

68 J. W. AMIS, JR., ET AL 3,4
ALTERNATE LATCH AND UNLATCH AND EJECT MECHANISM
OPERATED BY UNIDIRECTIONAL FORCES

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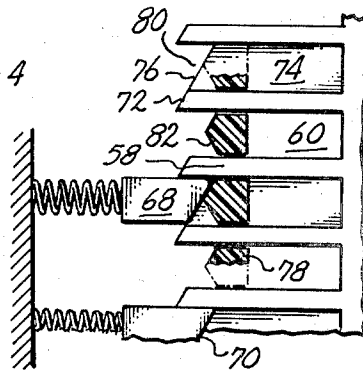


Fig. 7.

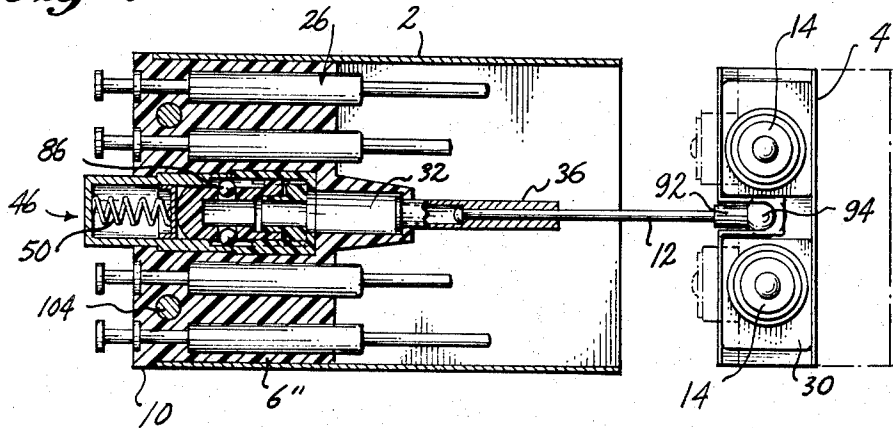


Fig. 8.

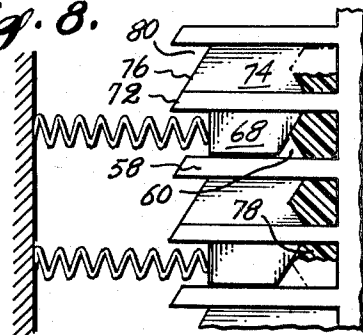
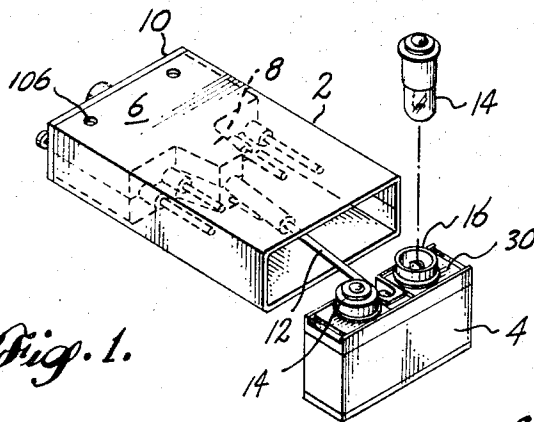


Fig. 1.



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1

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ALTERNATE LATCH AND UNLATCH AND EJECT MECHANISM OPERATED BY UNIDIRECTIONAL FORCES

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ABSTRACT OF THE DISCLOSURE

A mechanism is disclosed for alternately latching and unlatching a reciprocable element against reciprocation. The mechanism includes a pair of interlocking axially opposed and relatively axially shiftable members, which in use, are unlocked and relocked at alternate positions spaced along the axis thereof. It also includes means whereby the relatively oscillatory motion of the members between the alternate positions thereof, is used to alternately advance and release detent means into and from engagement with the element. Further features include the fact that the unlock and relock means may be responsive to unidirectional forces successively applied along the axis of the members; and the fact that the mechanism may also displace the reciprocable element in one direction of its reciprocation, each time that the detent means is released from engagement therewith.

This invention relates to releasable latch mechanisms for reciprocable elements and in particular to a mechanism of this type which operates to alternately latch and unlatch and eject the element in response to successive applications of a unidirectional force.

