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(54) **COMPACT FLASHLIGHT**

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Related U.S. Application Data

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(51) **Int. Cl.**
F21L 4/04 (2006.01)

(52) **U.S. Cl.** **362/206**; 362/205; 362/802; 200/60; 315/362

(58) **Field of Classification Search** 362/205, 362/206, 802; 315/287, 362; 200/60
See application file for complete search history.

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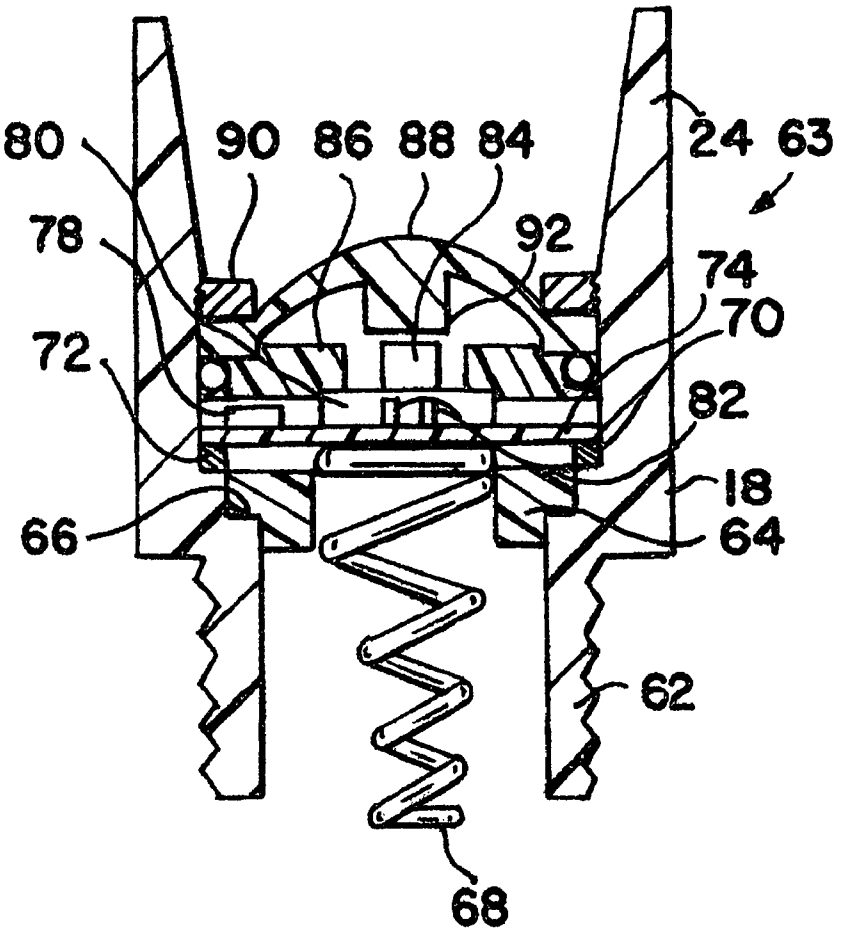
Primary Examiner—Stephen F Husar

(57) **ABSTRACT**

A flashlight is provided with an end cap which carries an axially-actuated switch for turning the flashlight on and off with a convenient one-handed operation. The switch is designed with a latching function and a mode selection function which can be cycled through high, low and strobed light outputs with a partial throw of the switch. Cut-out portions are provided in the end cap for guiding a user's finger toward the switch and away from the sidewalls of the end cap.

