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J. H. ANDERSEN ET AL.

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SELF-LOCKING FUSE BUTTON SWITCH OPERATING DEVICE

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INVENTORS.

JAMES H. ANDERSEN
JAMES W. AMOS, JR.
MAURICE D. FULLER
SELF-LOCKING PUSH BUTTON SWITCH OPERATING DEVICE


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This invention relates to electrical switch mechanisms and more particularly to an improved push button mechanism including a panel-mounted base unit and a cooperating lamp-illuminated actuator unit which incorporates one or more indicator lamps and is readily removable from the base unit as and when necessary to replace defective or burned-out lamps. An object hereof is to provide a push button actuator unit which while normally locked positively in the base unit is readily removable therefrom simply by an outwardly directed pull on the push button or equivalent operating element. The invention is herein illustratively described by reference to the presently preferred embodiment thereof; however, it will be recognized that various changes and modifications therein with respect to details may be made without departing from the essential features involved.

In addition to the general objectives of providing a reliable, durable and readily constructed device of compact and practicable form, this invention is directed to achieving a self-locking actuator unit which may be inserted in and removed from the base unit with access limited entirely to the front side of the latter. Switch mechanisms of this capability are highly useful in applications where instrument panels carry a number of similar devices or are otherwise crowded or encumbered so that problems should it be necessary to gain access to the rear of the panel each time it becomes necessary to remove an actuator unit.

A related object is to provide such a device in which no tools are necessary either to install and to unlock and remove the actuator unit, and no elements in the panel or switch device itself other than the manually operated push button and the related mechanism which it controls within the device.

A further objective is to achieve such an actuator mechanism the parts of which are readily manufactured, assembled and disassembled and certain elements of which perform multiple functions in order thereby to achieve general objectives as stated above. Moreover, the parts are well enclosed, protected and arranged against damage through careless handling or unskilled tampering.

Still another object is to achieve a simple, positive mechanical lock effective to hold the actuator unit against ejection by shock or vibration forces or by forces developed within the unit itself, including the recoil forces of lamp base contactor springs reacting outwardly on the actuator unit from the base unit. A related specific object is to provide an unlocking device the nature of which requires a deliberate outward movement displacement of the push button in order to unlock the actuator unit, thereby avoiding criticality of operation and a likelihood that the unit might falsely appear operatively installed when in fact it is unlocked.

As herein disclosed, certain features of the invention are embodied in the combination of spring-returned cam follower locking pins projectable outwardly from the actuator unit by cam action in order to engage abutments in the adjoining walls of the base unit, and a push button operated switch actuation plunger having cam means therein slidably engaged by spring-pressed follower pins, such cam means having relatively high and low lands and an intermediate rise with sides sloping to the lands. In lockingly displaced position engaging said abutments, the followers slide on the higher land surface of the cam in the switch actuation range of plunger reciprocation. In the plunger's rest position it is held against engagement by resilient return spring by the detent action of the followers contacting the cam rise. In the actuator unit locked condition, lamp base contactor spring reaction forces applied to the body of the actuator unit are resisted by abutment-engaged pins without applying displacement pressure to the plunger itself. When outward pull is exerted manually on the plunger, the cam rise is forced past the cam follower ends of the locking pins, which yield outwardly then advance against the deep land of the cam so as to retract the locking pins from the abutments and permit removal of the actuator unit.

Additional features are embodied in the assembly employing a hollow cap push button carrying an internal transversely disposed strut beam removably connected to the plunger by one of two threadedly engageable parts in which the plunger is formed. The part connected to the strut comprises an internally threaded sleeve. The remaining part, threaded into this sleeve, projects through the inner end wall of the actuator unit and is adapted both to engage and operate the switch when the push button is pressed and to be turned by a tool in order to thread and unthread the plunger parts, with the actuator unit removed from its supporting base.

These and other features, objects and advantages of the invention will become more fully evident from the following description thereof by reference to the accompanying drawings.

