# United States Patent

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[54] **LATCH MECHANISM FOR RELEASABLY ENGAGING PUSHBUTTON CAPS IN ELECTRICAL DEVICES**
**13 Claims, 7 Drawing Figs.**


[52] **U.S. Cl.** ..... **200/167 A,** 200/159 R, 200/169 PB
[51] **Int. Cl.** ..... **H01h 9/18**
[50] **Field of Search** ..... 200/167 A, 159, 169C, 169PB



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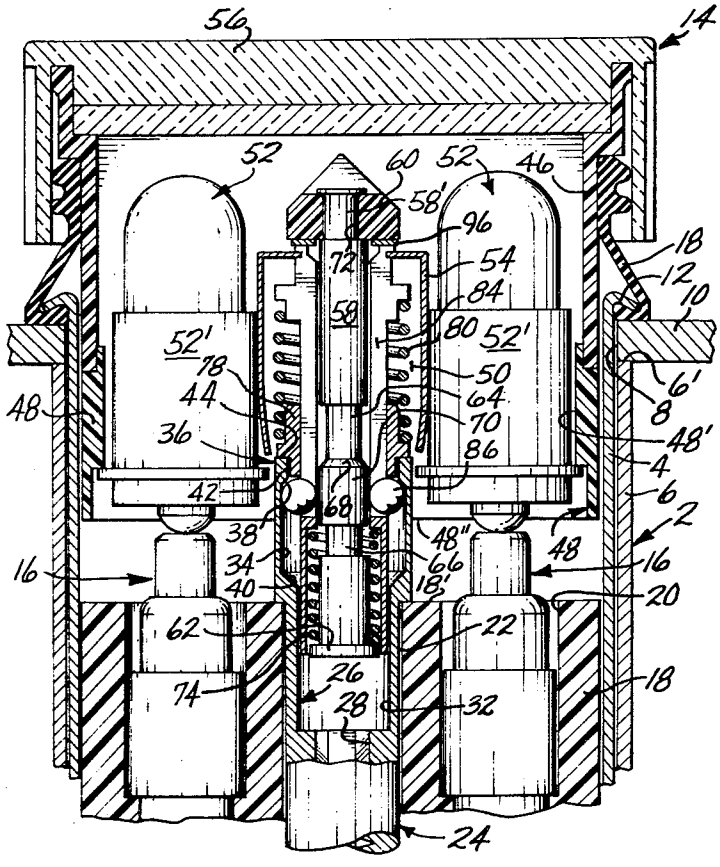
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**ABSTRACT:** A latch mechanism is disclosed whereby pushbutton caps and the like may be releasably engaged in electrical devices having flange means on a relatively stationary member therein, forming abutments on the opposite sides thereof. The mechanism includes an elongated element which is longitudinally reciprocated in relation to the member transverse to the flange means, during engagement and disengagement of the cap; and which has a pair of longitudinally spaced recesses therein forming a land therebetween which is spaced from the flange means on the member as the land passes the flange means in the reciprocable motion of the element. In addition, the mechanism includes slidably guided detent ball means on the land, and a pair of stop means which are slidably mounted on the element over the recesses, and yieldably biased relatively toward one another along the longitudinal axis of the element, with the detent ball means retained therebetween so that the detent ball means tends to remain on the land. The stop means are operatively insertable into the space between the land and the flange means, and the detent ball means is larger in dimension than the width of the space, but adapted to shift from side to side of the flange means under the bias of one of the stop means, when the detent ball means is displaced into the adjacent recess against the bias of the respective stop means as a consequence of abutting the adjacent side of the flange means as the element is reciprocated in relation to the member.