6 Claims, 3 Drawing Sheets



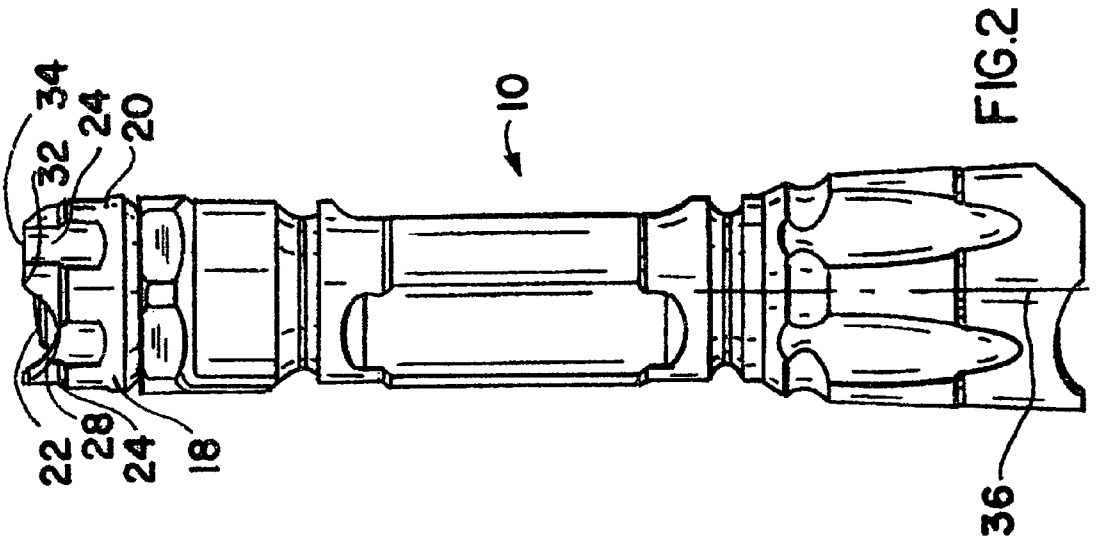

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FIG.2

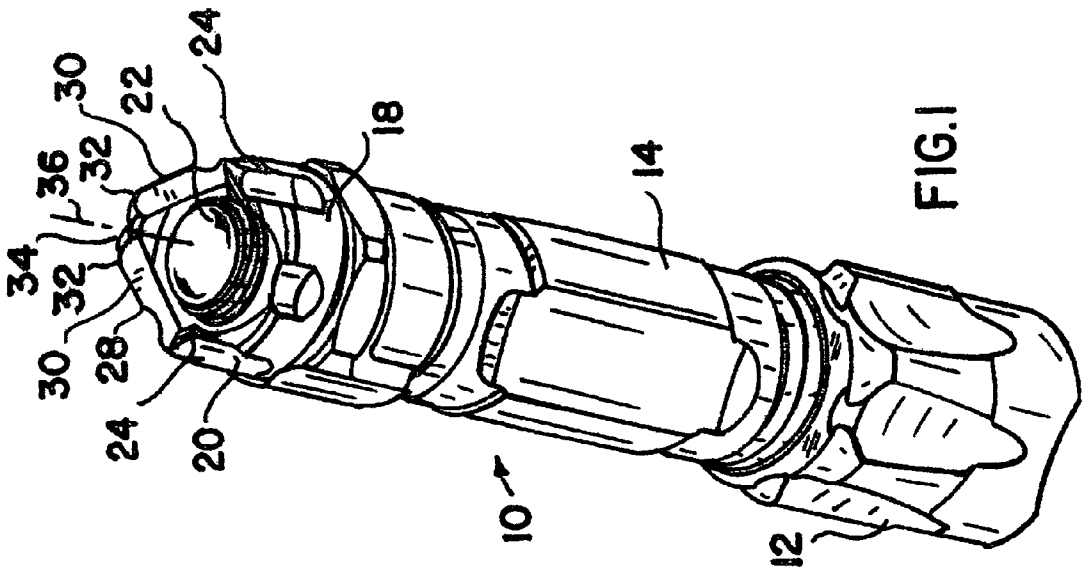
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FIG.1

