper des Schalters getrennt ist und an diesen über eine geeignete Leitung zum Übermitteln der An-/Aus-Befehle zum Leistungsschalter angeschlossen ist.

3. Elektrischer Leistungsschalter nach Anspruch 1 oder 2, bei dem die Dauer der Gleitzeit-spanne 168 Stunden oder ein ganzzahliges oder vielfaches davon ist.

4. Elektrischer Leistungsschalter nach einem der vorhergehenden Ansprüche, bei welchem der Umschalter eine weitere, von den Stellungen "Bereitschaft" und "Simulation" unterschiedliche stabile Stellung für eine Betriebsart "fail-safe-Bereitschaft" aufweist, so daß der Schalter, wenn der Umschalter in der "fail-safe-Bereitschaft"-Stellung ist, automatisch von der ursprünglichen Betriebsart "Bereitschaft" in "Simulation" übergeht, wenn der Hebel oder Knopf eine Zeit lang die eine vorgegebene Zeitspanne entsprechend einem Vielfachen von Stunden oder Tagen überschreitet, nicht von Hand aus betätigt wird, und automatisch in die Betriebsart "Bereitschaft" zurückkehrt, sobald der Hebel oder Knopf erneut betätigt wird.

5. Elektrischer Leistungsschalter nach einem der vorhergehenden Ansprüche, bei welchem vorgegebene kodierte Folgen von An-/Aus-Schaltungen, die durch den Zeitgeber gesteuert werden, als Anzeige für die Rückmeldung einer Information zum Benutzer bezüglich der Änderung der Betriebsart oder einer Fehlfunktion von fehlerhaften Bauteilen des Schalters selbst, verwendet werden.

6. Elektrischer Leistungsschalter nach einem der vorhergehenden Ansprüche, bei welchem das Betriebssystem des Mikroprozessors, die den Zeitgeber steuert, einen Programmabschnitt enthält, der beispielsweise alle 24 Stunden den Inhalt des Speichers prüft und der, falls 24 Stunden Abschnitte gefunden werden, die eine Zahl von An-/Aus-Folgen kleiner als eine vorgegebene Grenze enthalten, den Inhalt dieses Abschnittes löscht und durch den Inhalt eines anderen 24-Stunden-Abschnittes, der im Speicher vorliegt und eine Zahl von An-/Aus-Folgen hat, die größer ist als die vorgegebene Grenze, ersetzt.

7. Elektrischer Leistungsschalter nach einem



der vorhergehenden Ansprüche, bei welchem die Änderung der Betriebsart "Bereitschaft" in "Simulation" und umgekehrt durch einen eingebauten Hochfrequenzsignaldecoder aktiviert wird, der Signale von der Stromversorgungsleitung aufnimmt und sie in Befehle für den Zeitgeber umformt, wenn der Umschalter in eine Stellung "Fernsteuerung" gestellt ist, die von den Stellungen "Bereitschaft" und "Simulation" unterschiedlich ist.

8. Elektrischer Leistungsschalter nach Anspruch 7, bei welchem die zum Decodieren der Signale an der Stromversorgungsleitung benötigte Information in einem nicht löschbaren Halbleiterspeicher der Bauart EEPROM oder NOVRAM enthalten ist.

9. Elektrischer Leistungsschalter nach einem der Ansprüche 1 bis 6, bei welchem die Änderung des Betriebszustandes "Bereitschaft" in "Simulation" durch eine eingebaute elektronische Spracherkennungseinheit aktiviert wird, die eine durch ein eingebautes Mikrofon empfangene, akustische Information in Befehle für den Zeitgeber umwandelt, wenn der Umschalter in eine "Fernsteuerung" Stellung gestellt ist, die von den Stellungen "Bereitschaft" und "Simulation" unterschiedlich ist.

10. Elektrischer Leistungsschalter nach einem der vorhergehenden Ansprüche, bei welchem ein hochfrequenzsignalabgebendes Gerät eingebaut ist und an die Stromversorgungsleitung Alarmsignale abgibt, wenn der Hebel oder Knopf betätigt wird, wenn der elektrische Leistungsschalter in der Betriebsart "Simulation" ist.

