July 22, 1969 E. W. ROBERTS, JR., ET AL 3,457,383

LOW POWER TOGGLE SWITCH MECHANISM

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FIG. 1.

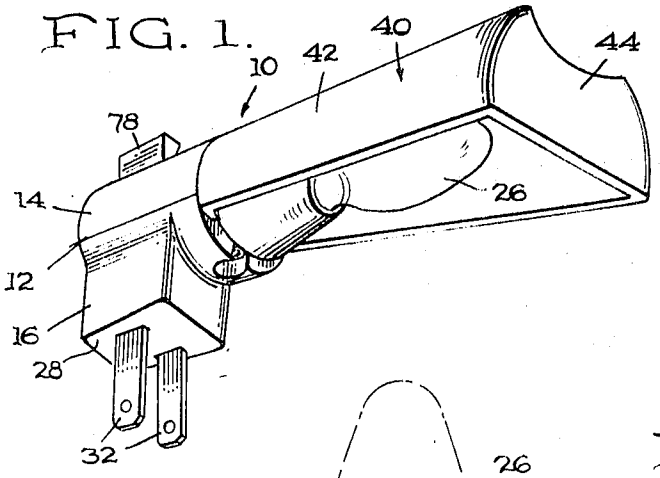


FIG. 2.

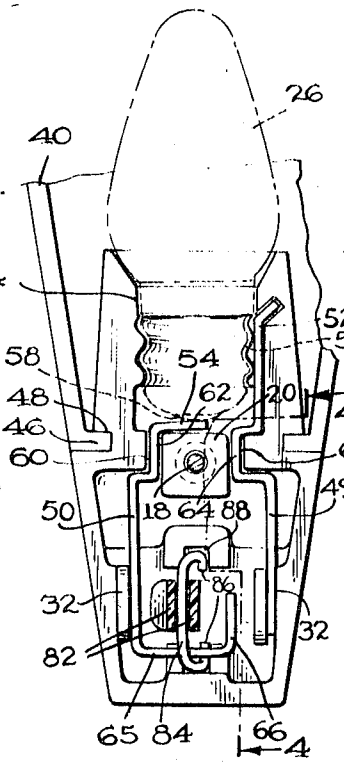


FIG. 3.

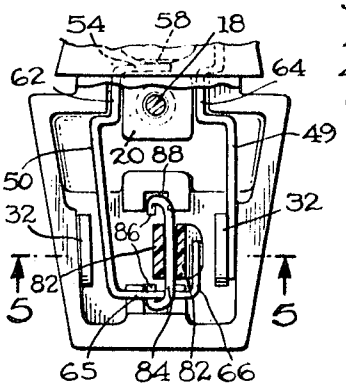
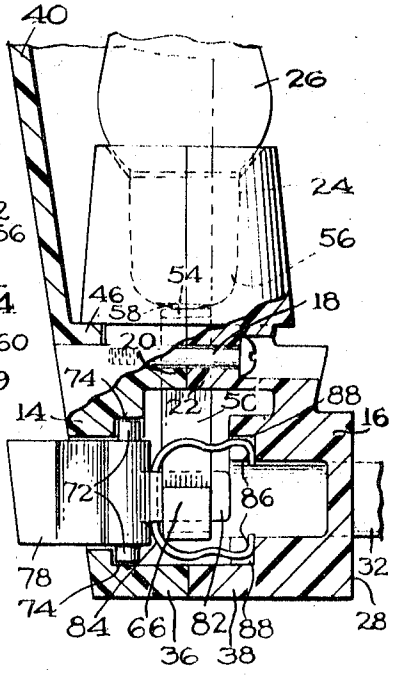


FIG. 4.



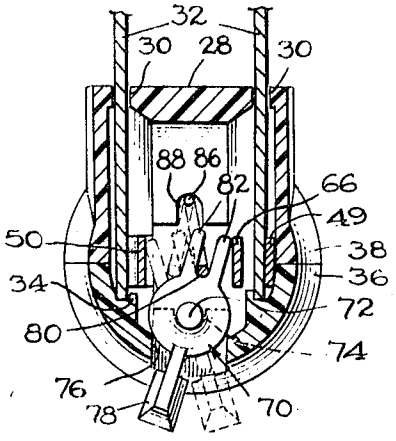


FIG. 5.