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SHEET 1 OF 2

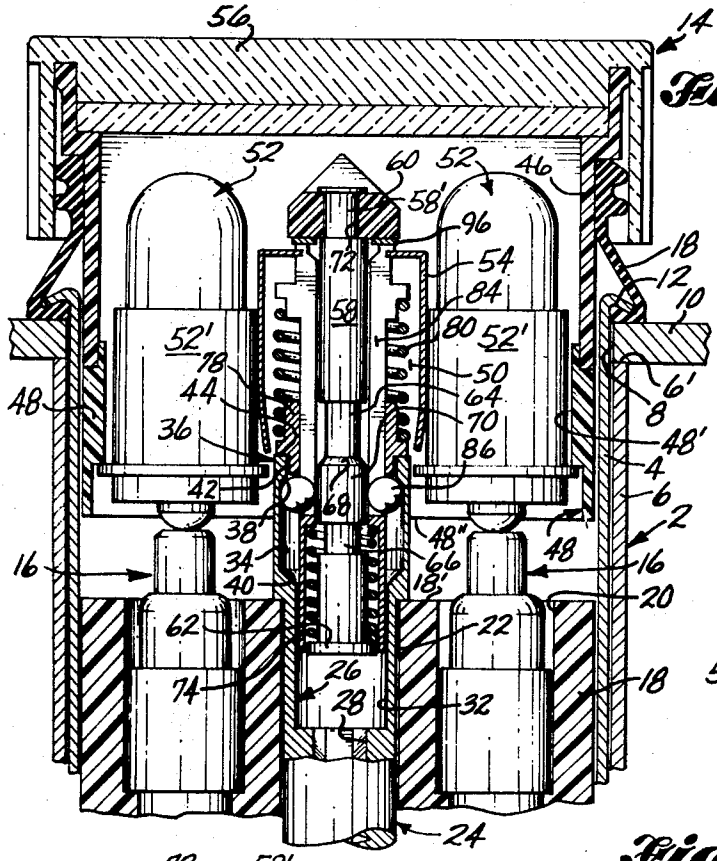


Fig. 1.

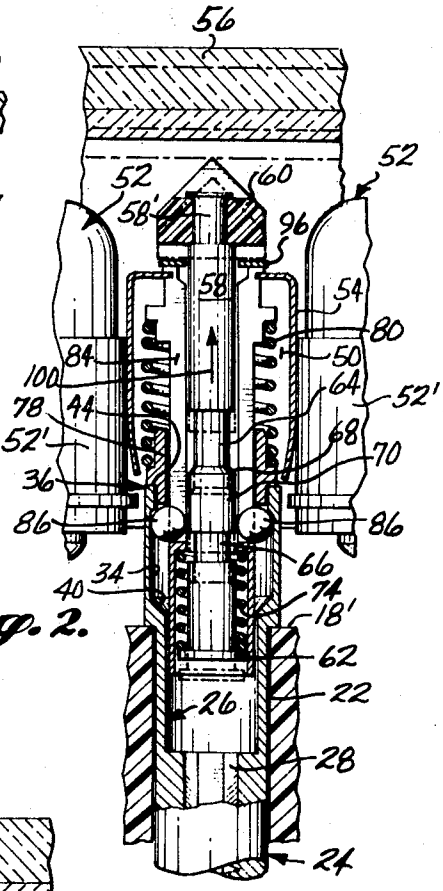


Fig. 2.

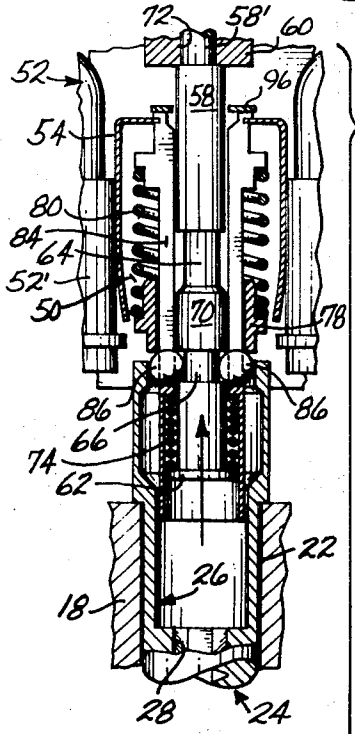


Fig. 3.