FIGURE 1 is an exploded isometric view of the improved switch mechanism including a portion of a supporting panel and securing elements thereon.

FIGURE 2 is an edge view of such a panel with a succession of similar switch mechanisms mounted therein.

FIGURE 3 is a side view of the switch mechanism with the base unit and actuator unit separated and with the major portions of the actuator unit separated from each other.

FIGURE 4 is a transverse sectional view taken on line 4-4 in FIGURE 5.

FIGURE 5 is an isometric view of the actuator unit from a rear aspect.

FIGURE 6 is an enlarged sectional detail of the principal working mechanism of the actuator unit, showing by solid lines its locking position and showing by broken lines the relative position of the cam follower pins in relation to the plunger with the device unlocked to permit removal of the actuator unit from the base unit.

Referring to the drawings, base unit 10 forms a receptacle of rectangular cross section open at its outer end 10a and having a tubular post 14a projecting endwise from its inner end 10b. The post carries a plunger and a separable switch 14 the details of which are not shown and comprise no part of the present invention. The actuator unit 12, also of rectangular exterior cross section slightly smaller than the interior of the receptacle of base unit 10, is removably insertable in the base unit receptacle. The actuator unit carries a push button cap 16 by which all functions of the actuator unit are controlled, including operation of switch 14, insertion and removal of the actuator unit in the base unit receptacle, and locking and unlocking of the actuator unit in conjunction herewith.

In order to mount the base unit 10 in a manner suitable for most applications of these switch devices, that is projecting to the rear of a supporting panel P a supporting member 18 extending between the base unit, screw operated clamps 19 being provided. These clamps have shoes 18a which bear inwardly against
the outside face of the base unit mounting flange 19c along the opposed broad sides of the base unit. A clamp screw 18b threads into the shank portion 18a’ of the shoe and, by reaction against the clamp yoke 18c which bears against the rear face of the panel P, draws the flange 10c tightly against the front of the panel in those areas where it overlaps the rim of the panel aperture, namely along the narrow sides of the base 10 as shown. Thus, a succession of similar switch bases 10 may be mounted in immediately adjacent positions separated only sufficiently to accommodate the clamps 18 therebetween, as shown in FIGURE 2.

Preferably the opposing broad sides 10b of the base unit receptacle and the intervening narrow sides 10e are formed of sheet metal whereas the inner end wall thereof, 10b, is formed of Micarta or other suitable insulation material having a central aperture aligned with the tubular switch post 14e. This end wall is also apertured at suitable locations to accommodate the lamp base terminal contactors 20, of which there are four in the example. These terminal contactors have soldering posts 20a projecting outside the receptacle and have yieldable spring-loosures in the buttons 20b projecting into the interior of the receptacle. It is the springs of these contractor buttons reacting against the exposed contacts 22a of the lamps 22 mounted in the actuator unit 12 which create a force tending to eject the actuator unit from the base unit 10 in the absence of suitable locking means retaining the actuator unit in place.

The broad sides 10d of the base unit receptacle have correspondingly positioned apertures 10d’ and associated tabs 10d’’’ struck inwardly adjacent the forward edges of these apertures which serve as locking abutments cooperable with actuator unit locking elements to be described.