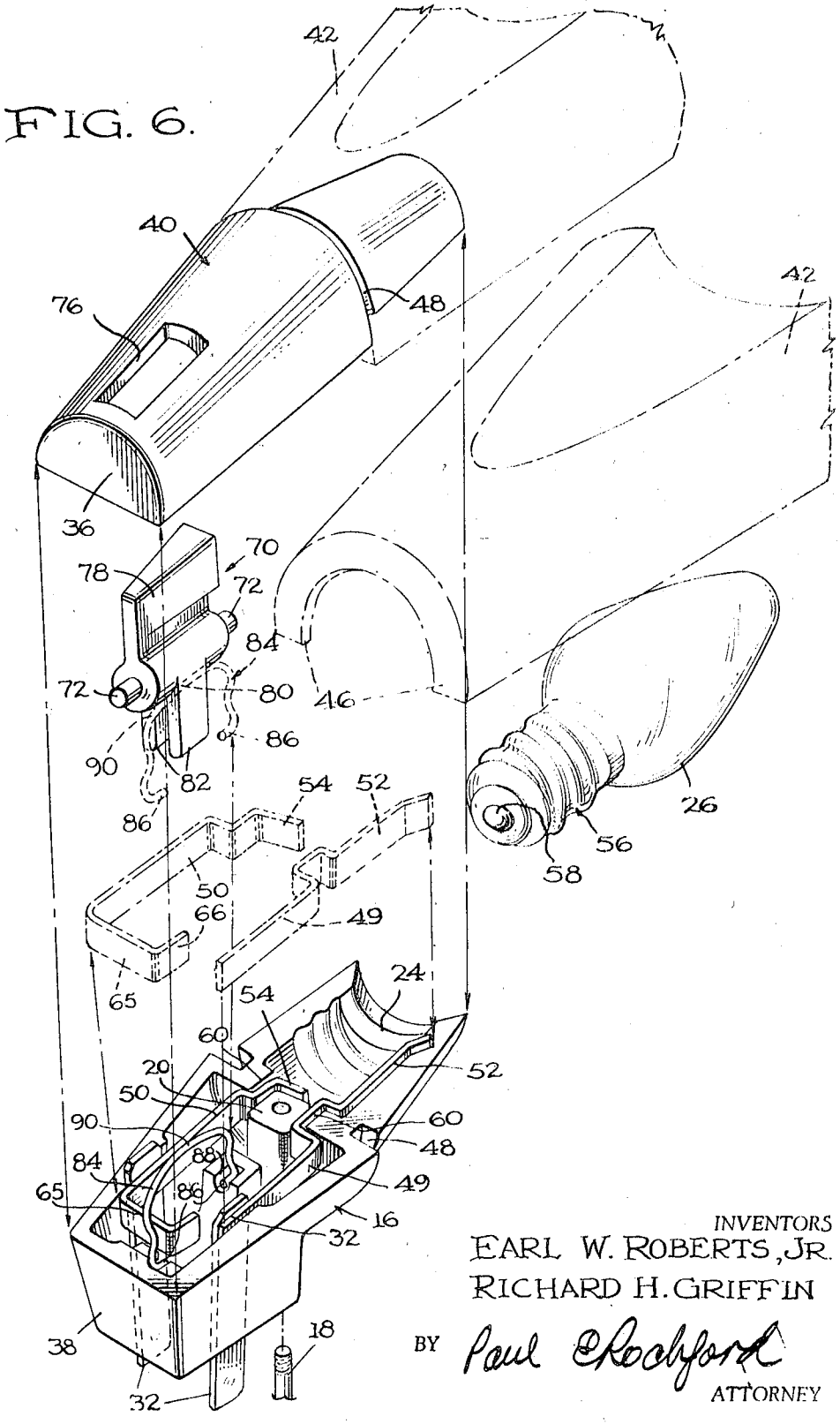
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FIG. 6.