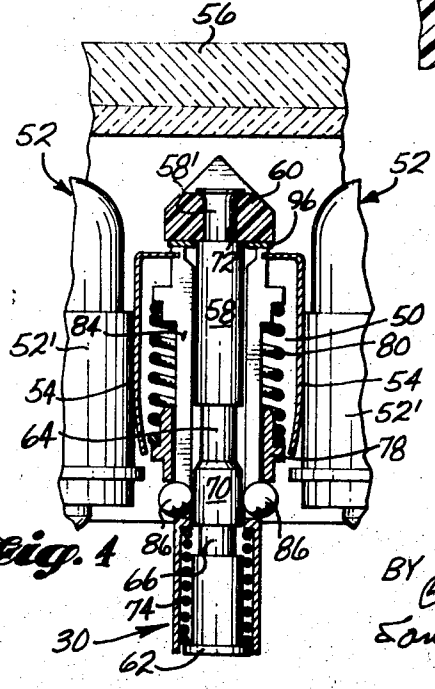


Fig. 4

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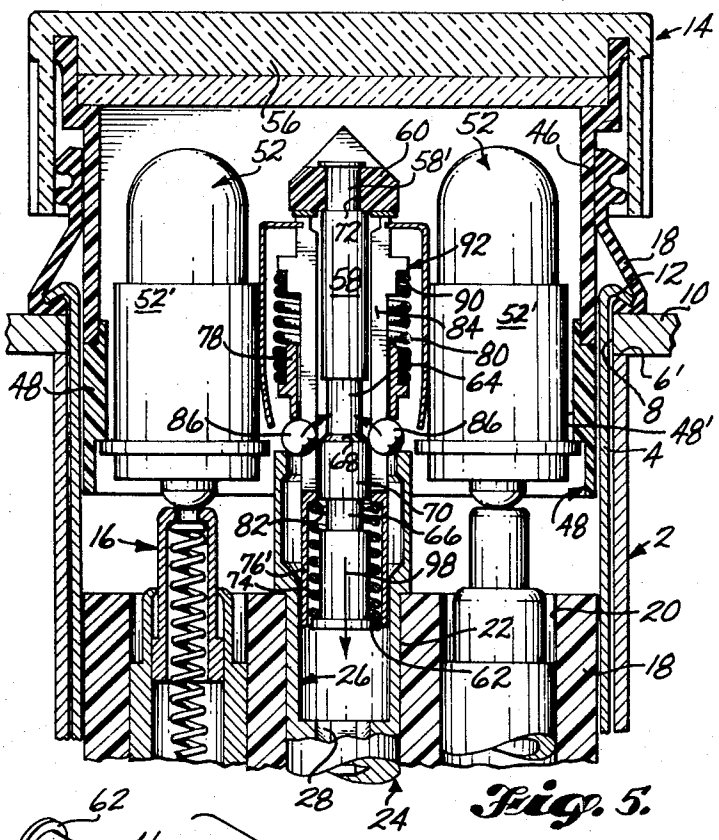



Fig. 5.

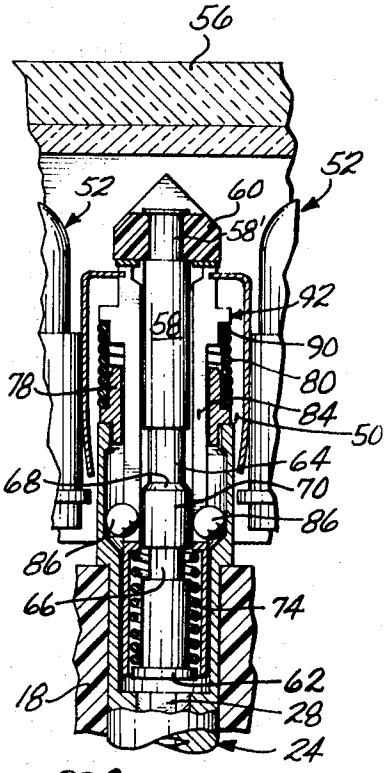



Fig. 6.