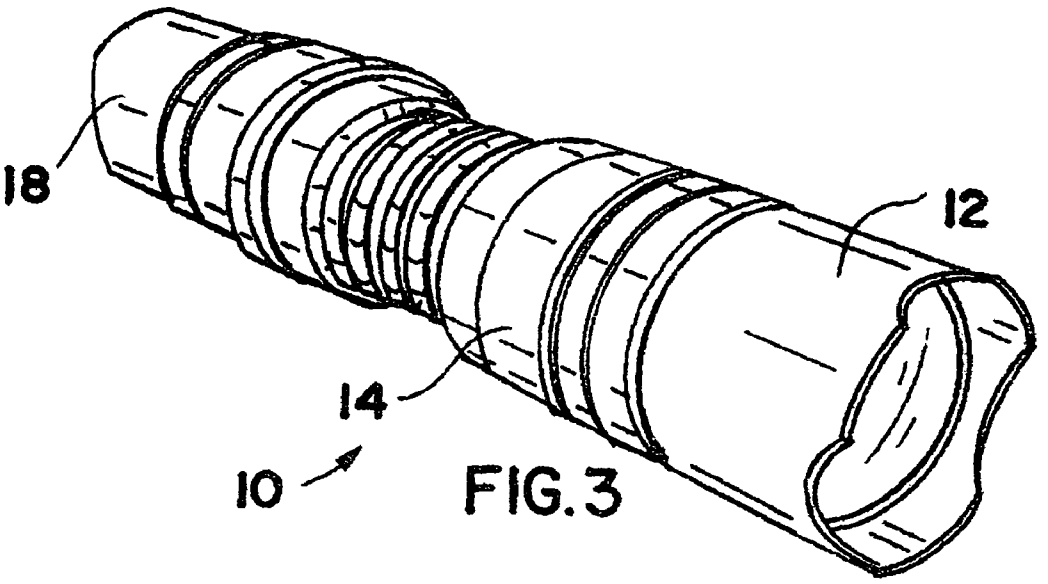

FIG.3

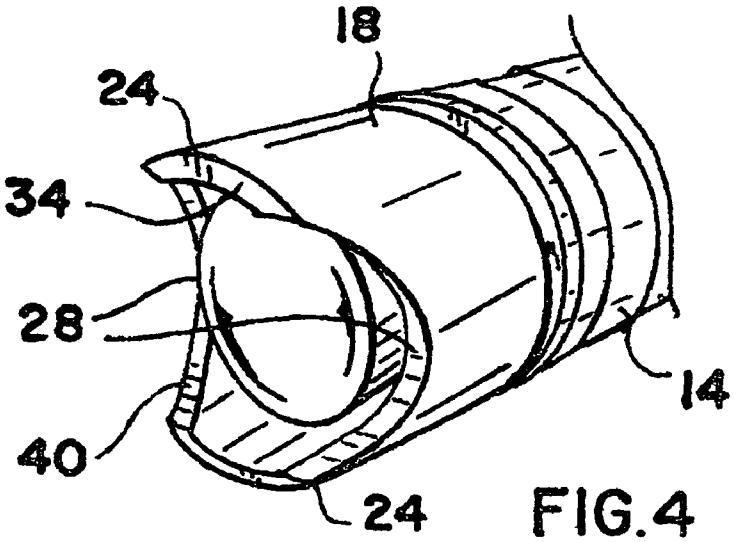

FIG.4

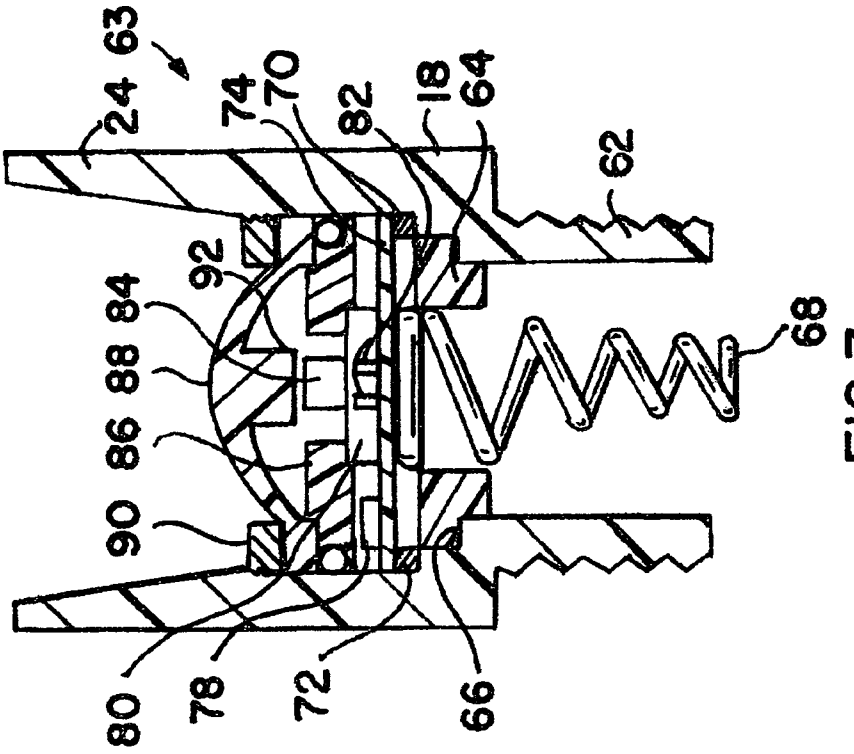

FIG.7

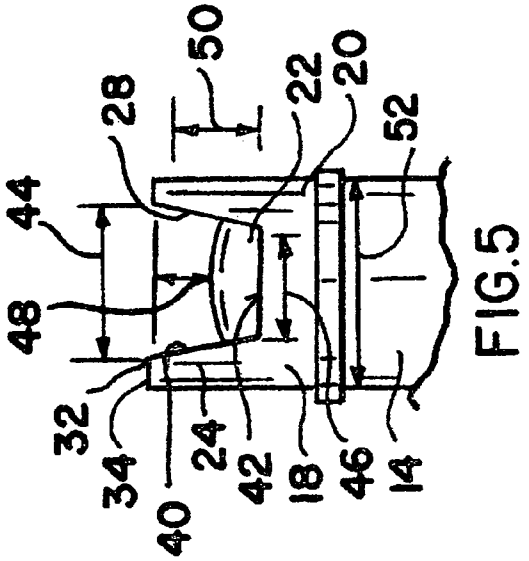

FIG.5

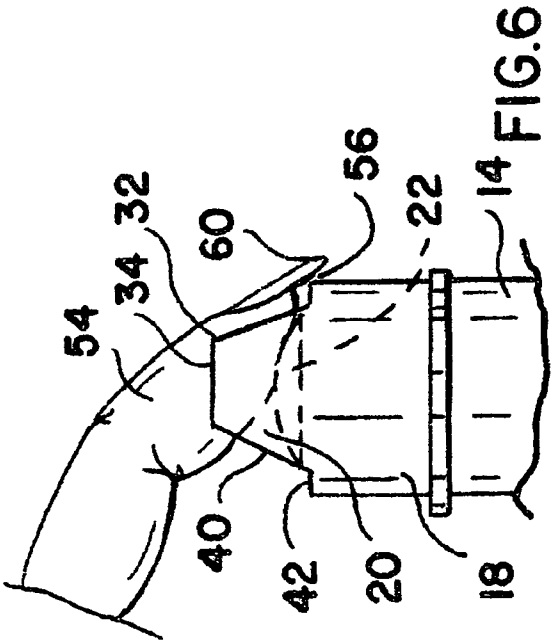

FIG.6

COMPACT FLASHLIGHT

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation application of prior application Ser. No. 12/075,930 filed Mar. 14, 2008 entitled Compact Flashlight, now U.S. Pat. No. 7,604,371, and which is incorporated herein by reference in its entirety

BACKGROUND AND SUMMARY

High intensity flashlights are commonly carried by police and other law enforcement agents to aid in illuminating dark locations and to serve as a form of self defense. A bright intense light can temporarily stun or disorient an attacker when the light is directed at the attacker's eyes. Civilian versions of these flashlights are currently available in various shapes and sizes.

Many of the commercially-available self defense or tactical flashlights adapted for civilian use are intentionally large, bulky and heavy so that they can also be used as a club for striking in self defense. While these flashlights work well, they are not particularly well adapted for use by women and children who tend to prefer smaller and lighter flashlights.

Although some flashlights have been designed with reduced size and weight, they tend to overlook certain operating or human factors that are common to women. One factor overlooked is the long fingernails commonly worn by women. It has been found that long fingernails tend to interfere with the housings surrounding on-off switches of the type used in self defense and tactical flashlights.

This interference is a particular problem on flashlights having rear end-cap switches which are bordered or surrounded by a rim. When the switch is depressed in an axial or longitudinal direction, a long fingernail tends to abut or snag against any rim or other structure around the switch. This can prevent proper operation of the switch and result in a damaged fingernail.

Although some flashlight end cap switches project rearwardly and outwardly from the end cap, these exposed switches are easily activated unintentionally when bumped or dropped. This can unknowingly turn on the flashlight and drain the battery or batteries.

To overcome these problems, a compact flashlight has been designed with clearance for fingernails when operating and end cap switch, yet provides a guard around the end cap switch to prevent accidental actuation of the switch. The body and end cap of the flashlight are ergonomically designed for easy and comfortable one-handed operation.

