FLASHLIGHT WITH AUTOMATIC TIME-DELAY CUT-OFF SWITCH

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10 Claims

ABSTRACT OF THE DISCLOSURE

The flashlight is operable by a rear cap that is movable axially forward on the cylindrical housing for the battery. A compression spring and an enclosing bellows are disposed in the housing and are compressed in the switch closing operation. An orifice at one end of the bellows, out of another, is controlled by a small ball valve which permits air to enter and refill the bellows to normal full open position under expanding force and movement of the compressed spring, seeking to return to its normal condition. In the compressed position of the bellows and the spring, the switch to the flashlight is closed; and in the open position of the bellows and permitted expanded position of the compression spring, the switch is opened to open the circuit from the battery to the lamp. The bellows and the compression spring thus operate as an automatic device to open the light circuit after a predetermined period of time, determined by the valve, when the flashlight is left unattended or forgotten.

This invention relates to flashlights, and, particularly, to flashlights provided with an automatic selfopening mechanism for opening the switch circuit that is usually provided for manual operation to connect the lamp to the battery cell or cells in the flashlight housing.

A flashlight is conventionally provided with a manually operable switch that connects the lamp to the battery in a closed circuit, and is stationary and remains closed until it is manually shifted to open position by the operator of the flashlight.

If the flashlight is operated to lighted condition and then left or forgotten, the switch will remain closed and the battery will be drained to destruction.

The object of this invention is to provide an automatic switch that will open after a predetermined interval of time, following the closure of the switch to connect the light and the battery, if the switch is not manually operated to open position before the end of that time interval.

In that manner, the battery is protected against being connected to the lamp too long without any beneficial use, and the switch will be opened to prevent destruction of the battery.

Another object of the invention is to provide a flashlight with a switch that operates automatically, and that is controlled by a simple time delay mechanism, that is efficient and constant in its operation, and that is easy to manufacture and to assemble in the flashlight.

The time measuring and delay device which permits the switch to remain closed for a specific limited time, without external reoperation, consists of a tubular element, of rubbery material, which can be compressed axially into bellows shape, of axially shortened dimension. The inner end of the bellows is closed by a circular metal plate to serve as an end wall for the bellows, and as a conducting element in the battery circuit to the lamp. The outer end of the bellows contains a small coaxial orifice, which is controlled by a small ball valve of porous material to permit free fast egress of the air from the bellows when the bellows is compressed, and to control ingress of air into the bellows to a very slow air stream, thereby establishing a relatively long time interval for refilling the bellows with air to permit it to resume its original elongated air-filled condition, and to open the switch.

Within the bellows two helical spring elements are provided. One spring element serves as a compression spring which is compressed when the bellows element is compressed, and then serves to push the bellows back to extended air-filled condition. The other helical spring serves as a compressible contact so that it may remain engaged against the cooperating contact during the preliminary restoring movement of the compression spring that pushes the bellows cylinder back to extended air-filled position.

The details of construction and the manner of operation of the flashlight constructed in accordance with the principles of this invention are explained more fully in the following specification, taken in connection with the accompanying drawings, in which:

FIG. 1 is a longitudinal view of the flashlight embodying this invention, with the cylindrical housing shown open and portions of the structure shown in elevation and portions shown in section; in fully extended position with the flashlight switch open;

FIG. 2 is a corresponding view of the flashlight in FIG. 1, showing only the rear section with the delay mechanism compressed to place the switch in circuit-closing position to energize the lamp, and shows the tubular rubber cylinder compressed as a bellows with the air valve in closing position.

FIG. 3 is a longitudinal sectional view of a supporting and guide can for the rubber bellows, and shows the porous valve button that controls the air flow through the orifice of the bellows member; and

FIG. 4 is an axial end view taken along lead line 3—3 from the open end of the can in FIG. 3, to show more fully the manner in which the air valve is supported on a cantilevered spring to rest against the opening or orifice in the other end of the bellows member.