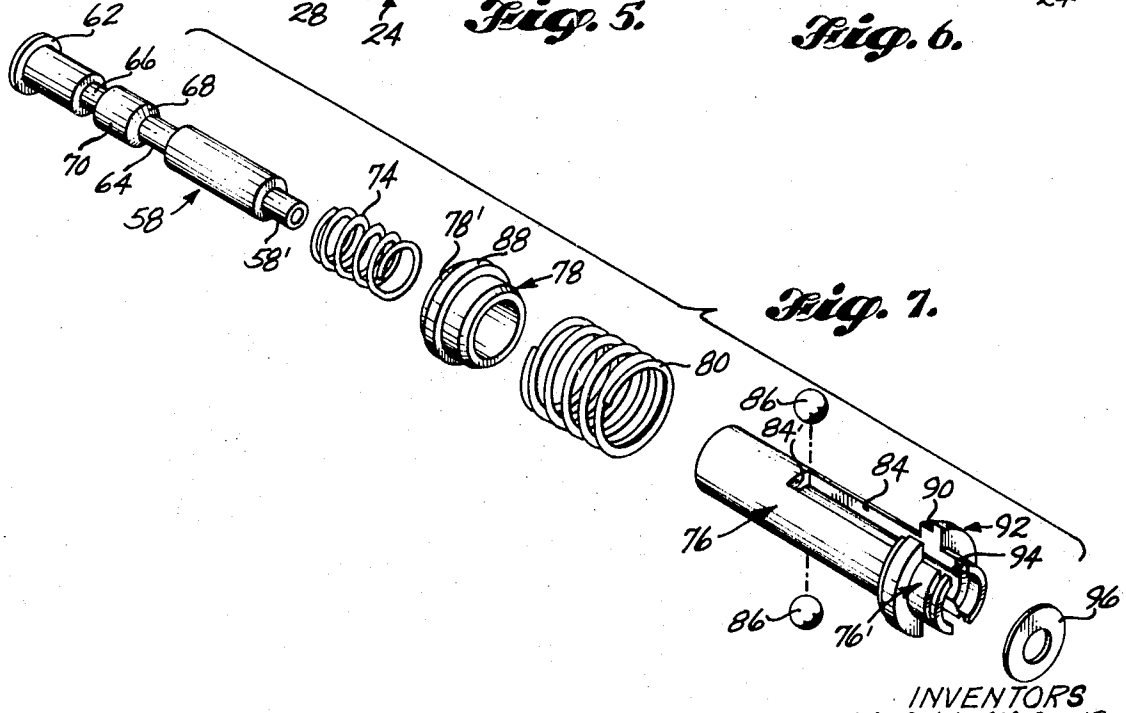



Fig. 7.

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# LATCH MECHANISM FOR RELEASABLY ENGAGING PUSHBUTTON CAPS IN ELECTRICAL DEVICES

## FIELD OF THE INVENTION

This invention relates to latch mechanisms for releasably engaging pushbutton caps and the like in electrical devices; and in particular to a mechanism of this type which is operative to safeguard the cap against unintentional dislodgement by sudden impact forces of considerable magnitude but short duration.

## BACKGROUND OF THE INVENTION INCLUDING CERTAIN OBJECTS THEREOF

In many electrical installations, parts are often enclosed in small tubelike cartridges on a panel. Each cartridge is closed by a cap which is releasably inserted and latched in the open end of the cartridge so that it can be withdrawn in the opposite direction to replace worn or spent parts in the unit without removing the cartridge as a whole. If possible, the mechanism for latching the cap is designed so that a small force level is required to remove the cap, such as 2–3 pounds of finger pressure thereon. The intention in this respect is that the cap can be quickly and easily removed without damaging it or some other part in the unit at the time. However, certain of these installations are subjected to unintentional environmental forces which have a magnitude sufficient to dislodge the cap, even though the forces are of relatively short duration. In aircraft installations for example, electrical assemblies are often subjected to sudden shock or acceleration forces which generate a sufficient burst of energy to dislodge the cap from the cartridge. In all such cases as these, therefore, a cartridge unit of this nature may not be acceptable to the user, even though the cap is easily removable for access to the cartridge.

One object of the present invention is to devise a releasable latch mechanism which provides a positive and reliable latch for a cap or other such reciprocable element of this nature, yet still makes it possible to disengage the element with light finger pressure. Another object is to provide a mechanism of this type which positively and reliably latches the element against high magnitude impact forces of short duration, yet readily and easily releases the element for reciprocation when a force of the same magnitude or even one of lesser magnitude, is applied over a greater stroke. A further object is to provide a mechanism of this type and capability which if desired, can be released without the assistance of a tool, even though it can withstand impact forces which are of high magnitude but short duration, as in the case of the shock or acceleration forces to which aircraft installations are subjected. Other objects include the provision of a mechanism of this nature which is operable to releasably latch the element against reciprocation in one direction thereof, whether the element is partially or wholly restrained against reciprocation in the other direction thereof; and which has a relatively small number of readily interchangeable parts that are cheaply manufactured and easily assembled in, or added to the electrical device. Still further objects will become apparent from the description of the invention which follows hereafter.