BRIEF DESCRIPTION OF THE DRAWINGS

In the Drawings

FIG. **1** is a rear perspective view of a first flashlight embodiment;

FIG. **2** is a side elevation view of FIG. **1**,

FIG. **3** is a front perspective view of a second flashlight embodiment;

FIG. **4** is a partial rear perspective view of the end cap of FIG. **3**,

FIG. **5** is a side elevation view of FIG. **4**;

FIG. **6** is a view of FIG. **5** rotated 90 degrees and schematically showing the position of an operator's index finger; and

FIG. **7** is a central axial sectional view through a representative end cap of the type shown in FIGS. **3-6**.

DETAILED DESCRIPTION OF THE EMBODIMENTS

A flashlight **10** shown in FIG. **1** includes a removable front crown **12** surrounding an axially-recessed lens covering a high intensity light-emitting-diode which provides an intense beam of light. The flashlight **10** further includes a tubular body **14** for housing one or more disposable or rechargeable batteries. A removable rear end cap **18** is threaded to the rear end of the tubular body **14**.

The end cap **18** includes a sidewall **20** that surrounds a user-operated switch actuator **22** which is operated by movement along flashlight axis **36**. As seen in FIGS. **1** and **2**, the sidewall **20** is formed with three axially-rearweardly extending wall portions **24** which are symmetrically and circumferentially separated and spaced apart by three recesses, grooves or axial cut-out portions **28**.

The grooves **28** in FIGS. **1** and **2** are formed as shallow U-shaped arcuate cuts or openings in the sidewall **20**. The edges **30** of each groove **28** are formed as sharp chisel edges for use in self defense. The top of each groove **28** meets a sharp corner point **32** at the corner of each flat end surface **34** at the rear axial end of the wall portions **24**.

The corner points **32** are useful for breaking glass, such as automobile window glass if needed to escape from inside a car or to free someone trapped inside a car.

As seen in FIG. **2**, the switch actuator **22** is axially and radially recessed between and within the wall portions **24**. The flat end portions **34** of the wall portions **24** can extend axially from several millimeters to a centimeter or more beyond the top end surface of the switch actuator **22**. In this manner, the rearwardly-extending wall portions **24** protect the switch actuator **22** from unintended or accidental actuation, such as when the flashlight **10** is dropped or bumped.

The flat end surfaces **34** extend in a plane perpendicular to the longitudinally axis **36** of the flashlight **10** so that the flashlight **10** may be placed and remain upright on a flat surface in an on or off condition. This can free both of an operator's hands to work on overhead areas illuminated by the upright standing flashlight **10**.

The cut-out portions or grooves **28** provide free finger or thumb access through the sidewall **20** to axially depress the switch actuator **22** and thereby operate the flashlight **10** with one hand. While this arrangement works well for most users, some users with long fingernails can hit the sides or edges of the cut-out portions **28** or hit the flat end surfaces **34** with their fingernail. This can prevent full or adequate axial depression of switch actuator **22** and thereby prevent the desired operation of the flashlight **10**, i.e., turning the flashlight on or off or cycling the flashlight through other modes of operation such as high beam, low beam and high strobed beam. Moreover, such unwanted interference can cause split or damaged fingernails and chipped fingernail polish.

In order to further minimize or eliminate this condition, the flashlight **10** of FIGS. **3-7** has been developed to provide free access to the switch actuator **22** while guiding a user's finger or thumb between a pair of opposed wall portions **24** and nesting the finger or thumb within a pair of diametrically opposed cut-out portions **28**. In this embodiment the wall portions **24** and cut-out portions **28** are diametrically and symmetrically opposed on opposite sides of end cap **18**.

As seen in FIG. **5**, the end cap **18** can be formed with flat end surface portions **34** for placing the flashlight **10** upright on a flat horizontal surface. The side edges **40** of the cut-out

portions **28** taper or converge axially forwardly and terminate at a flat horizontal floor portion **42** in sidewall **20**, or terminate at a curved floor portion as shown in FIG. **4**.

The mouth or opening distance **44** between the corners **32** should be about 1.5 to 2.0 centimeters to comfortably accept a finger or thumb tip. The width **46** across the floor portion can be about 1.0 to 1.5 centimeters to nest one's finger or thumb comfortably in each cutout portion **28** and snugly against their side edges **40**. The tapered side edges **40** tend to center and guide one's finger or thumb onto the switch actuator **22**.