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LOW POWER TOGGLE SWITCH MECHANISM

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Continuation-in-part of application Ser. No. 435,507, Feb. 26, 1965. This application Sept. 29, 1966, Ser. No. 592,957

Int. Cl. H01h 21/40, 9/16; H01r 13/70

U.S. Cl. 200—67 5 Claims

ABSTRACT OF THE DISCLOSURE

A toggle switch to switch currents of about one ampere or less is provided having an over center spring to operate a toggle lever and electrical contacts which are moved by an arm of the toggle lever opposite the handle. A simple C form of toggle spring and spring bias of the contacts cooperate to require a minimum of parts to operate through numerous cycles over an extended period of time.

This invention is a continuation-in-part of application Ser. No. 435,507 and relates to an electrical device incorporating a new and improved toggle switch, particularly to a device of relatively low wattage rating such as a night light incorporating such a switch.

To ensure a bistable snap action of the usual toggle switch it has been customary to use an over-center spring under compression or tension that engages the trigger of the toggle switch and is anchored in the switch housing. Coil springs as well as wire springs have been used for this purpose; in very light weight and small size switch structures wire springs of α configuration were found to be particularly advantageous and are described in Patent 3,178,530 assigned to the same assignee as this application. The reduction in size of the wire spring, however, tends to give rise to an inherent drawback, namely, an inherent decrease in its service life expectancy. As a result, the percentage of switch failures due to the breakage of the wire spring may increase with respect to other mechanical or electrical causes.

To remedy the above noted disadvantage, it has been proposed to use a wire spring made of a high quality steel. Such a solution, however, while improving the durability of the spring, introduces elevated costs which, in the mass production of reliable switches to be sold to the public at very low prices, is an undesirable result.

One of the objects of the present invention is to provide a night light having a novel toggle switch which is efficient and reliable in operation and yet, together with the other parts of the night light, may be economically manufactured and easily assembled into a light weight, compact structure that will experience prolonged service.

A further object of the present invention is to provide a night light whose external and non-conducting parts may be formed from plastic, utilizing inexpensive molding techniques.

A still further object of the present invention is to provide a night light that has a modernistic design while being highly versatile in use, and permitting its rapid conversion to period designs of distinctive motif.

An additional object is to provide such a toggle switch that may be incorporated into a night light without sacrificing appearance of the night light or limiting its versatility.

A still further object of the present invention is to provide a toggle switch in a night light which prevents flickering of the night light occasioned by inadvertent actuation of the switch toward open position.

An additional object is to provide an improved light

weight snap action toggle switch for use in electrical devices of low wattage rating for use in household appliances, lamps and the like, and more particularly an improved trigger and spring structure for use in such switches.

Other objects and advantages will become in part apparent and will be in part pointed out from the following description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective view of the night light embodying the present invention;

FIG. 2 is a longitudinal cross-sectional view of the night light with a portion of its shade broken away showing the internal switch mechanism in one position;

FIG. 3 is a view similar to FIG. 2, but with the switch mechanism in opposite position;

FIG. 4 is a fragmental cross-sectional view taken generally along lines 4—4 of FIG. 2;

FIG. 5 is a fragmental cross-sectional view taken along lines 5—5 of FIG. 3; and

FIG. 6 is an enlarged exploded view of the night light of FIG. 1.

In one of its broader aspects the objects of the present invention are achieved by providing, an electric switch to switch electric currents of about one ampere and less, a stationary contact and a movable contact said latter contact being movable out of engagement with said stationary contact against a bias integral to the movable contact, a toggle mechanism for actuating said movable contact including a toggle lever having a handle and an arm extending oppositely from a mid portion, means for mounting said lever for pivotable movement about a first axis extending through the mid portion between a first position wherein said arm engages the movable contact, and a second position wherein said arm is spaced from said movable contact permitting the same to move into engagement with said stationary contact, spring means mounted for pivotable movement about an axis parallel to said first axis, said spring means having an intermediate portion engaged at said mid portion of said toggle lever to bias the toggle lever into both stable positions of said toggle motion.

Briefly, according to the invention, in one of its narrower aspects a spring receiving portion of a trigger is formed in such a manner that the bias spring is held in an operative position even after breakage occurs.

Referring to the drawings in detail the night light generally designated 10, embodying the present invention, is shown for illustrative purposes only, as including a body 12 formed in two hollow sections 14 and 16, from any suitable material, such as plastic. Body sections 14 and 16 are held together by a screw 18 received in aligned bosses 20 and 22 in body sections 14 and 16. Bosses 20 and 22 may or may not be threaded depending on whether the screw 18 utilizes appropriate insulation material as a friction source. When so assembled, body sections 14 and 16 define a threaded socket 24 in the top end of the body for receiving a bulb 26 in the usual manner.