## SUMMARY OF THE INVENTION

Generally speaking, these objects and advantages are realized by a latch mechanism of our discovery wherein the cap or the like is releasably engaged in an electrical device having flange means on a relatively stationary member therein, forming abutments on the opposite sides thereof. The mechanism includes an elongated element which is longitudinally reciprocated in relation to the member transverse to the flange means, during engagement and disengagement of the cap; and which has a pair of longitudinally spaced recesses therein forming a land therebetween which is spaced from the flange means on the member as the land passes the flange means in the reciprocable motion of the element. In addition,



the mechanism includes slidably guided detent member ball means on the land, and a pair of stops which are slidably mounted on the element over the recesses, and yieldably biased relatively toward one another along the longitudinal axis of the element, with the detent ball means retained therebetween so that the detent ball means tends to remain on the land. The stop means are operatively insertable into the space between the land and the flange means, and the detent ball means is larger in dimension than the width of the space, but adapted to shift from side to side of the flange means under the bias of one of the stop means, when the detent ball means is displaced into the adjacent recess against the bias of the respective stop means as a consequence of abutting the adjacent side of the flange means as the element is reciprocated in relation to the member.

To position the cap on the member, one of the stop means has a flange thereon which abuts the adjacent side of the flange means on the member to yieldably limit the travel of the element in the direction of reciprocation corresponding to the bias on the one stop means, after the one stop means has entered the space between the land and the flange means on the member, and the detent ball means has shifted to the other side thereof. Also the other stop means may be slidably engageable in the relatively stationary member for this purpose. For example, the relatively stationary member may have a socket therein which has a circumferential lip interposed around the mouth thereof, forming abutments on the opposite sides thereof; and the aforesaid other stop means may be slidably engageable and disengageable in and from the socket as the element is reciprocated into and out of the same.

Preferably, the stop means comprise a pair of sleeves which are slidably engaged on one another on the element. For example, the element may comprise an elongated rod having flanges on the ends thereof, and a pair of spaced circumferential grooves therein which are interposed between the flanges on the rod; and the inner sleeve may normally abut the flange on one end of the rod and have the flange on the other end of the rod slidably engaged therein, there being a resilient compression element caged between the latter flange on the rod and the inner sleeve, and another resilient compression element caged between the outer sleeve and a flange on the inner sleeve. In the presently preferred embodiments of the invention, moreover, there is a pair of balls on the land which are slidably guided in a pair of diametrically opposed, longitudinally extending slots in the inner sleeve, at a position adjacent one end thereof.

## BRIEF DESCRIPTION OF THE DRAWINGS

These features will be better understood by reference to the accompanying drawings which illustrate one of the preferred embodiments of the invention as it is used in latching an illuminated pushbutton cap of an electrical switch which is housed in a cartridge on a panel.

In the drawings:

FIG. 1 is a part longitudinal cross-sectional view of the cap and cartridge assembly, including the latch mechanism therefor;

FIG. 2 is another part cross-sectional view of the assembly in FIG. 1, illustrating the operation of the latch mechanism as the cap is withdrawn;

FIG. 3 is a further part longitudinal cross-sectional view illustrating a further stage in the operation of the latch mechanism as the cap is withdrawn;

FIG. 4 is a part longitudinal cross-sectional view of the cap alone, illustrating the condition of the latch mechanism when the cap is disengaged from the cartridge;

FIG. 5 is a still further part cross-sectional view of the cap and cartridge assembly as the cap is reengaged in the cartridge;

FIG. 6 is a still further part longitudinal cross-sectional view of a later stage in the reengagement process; and