11. Elektrischer Leistungsschalter nach einem der vorhergehenden Ansprüche, bei welchem eine Fozelle auf einer geeigneten Seite des Gehäuses des Schalters angeordnet ist, um bei Tageslicht einen Gleichstrom geeigneter Größe zum Aufladen der aufladbaren Batterie erzeugen, die in die Stromversorgungseinheit eingebaut ist, welche die Uhr und den Speicher des Zeitgebers speist.

12. Elektronischer Leistungsschalter nach einem der vorhergehenden Ansprüche, bei welchem der Leistungsschalter ein zündungsgesteuerter Gleichrichter ist, der durch eine eingebaute Wechselstromphasen-sensitive elektronische Steuereinheit so gezündet wird, daß der Benutzer bei Betätigung eines geeigneten Knopfes von Hand aus in der Lage ist, die Menge von elektrischem Strom zu prüfen, die durch den Schalter in den "An"-Zustand geht.

13. Elektrischer Leistungsschalter nach einem der vorhergehenden Ansprüche, bei welchen während der Betriebsart "Simulation" und während einer Zeitspanne, wenn der Leistungsschalter im "An"-Zustand ist, jede Betätigung des Hebels oder Knopfes von Hand aus unwirksam ist, so daß sie keine Änderung des Zustandes "An" in den Zustand "Aus" des Schalters auslöst, und so dem Benutzer anzeigt, daß der Schalter in der Betriebsart "Simulation" ist.

14. Elektrischer Leistungsschalter nach einem der vorhergehenden Ansprüche, bei welchem an

einer Seite des den Schalter enthaltenen Gehäuses eine Digitalanzeigevorrichtung zum Anzeigen der Tageszeit und des Datums vorgesehen ist, die von Signalen hergeleitet werden, die von einem Mikroprozessor kommen, der den Zeitgeber handhabt, und bei dem zusätzliche mechanische Mittel vorgesehen sind, die es dem Benutzer erlauben, das Display auf Echtzeit und Datum zu schalten, wenn der Schalter erstmals in Benutzung genommen wird.

15. Elektrischer Leistungsschalter nach einem der vorhergehenden Ansprüche, bei dem der Speicher ein nicht-löschbarer magnetischer Blasen-Speicher mit einer Speicherkapazität von mehr als 100 kBit ist.

Revendications

1. Interrupteur d'alimentation électrique activé manuellement par un bouton ou levier, possédant une paire de bornes de connexion d'entrée de l'électricité, une paire de bornes de connexion de l'appareil à alimenter, des moyens d'interruption branchés entre les dites bornes d'entrée et de l'appareil, un commutateur auxiliaire avec au moins deux positions stables pour choisir le mode de fonctionnement "stand-by" ou "simulation", et un programmeur temporel autoprogrammé incorporé, lequel dans le mode de fonctionnement "stand-by" enregistre dans une mémoire pendant une période de temps donnée les séquences de commutation enclenché/déclenché commandées par le dit bouton ou levier et qui dans le mode de fonctionnement "simulation" commande les dits moyens d'interruption de telle façon à répéter les séquences d'interruption enclenché/déclenché avec les intervalles temporels respectifs comme enregistrés dans la dite mémoire et à la fin de chaque période de temps, automatiquement initialise une nouvelle répétition selon le même schéma de séquences enclenché/déclenché enregistré dans la dite mémoire jusqu'au moment où par ordre du dit commutateur le mode de fonctionnement est changé de "simulation" à nouveau sur "stand-by", caractérisé par le fait que les séquences de commutation enclenché/déclenché sont enregistrées par le programmeur temporel dans le mode de fonctionnement "standby" sur une période de temps mobile.

2. Interrupteur selon revendication 1, caractérisé en ce que le dit bouton ou levier pour manipulation est séparé dans l'espace du corps de l'interrupteur et connecté à celui-ci avec un câblage convenable pour amener les ordres enclenché/déclenché au dit moyen d'interruptions.

3. Interrupteur selon revendication 1 ou 2, caractérisé en ce que la durée de la dite période mobile de temps est de 168 heures ou un multiple entier de 168 heures.

4. Interrupteur selon une des revendications précédentes, caractérisé en ce que le dit commutateur auxiliaire a une autre position stable "stand-by de sécurité" différente des positions



"stand-by" et "simulation" de telle façon que si le commutateur se trouve dans la dite position "stand-by de sécurité", l'interrupteur automatiquement passe du mode de fonctionnement "stand-by" à celui "simulation" si le dit bouton ou levier n'est pas manipulé pendant un laps de temps d'une durée prédéterminée correspondant à un multiple d'heures ou jours et automatiquement revient au mode de fonctionnement "stand-by" dès que le dit bouton ou levier est manipulé à nouveau.