The actuator unit push button cap 16 has a translucent face 16a adapted to be illuminated by the lamps 22. The hollow cap has shallow recesses 16b in its sides adjacent the front end thereof, which afford finger grips for removing the actuator unit from the base unit. The cap fits slidably over the forward portion of lamp housing 24. At a central position between the narrow sides of the cap 16 a beam strut 26 extends transversely across the interior of the cap with the ends of the strut lodged in apertures 32e of such slot of cap as shown (FIGURE 4). An internally threaded slot 26a longitudinal of the cap, is apertured to pass the strut 26 and serves as one part of a switch-operating plunger 30 whose other part 32 is guided in the lamp housing 24 for longitudinal reciprocation therein. The part 32 has a through hole 32h in which there is inserted a tip 32b received in a notch 26a in the edge of beam strut 26 to prevent shifting of the strut lengthwise of itself. The opposite tip 32c has a screwdriver slot by which to turn the part 32 in order to thread and unthread the part 28. The plunger tip 32c projects beyond the lamp housing 24 and through tube 14a into a position for operating the switch 14 when the plunger is advanced by pressing in the push button cap 16. Longitudinal slots 26b in the lamp housing accommodate the strut 26 during relative reciprocation of the cap 16 in relation to the lamp housing, as occurs during push button operation of the switch 14.

Transversely projectable locking pins 34, having enlarged inner ends 34a adapted as cam followers, are slidably mounted in aligned transversely extending bores formed in the lamp housing 34. The outer ends of these pins are projectable beyond the sides of the lamp housing to engage the base wall abutments 10d’’ for locking the actuator unit 12 against ejection from the base unit 10 under the continuous force of lamp base contactors 20b.

Return springs 36 surrounding the shanks of pins 34 bear inwardly against the cam followers 34a, pressing the latter into sliding contact with the plunger 30 as shown.

The plunger cooperating with these cam follower pins has three principal cam portions. The first comprises a relatively long and high land 32d, the second a relatively short and deep land 32e, and the third an intermediate cam rise 32f having one side 32g sloping to the land 32d and its opposite side 32h sloping to the land 32e. Cam land 32e is formed by the exterior surface of sleeve part 28 threaded onto the other plunger part 32. The relative height of land 32d, i.e., the diameter of the plunger in that portion thereof, is sufficient to project the pins 34 into locking engagement with the abutments 10d’’. The deep land 32e is formed by a portion of the plunger which is of sufficiently small diameter wall thickness 28f to permit followers 34a of locking pins 34 are retracted into the lamp housing to avoid engagement with the abutments 10d’’. By reciprocating the plunger longitudinally so as to force the cam rise 32f one way or the other past the followers 34a, the locking pins are either projected or retracted, as shown in FIGURE 6.

With the followers 34a resting slidably on the elongated land 32d, a plunger-return spring 38 reacting outwardly on the plunger presses the rise 32f against the followers 34a, but with a light pressure which, because of the steepness of the land 32d, is insufficient to force the rise past the followers. A tubular extension 24c encloses the spring 38 and its centrally apertured end wall serves as a guide for the plunger 30 and as a stop for the end of the spring. The opposite stop 32g, carried by the plunger itself, abuts the followers 34a when the lateral drop into the slot defined by the land 32e. With the actuator unit 12 installed in the base unit 10 and with the followers 34a in the position shown by solid lines in FIGURE 6, locking the units together, the push button cap 16 is presented at the face of instrument panel P and is normally illuminated by the lamps 22. Pressing inwardly on the push button cap advances the plunger 30 to operate switch 14. During this actuating stroke of the plunger the followers 34a simply slide on the land 32d from a relative position abutted to the rise 32f to a position displaced therefrom toward the cap. When the push button is released, spring 38 returns the plunger to its detent position established by contact between the rise 32f and the followers 34a.

With the unit thus installed and operable, the projected locking pins 34 engaging the abutments 10d’’ resist the actuating force exerted on the actuator unit 12 by the springs of the 28, extending button 28b. Moreover, shock and vibration forces are also resisted by these positive-acting locking pins.