FIG. 7 is an exploded view in perspective of those components of the latch mechanism which are carried on the cap.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings it will be seen that the cartridge **2** comprises a pair of rectangular metal tube sections **4** and **6** which are telescoped with one another so that the cartridge can be mounted in an opening **8** of a panel **10** in the manner described in our copending application Ser. No. 826,964 filed on even date herewith. The inner tube section **4** has an outturned flange **12** thereon and according to the technique described in our above application, the edge of the panel opening **8** is clamped between the flange and the adjacent end **6'** of the outer tube section when the cartridge is mounted therein. The cap **14** is thereafter slidably inserted in the inner section **4** to engage the switch, which, as seen, is represented only by a pair of spring-loaded contact posts **16** carried in an insulative mounting block **18** in the inner section. See our above-mentioned copending application for a more detailed description of the cartridge and the switch. Also see our other copending application Ser. No. 826,963 which was also filed on even date herewith, for a more detailed description of the rectangularly shaped elastomeric gasket **18** which is clamped between the flange of the inner section and the outer face of the panel, to form a moisture seal for the cap when it is engaged in the cartridge.

The posts **16** are carried in a pair of transversely spaced and mutually parallel bores **20** in the block, and have a third such bore **22** interposed therebetween which is occupied by an elongated Allen head screw, only the head **24** of which appears in the drawings. The head **24** is flanged to abut the upper face **18'** of the block and has a stepped, deeply recessed socket **26** therein which has a characteristic hexagonal Allen head cross section in the bottommost portion **28** thereof. The remainder of the socket has a cylindrical cross section, however, and is relatively diametrically enlarged to receive an elongated latching shaft **30** projecting from the cap. The shaft slidably interengages in an intermediate portion **32** of the socket after passing through a still larger cavity **34** which forms the mouth of the socket. The cavity has a circumferential lip **36** at the opening thereof, and both the inner shoulder **38** of the lip and the lower end wall **40** of the cavity is chamfered to cooperate with the latch components of the shaft, as shall be explained hereinafter. The inner peripheral surface **42** of the lip is right angularly disposed, however, with respect to the outer face **44** of the lip.

The cap comprises a rectangular molded plastic tube section **46** which has an insulative mounting base **48** interconnected with the insertable end thereof. The base has three transversely spaced and mutually parallel bores **48'** and **48''** therein which are aligned with the bores in the cartridge and transversely interconnected with one another by rabbetted slots **50** opening therebetween. Two bulbs **52** are slidably engaged in the countersunk right and left-hand bores **48'** of the base, to illuminate the projecting end of the tube **46**. The bulbs are electrically interconnected with one another through the medium of a resilient, apertured U-shaped bus bar **54** carried on the shaft. The shaft is slidably engaged in the intermediate bore **48''** of the base, to project from the cap, and has the bus bar carried thereon so that it is received in the rabbetted portions of the slots **50**, to make contact with the conductive jackets **52'** of the bulbs. Thus, when the bulbs also make contact with the spring loaded posts **16** in the cartridge, they may be jointly energized by a circuit closed through the medium of the shaft, or some component thereof. The resulting illumination serves to improve the visibility of a skirted legend cover **56** applied over the projecting end of the tube **46**.

The latching shaft **30** has an elongated cylindrical rod **58** at the core thereof which is rigidly secured to a thick plastic beam **60** molded into the body of the tube **46** at a central location within the interior thereof. The rod has a flange **62** on the lower or relatively projecting end thereof, and a pair of spaced circumferential grooves **64** and **66** in the body thereof, the upper shoulder **68** of the land **70** between which is chamfered in the same manner as the shoulders **38** and **40** in the mouth of the cavity **34** of the screw **24**. In addition, the upper or inlying end portion **58'** of the rod has a reduced cross section which is adapted to pass through an aperture **72** in the beam. After the portion has been received in the aperture, the end of it is peened to "rivet" the rod to the beam. In advance of this step, however, the various latch components occupying the remainder of FIG. **7**, are slidably engaged on the rod and loaded into the intermediate bore **48''** of the base with the rod.