5. Interrupteur selon une des revendications précédentes, caractérisé en ce qu'une séquence prédéterminée de commutation enclenché/déclenché commandée par le dit programmeur temporel est utilisée comme signal à l'intention de l'utilisateur pour le renseigner sur les changements de modes de fonctionnement ou sur la malfonction de certains composants de l'interrupteur.

6. Interrupteur selon une des revendications précédentes, caractérisé en ce que le programme opératif du microprocesseur commandant le dit programme temporel contient une routine qui assure que toutes les 24 heures le contenu de la dite mémoire est contrôlé et si on y trouve des segments de-24 heures contenant un nombre de commutations enclenché/déclenché inférieur à une limite prédéterminée, le contenu du dit segment est effacé et remplacé par le contenu d'un autre segment de 24 heures contenu dans la dite mémoire et ayant un nombre de commutations enclenché/déclenché supérieur que la dite limite.

7. Interrupteur selon une des revendications précédentes, caractérisé en ce que le changement du mode de fonctionnement "simulation" à celui "stand-by" et vice-versa est commandé par un détecteur incorporé de signaux électriques à haute fréquence qui est sensible aux signaux présents sur la ligne électrique d'alimentation et les transforme en ordres pour le dit commutateur si celui-ci se trouve sur une position "commande à distance" différente des dites positions "stand-by" et "simulation".

8. Interrupteur selon revendication 7, caractérisé en ce que l'information nécessaire à décoder les dits signaux sur la ligne d'alimentation est contenue dans une mémoire non-volatile à semi-conducteurs du type EEPROM ou NVRAM.

9. Interrupteur selon revendications 1 à 6, caractérisé en ce que le changement du mode de fonctionnement "stand-by" à "simulation" est opéré par un détecteur incorporé de reconnaissance de la parole, qui transforme des signaux acoustiques captés par un microphone incorporé, en ordres pour le dit programmeur tem-

porel si le dit commutateur est sur la position "commande à distance", différente des positions "stand-by" et "simulation".

10. Interrupteur selon une des revendications précédentes, caractérisé en ce qu'un générateur de signaux à haute fréquence incorporé injecte des signaux d'alarme sur la ligne d'alimentation si le dit bouton ou levier est manipulé lorsque l'interrupteur est dans le mode de fonctionnement "simulation."

11. Interrupteur selon une des revendications précédentes, caractérisé en ce qu'un générateur photovoltaïque est incorporé sur un emplacement convenable extérieur de la boîte de l'interrupteur dans le but de fournir pendant le jour un courant continu suffisamment puissant pour recharger la batterie électrique incorporée dans l'unité d'alimentation de l'horloge et de la mémoire du dit programmeur-temporel.

12. Interrupteur selon une des revendications précédentes, caractérisé en ce que les dits moyens d'interruption sont des diodes à allumage qui sont commandées par une unité de commande incorporée sensible à l'angle de la phase du courant alternatif de l'alimentation de telle façon qu'en manipulant un bouton convenable, l'utilisateur peut contrôler l'intensité de l'énergie électrique transmise quand l'interrupteur est dans l'état "enclenché".

13. Interrupteur selon une des revendications précédentes, caractérisé en ce que pendant le mode de fonctionnement "stand-by" et contemporanément pendant un laps de temps dans lequel le dit interrupteur est dans l'état "enclenché", toute manipulation du dit bouton ou levier est hors fonction, et en conséquence ne provoque pas de changement d'état enclenché à celui déclenché, signifiant ainsi à l'utilisateur que l'interrupteur se trouve dans le mode de fonctionnement "stand-by".

14. Interrupteur selon une des revendications précédentes, caractérisé en ce que sur un côté de la boîte contenant le dit interrupteur il y a un affichage digital affichant l'heure et la date grâce à des signaux provenant du microprocesseur qui gère le dit programmeur temporel et en ce que des moyens mécaniques additionnels sont présents pour permettre à l'utilisateur de régler la date et l'heure affichées lors de la première mise en service.

15. Interrupteur selon une des revendications précédentes, caractérisé en ce que la dite mémoire, est du type non-volatile magnétique "a bulle" avec une capacité de mémorisation supérieure à 100'000 bits.