As shown generally, in FIGS. 1 and 2, the flashlight 10 constructed in accordance with the principles of this invention, comprises a lamp 12, a transparent lens 13, a battery 14 for energizing the lamp, a switch assembly 16, for controlling the circuit including the lamp 12 and the battery 14, a housing 18 for enclosing and supporting the foregoing components of the flashlight, and a rear end operating cap 20, fitted over the outer rear end of the housing 18, for actuating the switch 16, and a time delay mechanism 22, for automatically opening the switch mechanism following a predetermined interval after the switch is closed, if the switch is not otherwise manually operated to open position at the end of that time interval.

The lamp 12 is seated in a compartment at the front end of the housing 18, closed by the transparent lens 13. The lamp is conventional and is conventionally threaded in a socket 26, that is electrically and mechanically secured to the front wall 28 of the housing 18. The center contact or electrode 32 of the battery 14 is coaxially disposed to be pressed against the inner axial terminal of the lamp 12 in conventional manner.

The battery 14 is shown as a single body which may have one or more cell units and is coaxially disposed in the housing 18. The pressure on the rear of the battery 14 is established by a metallic button 34 having a backwardly extending coaxial stub 36, to which a helically wound metallic spring 38 is electrically connected by gripping of two or three of the convolutions at the end of the spring 38 on the stub 36. An insulating washer 40 rests against the shoulder 42 on the button 34 and serves as a bracing element for the front end convolutions 38A.
of the spring 38. The bracket end convolution of the spring 38 is seated in and crimped in a circular metal plate 46. This purpose of holding the spring 38 in proper axially aligned position, as a mechanical function, and also serves an electrical function by constituting an electrical terminal for the rear end of the spring 38 to engage a metal cap 46 that serves as a stationary terminal for the switch mechanism generally indicated at 16. That cap 46 is disposed and fixedly held in a particular position within the housing, and transversely to the axis.

As previously mentioned, the switch mechanism 16 is controlled by the time delay device 22, which is shown in open expanded switch open position in FIG. 1, and is shown in contracted switch closing position in FIG. 2.

The time delay device 22 comprises a normally air-filled bag 50 of neoprene or rubber or the like, which is structurally closed at its inner end, by a construction involving the metal cap 46, and that bag 50 is provided with a small orifice 52 at its outer end, through which air may be forced freely out of the neoprene bag 50. Later, air is permitted to enter bag 50 under valve-controlled conditions in order to refill the bag as the bag is expanded to its normal full air-filled condition. Within the neoprene bag 50, two springs 54 and 56 are disposed, which are arranged to be compressed when the neoprene bag 50 is compressed.

Spring 56 is an element of the switch circuit, and is anchored at one end, with its other end free to serve as the movable contact of the switch to engage metal cap 46 as the fixed contact. The spring 54 is a power spring, and is under some initial compression in order to hold the neoprene bag open under normal conditions. When the neoprene bag is expanded to its accordionpleated shape, as in FIG. 2, spring 54 serves two purposes. First, during compression, spring 54 serves to position the accordion pleats or folds that are formed in the neoprene bag 50 as that bag is compressed. Then the spring 54, as so compressed, serves to reexpand the neoprene bag to its air-filled condition, at a rate that is controlled by the rate of reentrance of air into the neoprene bag to refill the bag. Such air ingress is controlled by a valve 58, which consists of a simple hemispherical porous ball 60 mounted at the free end of a cantilever spring 62, and so disposed that the ball 60 normally seats on the rim of the orifice 52 in such manner that the reentrance of air into the neoprene bag is through porous ball 60, and therefore is controlled practically entirely by the porous structure of the porous ball 60.