First to be slidably engaged on the rod is a coiled spring **74** and a pair of biasing sleeves **76** and **78** which are slidably engaged on one another and relatively yieldably biased by a larger diameter spring **80** interposed therebetween. The inner sleeve **76** is substantially coextensive in length with the body of the rod lying between the flange **62** and the reduced upper end portion **58'** thereof. Also, the forward end portion **76'** of the bore in the inner sleeve is considerably enlarged to accommodate the smaller diameter spring **74** which is caged between the shoulder **82** of the enlargement and the flanged end **62** of the rod. The remainder of the sleeve has diametrically opposed and axially extending slots **84** therein which terminate just short of the enlargement **76'** so that the ends **84'** of the slots form stops for a pair of detent balls **86** which are slidably engaged therein. The balls are retained against the ends of the slots by the outer sleeve **78** which is shorter in length and yieldably biased by the larger spring **80** into abutment with the balls. The spring **80** is caged between a raised circumferential rib **88** on the outer sleeve and the shoulder **90** of a rabbetted circumferential flange on the rearward or inlying end portion of the inner sleeve **76**. Before the rod is secured to the beam **60** of the tube **46**, moreover, the U-shaped bus bar **54** is snapped into a circumferential groove **94** in the inlying end portion **76'** of the inner sleeve, and a resilient shock washer **96** is passed onto the body of the rod, over the reduced end portion **58'** thereof, to be interposed between the beam and the inlying end of the inner sleeve. The bus bar has diametrically opposing tabs (not shown) which project inwardly of the aperture therein, to interengage in the slots **84** of the inner sleeve and fix the angular orientation of the bar on the shaft.

When the shaft **30** is disengaged from the socket **26** of the screw **24**, and the latch mechanism is in a normal state, the inner sleeve **76** is abutted against the shock washer **96**, and the washer in turn against the beam **60**, and the detent balls **86** are positioned on the land **70** in a captive state between the ends **84'** of the slots **84** and the forward portion **78'** of the outer sleeve **78**. See FIG. **4**. Likewise, the rod is yieldably biased in relation to the sleeves, in the forward direction indicated by the arrow **98** in FIG. **5**, but is retained within the sleeves by the abutted condition of the inner sleeve **76** with the beam **60**. However, when the cap is advanced into the open end of the cartridge, in the direction of the arrow, and the shaft is inserted into the socket of the screw, and engaged in the intermediate portion **32** thereof, the balls abut the face **44** of the lip **36** and are rearwardly displaced in relation to the rod against the bias **80** on the outer sleeve **78**. See FIG. **5**. Ultimately, however, the rearward groove **64** of the two grooves **64** and **66** registers with the balls, and the balls are displaced by the lip into the groove; whereafter the inner peripheral surface **42** of the lip retains the balls in the relatively retracted position thereof while they enter the mouth of the socket under the driving force accumulated in the spring **80**. Still later, however, when the balls reach the cavity **34** of the mouth, they are released into the cavity by the counteraction of the chamfered shoulder **68** of the groove to the force of the outer sleeve. Simultaneously, the rib **88** of the sleeve abuts the face of the lip and further travel of the sleeve is thereafter prohibited in the direction of the arrow **98**. Moreover, the balls have come under the influence of the inner sleeve **76**, and as soon as the applied pressure on the cap is released, the accumulated compression of the spring **74** drives the balls into abutment with the shoulder **38** of the lip as the inner sleeve and rod are returned to the normal condition of FIG. **4**. The cap is now latched against disengagement from the cartridge, although it

can be displaced in either direction of reciprocation against the bias on the springs, within the longitudinal extent of the land to each side of the balls. See FIG. 1.

Should it become necessary or desirable to remove the cap from the cartridge, a light finger grip on the cap enables it to be withdrawn in the direction of the arrow **100** in FIGS. **2** and **3**, to reverse the operation described above. Thus, when the forward groove **66** registers with the balls, the shoulder **38** of the lip drives the balls into the groove and they are driven past the lip by the inner sleeve, as the inner peripheral surface **42** of the lip retains them in the groove. Once they are outside the mouth of the socket, however, the accumulated compression of the spring **74** urges them back into their relatively raised position on the land, where they are retained by the outer sleeve as indicated in FIG. **4**.