Rear body section 16 has a flat wall 28 provided with slots 30 through which extend electrical uprights or power blades 32 adapted to be inserted into a receptacle of extension socket (not shown) in typical fashion. Uprights 32 are located in their longitudinal position by abutment portions 34 formed in front body section 14 as shown in FIG. 5, while lateral movement of uprights 32 are prevented by wall 28. The bottom walls 36 and 38 of body sections 14 and 16, respectively, are formed flat so that the night light may be alternatively supported on a flat surface, such as a table.

Rotatably supported at the top of the body 12 is a shade which partially encloses the bulb 26.

Shade 40 is also molded from a suitable plastic and has a longitudinally segmented frusto-conical body 42

including a top wall 44 and an open end opposite to the top wall 44. In the preferred embodiment illustrated, shade 40 is rotatably mounted by means of an arcuate internal flange 46 projecting inwardly at the lower or open end of the shade to be receivable in a corresponding annular groove 48 formed in the periphery of body 12 by semi-circular grooves in body sections 14 and 16. The shade mounting flange 46 and its mating groove 48 in body 12 are dimensioned such that the shade figure is snapped into groove 48 for assembly after which flange 46 is free to move in groove 48 to facilitate adjustment of the shade.

Electrical contact to the bulb 26 for energizing and deenergizing the same is provided by a fixed contact 49 and a movable spring-like contact 50 which are positioned longitudinally in the casing with their upper portions 52 and 54, respectively, positioned to contact the bulb contacts 56 and 58, respectively, as best shown in FIGS. 2 and 6. In the illustrated embodiment, body sections 14 and 16 are formed in internal shoulders on opposite sides of bosses 20 and 22 to thereby form narrow passages 60 which receive portions 62 and 64 of contacts 49 and 50 to locate same in proper position in the body. In the specific form shown, upper ends 54 of movable contact 50 projects normally therefrom to engage the end or tip of bulb contact 58 while portion 64 of fixed contact 49 is U-shaped to be received in body passage 60, above which upper fixed contact portion 52 extends into engagement with the side of bulb contact 56.

The lower end of fixed contact 49 is in constant engagement with one of the uprights 32 (shown in FIGS. 2, 3 and 6 as the right-hand upright) while movable contact 50 is biased into engagement with its associated upright 32 and movable away therefrom as will be subsequently described.

Of substantial importance to the reliability of the long term functioning of the contacts in switching actions to energize and deenergize low wattage lamp load 26 is the composition of the metal parts 32 and 50 which form the two contact elements of the low wattage switch of the present invention. One metal employed in the power blade for reliable performance over an extended period is that disclosed in U.S. Patent 3,039,867. This is a copper base alloy consisting essentially of 2.1% to 2.6% iron, a trace to a maximum of 0.04% phosporous and the balance copper. In another form of the contact which permits access of the movable contact over a large surface of the stationary contact a pure copper contact may be employed, as for example a rivet or eyelet of copper may be mounted in an aluminum power blade or upright such as 32 at the place where the contact is made by the stationary and movable contacts 50 and 49 respectively.

The composition of movable contact 50 is the more conventional commercially available bronze as the contact is biased by integrally generated spring pressure toward blade 32.

It will be noted that no weld is employed as is conventionally done in establishing secure and reliable electrical energization of stationary contact 49 by contact with its power blade 32. Both power blades 32 are formed of the preferred copper alloy described above to minimize arcing and welding or pitting of contact surfaces subjected a flow of power normal to the surface thereof and loss of high contact efficiency.