The cantilever spring 62 is supported on a guiding and supporting cam 64, which provides reinforcing backing for the neoprene bag in its full open position, and which provides support for the cantilever spring 62 which carries and supports the porous ball 60. The neoprene bag 50 is provided with an outer end wall 66. That end wall 66 of bag 50 is suitably supported and braced by an annular seating ring 54, that is formed as an annular co-axial ring, pressed inwardly from the outer wall of the metal can 64. The can 64 has an extended cylindrical body 70, which serves as a guiding, limiting and reinforcing outer wall for the rearward portion of the neoprene bag 50, during its compression and reexpansion. The inner cover can 64 is also provided with an annular peripheral flange 72 which serves as a guide for the can during certain inward movement of the can to close the switch, and as a limiting stop for the can 64 when the can 64 is moved outward by the subsequent outward movement of the neoprene bag 50 as it is being refilled with air during the restoring action of the restoring compression.

Movement of the metal can 64 inwardly to compress the spring 54 serves to close the main switch for the flash-light, and in such inward movement of the can is established by axial movement of a plastic back end button 76 which is mechanically locked onto the metal can 64 by means of a bearing ring 78, which is initially cylindrical, as shown in FIG. 3, but is peened over to form a flange 80, as shown in FIGS. 1 and 2, to lock the plastic button 76 mechanically and securely onto the metal can 64.

When the back end button 76 is pressed axially forward, three things occur. First, the initially compressed spring 54 is further compressed so it may later function to force the can 64 with its button 76 and neoprene bag 50 backward, and axially outward, to restore the bag to air-filled condition. Secondly, the forward compression of the switch-closing button 76 also moves the contact spring 56 axially forward, so its free inner end convolution 56A will engage the metallic circular plate 46, previously referred to as one electrode of the switch. The end convolution 56A of contact spring 56 serves as the movable electrode to engage that stationary electrode, the plate 46. The compressibility of contact spring 56 permits contact to be made between 56A and plate 46, immediately upon operation of the plastic button 76 at the end of the flashlight, and the compressibility of the spring 56 takes up any lost motion otherwise necessary to accommodate the inward movement of the outer end wall of the neoprene bag 50 and the metal can 64.

The third thing that is done by forward movement of the back end button is the accordion folding of the rubber bag 50. Those folds drop in between the convolutions of spring 54, as in FIG. 2.

The outer end convolution 54A of the power compression spring 54 rests against a metallic washer 55, which engages the inner surface of the end wall of neoprene bag 50, and takes the pressure of the compression spring 54, and protects the surface of the end wall 66 of the neoprene bag 50 from injury. The inner free or floating end of the contact spring 56 is supported due to its back end convolution being suitably secured and anchored coaxially to the supporting and bracing washer 55 that is held in place by the power compression spring 54.

The front end convolution 54A at the inner end of the power compression spring 54 is appropriately anchored to the inner peripheral edge of the neoprene bag, including cap 46, so the bag and the springs can be handled as an assembled sub-unit for convenient handling and assembly in making up the flashlight structure.

As shown in FIGS. 1 and 2, the front end convolution 54A of power spring 54 rests on a circular arcuate seat 85 of an annular seating ring 86, for the essential purpose of conduction. The seating ring 86 is part of a metallic tubular electrically conducting element 88 which is adapted to be fitted snugly into the metallic housing 18 of the flashlight, or to engage a thin copper conducting strip that may alternatively be disposed lengthwise within the housing if an insulating housing is employed.

Electrical conductivity is thus established from the battery front terminal through the lamp 12, then through the housing 18, the tubular element 88, the power spring 54, metallic washer 55, contact spring 56 to front convolution 56A of contact spring 56, as the movable switch contact.

The annular supporting ring 86 and the end of the neoprene rubber bag 50, and the end convolution 54A of the power spring 54 are then tightly coupled in cramped relationship by and on an annular crimping plate 92, of insulating material. Plate 92 is made of insulating annular plate 94 with a central axial opening 96, and is provided with crimping fingers 98, which are cramped to lock the open peripheral end edge of the neoprene bag tightly in position in engagement with the end convolution 54A of the compression power spring 54, by a back-up metallic crimping ring 96, which was previously referred to as the stationary contact of the switch.