However, in order to remove the actuator unit 12, as may be necessary from time to time, for example in order to replace the lamps 22, the finger grips 16b are grasped manually and the plunger drawn outwardly thereby so as to force the rise 32f past the followers 34a. During this withdrawal action, the pins 34 are actuated outwardly through the apertures 10d’ as a result of the wedging action exerted thereon by the slope 32f. Thereupon, after the peak of the rise is passed, continued outward movement of the plunger is accompanied by descent of the followers 34a down the slope 32f’’ to the land 32e in order to retract the pins 34. This continuous direct movement of the plunger effected by pulling outwardly on the push button cap 16 is sufficient both to unlock and to withdraw the actuator unit from the base unit. Moreover, a definite and established amount of outward displacement of the plunger from its normal position shown in FIGURE 6 (by solid lines) is necessary in order to unlock the actuator unit, since it is necessary for the followers 34a to slide up and over the crest of the cam rise 32f before the locking pins can be retracted. In fact they are projected to an even greater extent in the sense to lockingly engage the abutments as the cam followers move up the rise slope 32f’, until they pass the crest. If they fail to pass the crest they will remain in locking position even though they may retract inwardly to their normally projected position by the cam followers returning to the
position shown by solid lines in FIGURE 6. This avoids criticality of operation and false appearances of the actuator unit being in operating position when in fact it is unlocked and inoperative.

To those skilled in the art these and other aspects of the invention will be evident on the basis of the foregoing description of the presently preferred embodiment thereof.

We claim as our invention:

1. A panel type switch operating device comprising a switch structure having an open receptacle therein, said receptacle having an abutment element in one side thereof, and a switch actuator unit removably insertable into said receptacle, said actuator unit having a switch-actuating plunger operable by longitudinal movement inwardly of the receptacle, a transversely projectable and retractable locking element carried by said actuator unit in relative position thereon to lockingly engage said abutment element with the actuator unit inserted, first positioning means on the plunger operatively engageable with the locking element to maintain the locking element projected in engagement with the abutment element, thereby to resist toward forces tending to eject the actuator unit from the receptacle, while permitting plunger reciprocation through a predetermined switch-operating range thereof, and second positioning means on the plunger spaced longitudinally from the first positioning means and registrable with the locking element by drawing the plunger relatively outwardly into actuator unit beyond said range, said second positioning means thereby effecting locking element retraction to unlock the actuator unit for withdrawal thereof from the receptacle.

2. The device defined in claim 1, wherein the locking element comprises a pin spring means acting on the plunger to resist drawing of the same outwardly beyond said range.

3. The device defined in claim 1, wherein the locking element comprises a pin spring means acting on the plunger to resist drawing of the same outwardly beyond said range.

4. The device defined in claim 1, wherein the locking element comprises a pin spring means acting on the plunger to resist drawing of the same outwardly beyond said range.

5. The device defined in claim 1, wherein the locking element comprises a pin spring means acting on the plunger to resist drawing of the same outwardly beyond said range.

6. The device defined in claim 1, wherein the locking element comprises a pin spring means acting on the plunger to resist drawing of the same outwardly beyond said range.

7. The device defined in claim 1, wherein the locking element comprises a pin spring means acting on the plunger to resist drawing of the same outwardly beyond said range.

8. The device defined in claim 7, wherein the yieldable spring means includes a spring pressing the follower into engagement with the first surface, said locking element on the plunger intermediate the first and second surfaces, interengagement between said follower and detent surface occurring during said withdrawal of the plunger to deflect the follower against the force of said spring.

9. A self-locking switch assembly comprising a base unit, including switch means, an actuator unit removably insertable into said base unit and including operating means guided for independent movement in said actuator unit inwardly and outwardly from a normal position therein, force-applying means tending to eject the actuator unit when so inserted, and a detent surface engaging means controlled by positioning of said operating means in said actuator unit with the latter inserted in the base unit, including cooperative elements carried by the respective units, and when actuated holding the units together positively against the ejection force, said normally positioned operating means being engageable with the switch means by movement in one direction from its normal position to operate said switch means, and being engageable with the locking means by movement in the opposite direction from said normal position to deactivate said locking means, said actuator unit further including means operatively associated with said locking means and operable upon insertion of such unit into the base to actuate said locking means.