Formed on the lower end of movable contact 50 is a normally projecting portion 65 which extends toward fixed contact 49 and terminates in an upwardly extending tab 66 employed to move contact 50 to open position. In accordance with one of the aspects of the present invention, a novel toggle mechanism is provided for actuating movable contact 50 out of engagement with its associated upright 32. This toggle mechanism, as illustrated in the drawings, includes a toggle lever 70 mounted at its mid section in the front body section 14 between contacts 49 and 50 for pivotable movement toward and away from the movable contact 50. In the shown embodiment, the handle 78 and oppositely extending arm 82 of toggle lever 70 are integrally molded from plastic and the toggle lever is pivotally mounted at its mid portion by pivots or pins 72 extending laterally from opposite sides of the lever to be received in a pair of the lined recesses 74 formed in the front body section 14 as shown in FIG. 4. Toggle lever 70 projects laterally out of the front body section 14 through a slot 76 formed in the latter of appropriate dimension to accommodate movement of lever 70. An enlarged handle 78 of appropriate design is provided for operating toggle lever 70 externally of the body 12

The alignment of the trigger or toggle handle 78 seen with reference to FIG. 1 is for pivoting about an axis generally parallel to the axis of the lamp socket and of the longest dimension of the assembled device. The uprights or power blades 32 are located in the plane of movement swept by the trigger and, for this reason, afford a high level of stability to the secure retention of the device in place in a convenience outlet when the lamp is energized or deenergized by operation of the switch. The handle is thus so pivoted and aligned with reference to the blades 32 that the switch can be operated by the wiping action of an inarticulated activating surface such as the surface of the forearm of an individual whose hands were not free for application to this purpose.

Projecting oppositely from lever handle 78 at right angles to the pivotal axis of the lever is a forked portion 80 including two parallel arms 82 spaced to receive a biasing spring 84.

As will be evident from the figures the trigger and arms are symmetrically placed on the lever so that it cannot be inserted incorrectly into place in the device. However, as will also be evident from the description which follows, only one of the symmetrically formed arms actually operates on the electrical contacts. Accordingly it is within the scope of the present invention to employ a single arm to act on the contact and either of the arms 82 may be omitted with appropriate adjustment of the shape of contact tab portion 66 to bring the arm into driving relation with respect to movable contact 50 as explained more fully below.

Biasing spring 84 is shown as generally C-shaped and has opposite extremities 86 pivotably received in associated pockets or recesses 88 formed in the rear body section 16 with intermediate portion 90 of spring 84 received between lever arms 82.

As is evident from the figures although intermediate portion 90 of spring 84 is nested in the notch formed between the arms 82 the extent of the arms beyond that needed to form the notch do not play a part in the retention of the intermediate portion of the spring in contact with the toggle mechanism. Accordingly it is evident that the spring receiving notch formed at the forked portion 80 may be disposed at any location on the toggle lever 70 which gives the over-center spring action and may accordingly be situated independently of the arms 82 or of one of the arms which actuates the movable contact 50.

Intermediate spring portion 90 may accordingly be engaged against lever 70 at the fixed end of arms 82 or in an equivalent notch disposed on lever 70 so that when lever 70 is in either remote pivotable position, spring 84 will be stressed to impose an over-center bias on toggle lever 70.

As seen particularly in FIGS. 4, 5 and 6, the intermediate or bight portion 90 of the spring 84 is in engagement with base 80 along a substantial length thereof. The base 80 has a radius of curvature substantially equal to or very slightly larger than that of the cross section of the bight 90 so that the latter is adapted to nest in base 80. It was found that due to the cooperating structure of bight 90 and base 80, a breakage of spring 84 (that occurs somewhere along the nested portion of bight 90) will not render the trigger inoperative but will continuously maintain its snap action. The broken halves of the spring do not drop away

but maintain their compressed, abutting relationship due, on one hand, to the continued pressure of the trigger **70** on both halves, and, on the other hand, to the cooperating structure of base **80** and the bight preventing the latter from snapping into misalignment with respect to one another either during motion or during stable rest positions of the trigger.

Movement of toggle lever **70** is transmitted to movable contact **50** through contact tab portion **66** received between the fixed contact **49** and the forked portion **80** to be driven thereby between two opposite positions connecting and disconnecting movable contact **50** relative to its associated upright **32**. FIGS. 3 and 5 show the position of lever **70** whereby movable contact **50** is spaced from its associated upright to deenergize bulb **26** when the uprights are plugged into an outlet.