The crimping insulation fingers 98 are shaped and spaced to extend through openings or window slots 102 in the end wall 104 of the tubular element 88, to be then bent over to press the end edge of the rubber bag 50 tightly against the end convolution 54A, and to be held in such
crimping position by similar metallic crimping fingers 46A of the metallic crimping ring plate 46. The crimping fingers of the metallic ring plate 46 also extend through the window slots 46A, but appropriately spaced to avoid electrical contact with the metal of the tubular element 88. The crimping ring plate 46 is engaged by plate 44, and serves as the stationary switch terminal with the potential of the rear surface 50 of the battery. Any air leakage will be slight and not harmful since the effect would be merely to reduce the air gap of a predetermined interval of the delay mechanism.

The central axial opening 96 in the insulating plate 94 and the central axial opening of the circular seat 85, 86 for the convolution 54A, permit axial movement of contact spring 56 to engage the stationary switch contact, the switch plate 46.

In order to hold switch plate 46 in fixed position, a guide cylinder 110 of insulating material is slip-fitted into the housing 18, from the open end of the housing, as a sub-assembly into which the neoprene bag 50, the two springs 54 and 56, the guide can 70, and the elements at the inner end of the bag have been previously assembled. The end cap 76 will also have been assembled on the can 70 and said guide cylinder 110, in the manner shown in FIG. 1.

That guide cylinder 110, of thermo plastic or resinous material, is origially formed with axially or longitudinally projecting end fingers 112, to extend through window slots in the tubular element 88, disposed peripherally around the tubular element 88. That cylinder 110 thus serves as a housing for the assembly. When appropriately assembled, the projecting end fingers 112 are heated and peeled over to seal the housing 110 on the assembly. The entire assembly, including the housing 110 and the cap 76 may thus be appropriately positioned in the end of the main flashlight housing 18.

As previously explained, upon compression of the end cap 76, the neoprene bag 50 and the springs 54 and 56 will be compressed, and air in the bag 50 will be expelled through the orifice and freely past the porous ball 60. The spring 62 will then force ball 60 to its seat, and air can reenter the bag practically only through the ball 60, thus controlling the bag refilling and expansion in response to expansion pressure of the compressed spring 54. In the meantime, contact spring 56 at convolution 56A remains in contact with plate 46 until bag 50 refills to pull spring contact 56A away from plate 46.

The invention thus discloses the automatic time delay device for opening the lamp circuit of a flashlight after a predetermined time interval following the closure of the switch, in case the switch is not manually opened before the termination of that interval.

It will be understood that variations may be made in the details of construction and arrangement, without departing from the spirit and scope of the invention as described, and as defined in the claims.

What is claimed is:

1. A flashlight with a built-in turn-off switch, comprising a hollow cylindrical housing having a front space in said housing to receive a cylindrical battery axially disposed within and near one end of the housing, the battery normally having two end faces, with a terminal on each end face; means for supporting a lamp at the front end of the housing, which lamp will have two terminals, one lamp terminal to engage the battery front terminal on the front end face of the battery, and the other lamp terminal to engage a metal conductor means extending back along the length of the housing; switch means on said housing having an open and a closed position; manually operable means on said housing for operating said switch means to electrically connect said lamp to the battery in closed circuit; and means associated with said switch means for opening said switch means automatically after the lapse of a predetermined time interval, if said switch is left in closed position longer than said time interval;

2. A flashlight as in claim 1, in which said manually operable means serves to prime said automatic opening means each time the switch means each time the switch means is moved to closed condition after the lapse of a predetermined time interval;