The switch actuator **22** can be recessed a distance **48** (FIG. **5**) below the flat surfaces **34** by two to six millimeters, preferably about three or four millimeters. The axial depth **50** of the cut out portions **28** can be about four to eight millimeters, preferably about four or five millimeters. The overall length of flashlight **10** can be anywhere from about 9 centimeters to about 15 centimeters or more with a diameter or width **52** of about 1.5 centimeters to 2.5 centimeters. These dimensions will provide a lightweight compact flashlight that can be easily operated with one hand.

As shown in FIG. **6**, a user's index finger **54** can fully and easily depress the switch actuator **22** while maintaining a safe margin of clearance **56** with the floor **42** of recessed cut-out portion **28** of sidewall **20**. The user's long fingernail **60** is directed away from any portion of the sidewall **20** by the recesses **28** which direct the fingernail outwardly and away from the sidewall **20**, side edges **40** and floor **42**.

Details of a representative end cap assembly **63** are shown in FIG. **7**. End cap **18** can be formed of an aluminum alloy, as can the remainder of the flashlight body **14** and front crown **12**. A threaded collar **62** is provided on end cap **18** for threaded removable engagement and electric continuity with the tubular body **14**.

The endcap assembly **63** includes a plastic insulating collar **64** which seats on a radial ledge **66** and receives a metal conical compression spring **68** which biases against and makes electrical contact with a battery housed within the tubular body **14**. A copper wave washer **70** seats on a second radial ledge **72** and makes electrical contact with the aluminum end cap **18**.

A circular circuit board **74** has conducting lands on its undersurface which make electrical contact with the spring **68** and with the end cap **18** through the wave washer **70**. The circuit board **74** can be provided with one or more integrated circuits or "chips" including micro logic circuits **78** that can control the operation of the flashlight **10** as discussed below.

A conventional button switch **80** includes a rectangular or box-shaped housing. A pair of electrical leads **82** extending outwardly from within the housing interconnect internal button switch terminals within the switch housing with circuits and control logic on circuit board **70**. A spring-biased plunger **84** completes contact between the electrical leads **82** when the plunger is axially depressed.

A plastic platform **86** seats on top of the button switch housing and provides a support surface for a dome-shaped resilient elastomeric diaphragm **88**. An externally-threaded washer **90** mates with an internal threaded portion of end cap **18** to clamp and hold the perimeter of diaphragm **88** in fixed axial position. The diaphragm **88** includes a movable plunger portion **92** which is coaxially aligned with the plunger **84** on the button switch **80**.

A light-activated luminescent material or a light-emitting material may be added to the elastomeric material of the diaphragm **88** to provide a "glow-in-the-dark" function. This facilitates locating and operating the diaphragm **88** in the dark.

When a user depresses the diaphragm **88**, the plunger **92** on the diaphragm depresses the plunger **84** on the button switch **80** and completes an electrical circuit across electrical leads **82**. This allows electrical current to flow through the circuits and logic components **78** on circuit board **74** via metal spring **68** which makes electrical contact with a land on the underside of circuit board **74**. The circuit is completed through the battery or batteries, through the LED's and through the body of the flashlight and wave washer **70** and back to the circuit board **74**.

Each time the button switch is pushed, the logic circuits **78** can be programmed to step the operation of the flashlight in virtually any desired sequence. For instance, the logic can operate as a simple alternating on-off switch which latches on or off each time the plunger **84** is fully depressed through a full axial throw.

Alternatively, the logic circuits **78** can be programmed to operate the flashlight in a sequence of high or bright light when the flashlight is first switched on, followed by a low or dull light when the plunger **84** is depressed again, and then off when the plunger is pressed a third time. In each case in this example, the functions of high, low and off are each maintained in a latched state until switched to the next function.

A rapidly pulsing or strobed lighting function can be easily provided to the function-switching sequences on either a high or low intensity setting by programming a timing and switching function in logic circuits **78**. In this case a user could select from high, high strobe, low or low strobe, each in a latched state.

Another option is to provide lighting functions with a conventional latched on and latched off function in combination with high, low and strobe light functions. This can be achieved by turning on the flashlight with a relatively long axial depression or axial throw of the plunger **84** to latch the flashlight on. Smaller or shorter axial depressions or axial throws of plunger **84** can provide pulses to the logic circuits **78** to scroll through any desired sequence of operations until the plunger is again fully depressed and latched off.