What is claimed is:

**1**. In an electrical device, a relatively stationary member having flange means thereon forming abutments on the opposite sides thereof, an elongated element which is longitudinally reciprocable in relation to the member transverse to the flange means, and which has a pair of longitudinally spaced recesses therein forming a land therebetween which is spaced from the flange means on the member as the land passes the flange means in the reciprocable motion of the element, slidably guided detent ball means on the land, and a pair of stop means which are slidably mounted on the element over the recesses, and yieldably biased relatively toward one another along the longitudinal axis of the element, with the detent ball means retained therebetween so that the detent ball means tends to remain on the land, said stop means being operatively insertable into the space between the land and the flange means, and said detent ball means being larger in dimension than the width of the space, but adapted to shift from side to side of the flange means under the bias of one of the stop means, when the detent ball means is displaced into the adjacent recess against the bias of the respective stop means as a consequence of abutting the adjacent side of the flange means as the element is reciprocated in relation to the member.

**2**. The device according to claim **1** wherein one of the stop means has a flange thereon which abuts the adjacent side of the flange means on the member to yieldably limit the travel of the element in the direction of reciprocation corresponding to the bias on the one stop means, after the one stop means has entered the space between the land and the flange means on the member, and the detent ball means has shifted to the other side thereof.

**3**. The device according to claim **2** wherein the other stop means is slidably engageable in the relatively stationary member.

**4**. The device according to claim **3** wherein the relatively stationary member has a socket therein which has a circumferential lip interposed around the mouth thereof, forming abutments on the opposite sides thereof, and the other stop means is slidably engageable and disengageable in and from the socket as the element is reciprocated into and out of the same.

**5**. The device according to claim **1** wherein the stop means comprise a pair of sleeves which are slidably engaged on one another on the element.

**6**. The device according to claim **1** wherein the element comprises an elongated rod having flanges on the ends thereof, and a pair of spaced circumferential grooves therein which are interposed between the flanges on the rod.

**7**. The device according to claim **6** wherein the stop means comprise a pair of sleeves which are slidably engaged on one another on the rod, the inner sleeve normally abutting the flange on one end of the rod and having the flange on the other end of the rod slidably engaged therein, and there being a resilient compression element caged between the latter flange on the rod and the inner sleeve, and another resilient compression element caged between the outer sleeve and a flange on the inner sleeve.

**8**. The device according to claim **7** wherein the inner sleeve has a pair of diametrically opposed, longitudinally extending slots therein, and there is a pair of detent balls on the land which are slidably guided in the slots at a position adjacent one end thereof.

**9**. The device according to claim **7** wherein the relatively stationary member has a socket therein which has a circumferential lip interposed around the mouth thereof, forming abutments on the opposite sides thereof, and the inner sleeve is slidably engageable and disengageable in and from the socket as the rod is reciprocated into and out of the same.

**10**. The device according to claim **1** wherein the relatively stationary member has an electrical switch assembly therein, and the reciprocable element has a pushbutton cap thereon which operates the switch on reciprocation of the element.

**11**. A pushbutton cap which is releasably engageable in an electrical device having flange means on a relatively stationary member therein, forming abutments on the opposite sides thereof, said cap having an elongated rod projecting therefrom which has a pair of longitudinally spaced grooves therein forming a land therebetween, slidably guided detent ball means on the land, and relatively inner and outer sleeve means which are slidably engaged on one another on the rod over the grooves and yieldably biased relatively toward one another along the longitudinal axis of the rod, with the detent ball means retained therebetween so that the detent ball means tend to remain on the land between the grooves, but are displaceable into either of the grooves against the bias of the adjacent sleeve means when a force is applied to the detent ball means in the longitudinal direction of the rod opposed to the bias of the sleeve means, as the rod is relatively reciprocated in the opposite longitudinal direction thereof.

**12**. The pushbutton cap according to claim **11** wherein the inner sleeve means has a pair of diametrically opposed, longitudinally extending slots therein, and a pair of detent balls are slidably engaged in corresponding ends of the slots at positions opposite the land.

**13**. The pushbutton cap according to claim **11** wherein the rod has a flange on the free end thereof, and the inner sleeve means is normally abutted against the cap with the flange of the rod slidably engaged therein, there being a resilient compression element caged between the flange and the inner sleeve means, and another resilient compression element caged between the outer sleeve means and a flange on the inner sleeve means.