3. A flashlight with built-in turn-off switch as in claim 1, in which said means for opening said switch automatically includes: a collapsible air container having an air-full and an air-empty position; means for compressing the container from air-full position to air-empty position to express the air from said container; a compression spring normally tending to hold the container expanded to air-full position, said spring being compressed by and when said compressing means is operated to compress said container to air-empty position, and said compression spring serving then to reexpand said container to air-full position; and valve means on said container for permitting free air outflow when said container is compressed, but restricting air return inflow when said compression spring reexpands the compressed container to air-full position;

4. A flashlight with built-in turn-off switch, as in claim 3, in which said collapsible container consists of an elongated cylindrical bag, of air-impervious material, having its back end wall completely closed with a rigid closure cap, and having its front end wall substantially closed except for a small orifice for air passage into and out of said container; a rigid bracing washing plate is disposed to rest against the inner surface of said front end wall; and said compression spring is disposed within said bag to rest one end against said rigid bracing washer plate at the front end wall and the other end of said spring rests against said closure cap at the back end wall; and said valve means is disposed at said orifice to control the air passage into and out of said collapsible container;

5. A flashlight with a built-in turn-off switch, as in claim 1, in which said means for automatically opening said switch means include a collapsible bag of air-impervious material, means for collapsing said bag when operating said switch means to closed position, means for restoring said bag to normal air-full position and thereupon operating said switch means to open position, and means for controlling the time required to restore said bag to normal air-full position, to thereby control the duration of time that the switch means will be permitted to remain in closed position without further manual operation;

6. A flashlight with built-in turn-off switch, as in claim 5, in which said time-controlling means includes an orifice in the wall of said bag, and means for controlling the passage of air into said bag through said orifice.

7. A flashlight with a built-in turn-off switch, as in claim 5, in which means means disposed within the bag serves to direct and to position pleats formed in the bag material as the bag is compressed to accordant shape.

8. A flashlight, as in claim 1, including further, an insulating guide sleeve co-axially disposed in said housing at its back end, with a peripheral outer end face extending axially beyond said housing;
an end cap fitted coaxially over said peripheral outer end face and manually movable coaxially inwardly, over said outer end face, from outer position to inner position, to operate said switch means;
means associated with said automatic switch opening means of claim 1 for moving said end cap back to outer position;
and means on said end cap cooperating with said guide sleeve to limit the extent of movement of said end cap to its outer position.
9. In a flashlight structure, as in claim 1, time-delay switch-opening mechanism comprising a contact button to engage one end face terminal of a flashlight battery in place;
a helical metallic spring having one end grippingly coupled to said contact button and the other end electrically engaging a bracing wall of electrically conducting metal;
an insulating support for said bracing electrically conducting metal wall;
an air-impervious bag relatively elongated along an axial dimension and open at its inner end;
means peripherally supporting said open inner end of said bag adjacent said electrically conducting metal wall;
a compressible spring having one end fixedly braced against said electrically conducting metal wall and the other end braced against a reinforcing plate at the outer coaxial end of said air-impervious bag;
a pressure element disposed adjacent said outer end of said bag for coaxially compressing said bag;
switch contact means supported from said outer end of said bag and operative to engage said electrically conducting wall when said bag is axially compressed and the air expelled therefrom;
and valve means for permitting free egress of air from said bag upon compression of the bag, and for controlling timed ingress of air into said bag upon re-expansion to air-full condition.
10. A flashlight time-delay switch, to open a flashlight battery circuit, said switch comprising a generally cylindrical collapsible bag generally open at its inner end and closed at its outer end except for a small orifice for egress and ingress of air; electrically conductive means for supporting said inner end of said bag to be held in generally circular normal form, and for also closing said inner end of the bag against air passage;
means for collapsing said bag to cause egress of air through said orifice and for moving one end of said bag toward the other end;
switch means supported at the outer end of said bag and movable therewith to engage said electrically conductive supporting means at the inner end of said bag to complete an electric circuit of the flashlight;
means for restoring said bag to its expanded condition; and valve means at said small orifice for controlling the passage of air therethrough for controlling the time required to refill the bag to its expanded condition.

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