For example, with the flashlight off, a user can latch on the flashlight **10** in a high-intensity mode by strongly pressing the diaphragm **88** through its full range travel and releasing it. The high intensity light beam will stay on until the user either strongly depresses the diaphragm **88** through its full length of axial travel or until the user lightly depresses and releases the diaphragm through a short stroke or depression of diaphragm **88**. This short stroke and release will switch the light into a low intensity light beam output mode until the user fully and strongly depresses the diaphragm **88** again to turn the flashlight off, or again lightly depresses and releases the diaphragm **88** to switch to a strobe light output mode where the flashlight emits pulsed bursts of high intensity light beams.

The strobe mode will remain strobing until the operator fully depresses and releases the diaphragm **88** to turn off the flashlight or lightly depresses and releases the diaphragm **88** to cycle the function back to the high intensity light mode. In any mode of operation, the diaphragm **88** can be depressed and lightly held in a depressed condition without latching and thereby turn off the flashlight as long as the operator holds the diaphragm down. Upon releasing the diaphragm, the flashlight will return to its previous mode of operation. Alternatively, the circuit **78** will cycle the flashlight to a new mode of operation.

All of the above functions are conveniently provided by the microchip or control chip **78** in combination with the operation of the button switch.

There has been disclosed heretofore the best embodiment of the invention presently contemplated. However, it is to be

understood that various changes and modifications may be made thereto without departing from the spirit of the invention.

What is claimed is:

1. A method of operating a flashlight having a plurality of operating modes including a high intensity light mode, a low intensity light mode and a strobe light mode, the flashlight having a user-operated switch having a long throw latching the flashlight on and off and a shorter throw cycling the flashlight through one or more of the plurality of operating modes, and logic circuits responsive to the switch and providing a selection of any one of the plurality of operating modes, wherein said method comprises:

turning on the flashlight with a first long throw and release of the switch and latching the flashlight on in a high intensity light mode with the long throw and release of the switch;

providing a first electrical pulse to the logic circuits with a short throw and release the switch;

switching from the high intensity light mode to a low intensity light mode with the first electrical pulse;

providing a second electrical pulse to the logic circuits with a short throw and release of the switch; and

switching from the low intensity light mode to a strobe light mode with the second electrical pulse.

2. The method of claim **1**, further comprising providing a third electrical pulse to the logic circuits with a short throw and release of the switch; and switching from the strobe light mode to the high intensity light mode with the third electrical pulse.

3. The method of claim **1**, further comprising turning off the flashlight by switching from any one of the high intensity light mode, the low intensity light mode, and the strobe light mode with a second long throw of the switch.

4. A method of operating a flashlight having a plurality of operating modes including a high intensity light mode, a low intensity light mode and a strobe light mode, the flashlight having a user-operated switch having a long throw for latching the flashlight on and off and a shorter throw cycling the flashlight through one or more of the plurality of operating modes, and logic circuits responsive to the switch and providing a selection of any one of the operating modes, wherein the method comprises:

turning on the flashlight with a first long throw and release of the switch and latching the flashlight on in a first mode of the plurality of operating modes with the long throw and release of the switch;

switching from the first mode to any one of the remaining plurality of operating modes with one or more short throws and releases of said switch; and

turning off the flashlight in any one of the plurality of operating modes with a second long throw and release of the switch.

5. The method of claim **4**, wherein the long throws of the switch are achieved with a strong switch depressing force and the short throws of the switch are achieved with a light switch depressing force, and wherein the method further comprises switching the flashlight on with a long throw and release of the switch and with a strong switch depressing force to turn the flashlight on in a first one of the operational modes and switching to a second one of the operational modes with a short throw and release of the switch and with a light switch depressing force less than the strong switch depressing force.

6. A method of operating a flashlight having a plurality of operating modes including a high intensity light mode, a low intensity light mode and a strobe light mode, the flashlight having an axially-movable switch actuator provided on an axial end portion of the flashlight, the switch actuator configured for operation with a single finger or thumb, the flashlight having a user-operated switch coupled to logic circuits which provide a serial cyclic selection of any one of the operating modes in response to a serial actuation of the switch, and wherein the method comprises:

turning on the flashlight in one of the plurality of modes with a first axial throw of the switch by applying a first axial force to the switch actuator with a finger or thumb;

selecting another operating mode with a second axial throw of the switch by applying a second axial force to the switch actuator with a finger or thumb; and

wherein the first axial throw is longer than the second axial throw and the first axial force is greater than the second axial force.

* * * * *