10. A push-button type switch assembly comprising a base unit adapted to be mounted in a supporting panel to project rearwardly therefrom, said unit having a switch mounted thereon, and a push-button type switch-actuating unit removably engageable with the base unit in such relative position as to permit operation of the switch thereby, said units including respective locking elements interengageable to hold the units together, said actuation unit having a push-button type switch-operating means guided therein to reciprocate through a switch-operating range of positions and outwardly beyond such range to an unlocking position, said switch-operating means including respective cam portions spaced lengthwise thereon, said cam portion being engaged by one locking element to effect interengagement of the locking elements with said switch-operating means within said range of positions, and the other cam portion being engaged by said one locking element to disengage the locking elements with the switch-operating means in said unlocking position.

11. The switch assembly defined in claim 10, wherein the switch-operating means includes a return springacting outwardly thereon from the actuation unit, and yeldable detent means limiting outward displacement of said means by said return spring short of said unlocking position.

12. The switch assembly defined in claim 11, wherein the locking element of the actuation unit comprises a transversely reciprocable pin element and spring means urging the same yieldably inwardly into contact with either cam portion, and wherein the detent comprises an intermediate cam ride portion on said switch-actuation means, engageable with the pin element.

13. The switch assembly defined in claim 12, wherein the actuation unit further comprises a hollow lamp housing including an indicator lamp element in which the switch is mounted, said housing being removably insertable into said receptacle, with said indicator lamp element being receivable into said receptacle when the actuator unit is in its outward position.

14. A push-button switch mechanism comprising a housing having a switch-operating member reciprocable therein through a predetermined switch-operating range.
and beyond said range in a direction outwardly of the housing, a switch base to which said housing is lockingly connected, normally engaged cooperative locking means respectively carried by the housing and base to thus lock the housing and base together, and means to operate the locking means, including actuator means controlled by positioning of the switch-operating member in said housing to maintain the locking means interengaged throughout movement of the member in said operating range and to effect disengagement of the locking means by movement of said member outwardly of the housing to a position beyond said range.

15. The push-button switch mechanism defined in claim 14, including switch means disposed on the switch base to be actuated by movement of the switch operating member in the direction toward said switch means, a return spring acting oppositely on said member, detent means limiting return movement of said member at a position short of said unlocking position, and spring means, separate from said return spring, reacting between the housing and base tending to separate the same.

16. A switch operating device comprising a base including socket means having an abutment element, a switch actuator unit movably insertable into said socket means, said actuator unit having a switch-actuating means guided therein for movement inwardly of the socket means, and a normally retracted locking element carried by said actuator unit and projectable therefrom transversely to the direction of said movement to lockingly engage said abutment element with the actuator unit inserted, said switch-actuating means including first positioning means engageable with and maintaining the locking element engaged with the abutment element throughout a predetermined switch-operating range of reciprocation of said switch-actuating means, and second positioning means spaced from the first positioning means in the direction of said reciprocation to become registrable with the locking element by drawing the switch-actuating means relatively outwardly in the actuator unit beyond said range, said second positioning means thereby effecting locking element retraction to unlock the actuator unit from the socket means.

17. A self-locking switch assembly comprising a base unit having a device to be operated therein, an actuator unit movably insertable into said base unit and including operating means guided for independent movement in said actuator unit inwardly and outwardly from a normal position therein, force-applying means tending to eject the actuator unit when so inserted, and actuatable and deactuatable locking means controlled by positioning of said operating means in said actuator unit with the latter inserted in the base unit, including cooperate elements carried by the respective units, and when actuated holding the units together positively against the ejection force, said normally positioned operating means being engageable with the device by movement in one direction from its normal position to operate said device, and being engageable with the locking means by movement in the opposite direction from said normal position to deactuate said locking means, said actuator unit further including means operatively associated with said locking means and operable upon insertion of such unit into the base to actuate said locking means.

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BERNARD A. GILHEANY, Primary Examiner.