Referring to FIG. 5, when toggle lever **70** is moved counterclockwise from its position shown in solid lines to the dotted line position, the resiliency of movable contact **50** aided by movement of lever **70** will cause movable contact **50** to engage its upright **32** to establish a closed circuit for energizing bulb **26**. Through its own resiliency movable contact **50** which acts like a leaf spring is biased into the upright contacting position. Moreover, when movable contact **50** engages its upright lever, the forked portion **80** does not press on tab **66** of movable contact **50**, but rather floats relative thereto in the manner of a lost motion connection. In this way accidental contact with toggle lever **70** when movable contact **50** is closed will not cause destruction of the circuit resulting in flickering of the light. However, when it is desired to switch off the light, toggle lever **70** (now referring to FIG. 5) is turned back to the position shown in full lines in FIG. 5, and when lever **70** moves past its center position, spring **84** will become effective to snap the lever and therefore the movable contact away from its associated upright. While in this open position, contact **50** is biased away from its associated upright by one of the lever arms **82** which, acting under the influence of spring **84**, swipes contact **50** for a very short travel relative to the travel of the contact. This short stroke of the lever arm **82** and the relatively low contact pressure required insure positive breaking of the contact **50**.

An important feature of the toggle switch mechanism of the present invention is the capability of the switch to be operated by a lever which applies force at the end of the movable contact **50** at which the electrical contact actually is made. This is advantageous in breaking any welds formed between the contacts by arcing. In this respect it will be observed that the action of an arm **82** on the contact will yield a force adapted to peel the contacts apart by urging the tab **66** toward stationary contact **49** with a force applied at about the position on the movable contact at which its separating effect will be maximum.

In conventional switch structures having biased contact arms the force is applied at some intermeidate point between the held end and the contract or terminal end of a movable contact arm. By contrast the force is applied pursuant to this invention at the terminal end.

Moreover as also evident from the figures pursuant to this invention the toggle lever acts directly against the terminal end of the contact arm to move it essentially parallel to the direction of movement of the end of the toggle arm itself. This parallel movement of electrical contact and actuating lever contrasts with a wedging action of conventional toggle switch mechanisms such as is produced when a lever arm acts on the midsection of a biased spring contact arm and is oriented when applying force to the midsection with its longitudinal axis generally perpendicular to the midsection of the longitudinal axis of the contact arm when the toggle lever is in its middle position, i.e., between its two at-rest positions.

Because of the toggle action described above, and particularly the arrangement for lost motion in the action, the switch of the present invention has inherent slow-make and fast-break characteristics deemed desirable in alternating current switches. The slow-make is accomplished by positioning the lever arm **82** relative to the tab **66** so that the on occurs soon after the beginning of the toggle action and accordingly while the toggle is moving comparatively slowly.

The fast-off is achieved by the converse positioning of the tab **66** relative to the toggle arm **82** so that the toggle arm has passed the over-center position and is being accelerated by both the bias of the contact arm and that of the over-center spring toward the at-rest position in which the switch is on. The contact is actually made as explained above just prior to the lever reaching the mechanically stable at-rest position.

To test the reliability of the switching capabilities of the switch over an extended use period the switch was used to energize a seventy-five watt lamp and the action was compared to that of a comparable commercially available switch of another manufacturer. The Underwriters' Laboratories requires that a switch used to energize such a lamp be capable of operating on direct current through 50 on-off switching cycles at $\frac{9}{10}$ of an ampere of current and 125 volts and then be capable of operating through 6000 on-off switching cycles at $\frac{6}{10}$ of an ampere of direct current at 125 volts.

Four of the comparable switches were purchased commercially and operated successfully through the 50 cycles of the $\frac{9}{10}$ ampere test. When then placed on the $\frac{6}{10}$ ampere test two of the four switches failed after five cycles, a third became intermittent after 5500 cycles and the fourth also became intermittent after 6010 cycles. Both the third and fourth failed at 8300 cycles.

Six samples picked at random from a production lot of the toggle switch of this invention were subjected to the same testing series. All six passed the UL testing requirements. Following the successful test all six were subjected to life endurance tests by continuing the cycling at $\frac{6}{10}$ amp and 125 volts of direct current electric power.

Three of the six developed broken springs at 29,729 cycles, 19,746 cycles and 35,043 cycles, respectively, but were in working order even though the spring was broken. The broken spring was detected without disassembling the switch by a change of operating characteristics of the switch in the mechanical testing apparatus used for the test series. A fourth and fifth failed to light after 24,947 and 12,397 cycles, respectively, and the sixth became intermittent after 112,405 cycles.

To assemble the night light, uprights **32** are first positioned in the rear body section **16** by passing the uprights through slots **30**. Contacts **49** and **50** are then positioned in the rear body sections **16** as facilitated by passages **60** thereof. Spring **84** is then inserted to position its extremities **86** in recesses **88** and to hold the spring in this position for assembly, a viscous non-hardenable lubricant may be inserted in recesses **88**.

An additional feature of the toggle mechanism which contributes to both the ease of assembly and the long useful life of the mechanism is the form of the ends of the C form of the wire spring. The rounding of the ends to prevent the tips of the wire from bearing against the insulating housing is important in extending the operating life of the overcenter spring because it prevents the abrasion or eating of the sharp end of the wire into the insulation. Such wear eventually causes changes in alignment of parts and redistribution of stresses so that the toggle action is unsuitable for switch operation.

The formation of the C spring with outer height dimensions slightly larger than the recesses **88** into which these are received and the curvature of the wire ends to provide reduced radius outer bearing surfaces to bear against the flat inner surfaces of the recesses **88** facilitates assembly and the low-wear operation of the bearing surfaces against the inner surfaces of recesses **88**.

Before joining front body section **14** into rear body sec-

tion 16 toggle lever 70 is positioned properly in slots 76 in front body section 14. Then body sections 14 and 16 are joined together with intermediate spring portion 90 received between arms 82 of toggle lever 70. Screw 18 is then threaded into the body sections 14 and 16 to hold them together and finally shade 40 is snapped into place.

Although not illustrated, a resistor may be connected in series with one of the uprights to thereby cut down the voltage across the lamp by 10 volts from 120 volts to 110 volts, and, consequently, tripling the lamp's life. To accommodate such a resistor the body section may be modified accordingly.

Although only one embodiment of the invention has been depicted and described, it will be apparent that this embodiment is illustrative in nature and that a number of modifications in the apparatus and variations in its end use may be effected without departing from the spirit or scope of the invention as defined in the appended claims.

We claim:

1. In a night light having a pair of spaced uprights and a fixed contact engaging the first upright and a movable contact inherently biased toward engagement with the second upright and movable away therefrom to open position; a toggle mechanism for actuating said movable contact to its open position including a lever mounted intermediate said contacts for pivotable movement between first and second positions, generally C-shaped overcenter spring means biasing said lever to both of said positions thereof, said movable contact having a return portion projecting back toward said lever and said lever having an arm engageable with said backward projecting portion for moving the movable contact away from the second upright when the lever is moved to its first position, said lever arm being spaced from said backward projecting portion when the lever is moved to its second position permitting the movable contact to move into engagement with said second upright under its own inherent bias.

2. A switch comprising an insulating housing having an opening therein:

a toggle lever pivotally mounted within said housing at a mid portion thereof and having a handle and an arm oppositely extending from said mid portion,

said handle extending through said opening to receive actuating motion from the housing exterior and said arm extending toward a contact to deliver switching motion thereto when said lever is pivoted about an axis extending through said mid portion,

and an over center spring for said toggle, said spring being generally C-shaped and being mounted with the central portion thereof biased against the central portion of said lever to pivot about an axis parallel to the pivotal axis of said lever and to impart to said lever an over center snap action,

a movable contact leaf spring arm inherently biased toward engagement with a fixed contact and movable out of engagement therewith,

said lever arm acting at its end portion directly against the terminal end portion of said movable contact arm to apply a force thereto in a direction to overcome the inherent bias on said movable arm and to separate said contacts.

3. The switch of claim 2 in which the contact surfaces of the stationary contact and movable contact are of copper and bronze respectively.

4. The switch of claim 2 wherein a night light having a toggle switch the toggle handle of which is aligned for motion in a plane which is proximate and parallel to the longitudinal axes of a pair of power blades extending from said night light and by which the lamp of said night light may be conveniently energized when said night light is wall mounted in a convenience outlet.

5. A switch according to claim 2, wherein said C-shaped spring is rotatably supported in a pair of recesses at respective portions adjacent the extremities of said spring whereby said extremities are free of contact with said recesses.

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