There is a general need for such a mechanism, but the need is best illustrated in the electrical industry. In this industry, parts are often enclosed in small tube-like cartridges on a panel. The open end of each cartridge has a cap which is inserted and latched in the end to face outwardly of the panel. Thus, when it is desired to replace worn or spent parts in the cartridge, without removing the cartridge as a whole, it is also necessary to unlatch and remove the cap at the same time. Removing the cap is not always an easy operation, however. For example, if the cap is fully recessed in the cartridge or small in size, or both, it may be difficult to remove it without the assistance of special extraction tools, or special grips and the like built into the face of the cap. Moreover, it may be that for appearance sake, or for the sake of simplicity and economy, the cap has a plain face which is relatively free of protrusions and indentations, and which is drawn up flush with the face of the panel so as to be as unobtrusive as possible. In all such cases, therefore, the operator may find that the only practical and convenient way of removing the cap is to do so with a force corresponding to that with which it is returned to the cartridge, that is, with one which is applied in the relatively inward direction.

A principal object of the invention is to provide a latch and unlatch and eject mechanism for a cap or other such element which is confined in this manner. A related object is to provide a mechanism of this type which makes it possible to unlatch and eject the cap with the same motion that is used in returning the cap to the cartridge. Another object is to provide a mechanism of this type and capability which operates in a positive and reliable manner in latching the cap in the cartridge, to guard against internal forces tending to force the cap out of the cartridge. Still another object is to provide such a mechanism as this which operates, on the other hand, when

2

the cap is unlatched, to force the cap from the cartridge in the relatively outward direction, for purposes of removing it more easily. A still further object is to provide a mechanism of these characteristics which is capable, however, of limiting the extent to which the cap is ejected from the cartridge, should it be desired to remove the cap in more than one step. Other objects include the provision of a limited ejection arrangement of this nature in which the cap is articulated to be swung aside from the cartridge, or otherwise manipulated to facilitate the task of removing and replacing the part or parts in question.

Generally speaking, these and other objects are realized in accord with the invention, by slidably guiding the cap to reciprocate between positions relatively within and without the cartridge, and yieldably biasing it in the direction relatively outward of the cartridge, under the control of a latch and unlatch and eject mechanism which is responsive to successive applications of force in the direction opposed to the bias, alternately to latch the cap against reciprocation at its position relatively within the cartridge, and to unlatch and eject the cap to its position relatively without the cartridge. The terms "within" and "without" are used in the sense of denoting, firstly, a condition in which the cap is substantially entirely recessed in the cartridge so as to present a difficult task in removing it without the use of a tool or grip of the nature mentioned; and, secondly, a condition in which the cap at least in part projects from or is removed from the cartridge, so as to enable it to be readily and easily manipulated, as by hand, for purposes of reaching parts or objects otherwise enclosed by the cap in the cartridge. In most instances, the mechanism is arranged to position the cap substantially flush with the mouth of the cartridge and/or the face of the panel in the first condition, and to shift it to a new position relatively outwardly from such position in the second condition. The mechanism may be responsive to the application of force on the cap itself, or it may be that the force is applied to some part of the enclosing medium around the cap. Also, the part or parts to be replaced may be mounted in the cap, or in the cartridge, or conceivably, reciprocably connected between the two.

The latch and unlatch and eject mechanism employs latch means which are operatively interconnected with a jaw clutch mechanism which is operated as a spring-biased cam-ratchet device. The applied force is operative to rotate the clutch members relatively from one angularly related ratchet position to the next. The clutch members simultaneously relock with one another, and each time they do so, the latch means are alternately actuated or deactuated with respect to the cap. Moreover, each time the latch means are deactuated, the bias on the cap is operable to eject it from the cartridge. To limit the extent of its ejection, however, there is a limit stop in the cartridge to control the travel of either the bias or the cap, or of both.

According to preferred features of the invention, the jaws of the clutch members are adapted so that in rotating and relocking with one another, from one position to the next, one clutch member is caused to shift in relation to the other member between alternate positions spaced along the axis of the members. The alternate shifting action of this one member is used to actuate and deactuate a detent device in the latch means, and may also be used on the deactuation stroke to eject the cap as it becomes unlatched. In such a case, the ejection of the cap is limited to the extent of the shift, however, and accordingly, it is preferred to yieldably bias the cap by other or additional means if possible, which are capable of a greater stroke.

The accompanying drawings illustrate a practical application of the invention in which the detent device takes the form of a pair of caged balls that are alternately caged and uncaged by the shift of the clutch member, there being a reciprocable catch element on the cap which is recessed to receive the balls when they are caged, and slidably guided to slip between the balls when they are uncaged.

In the drawings,

FIGURE 1 is a view in perspective of an illuminated indicator cartridge in which the indicator cap is articulated with respect to the catch element to enable the cap to be swung into planes relatively transverse the element's plane of movement;

FIGURE 2 is an exploded view in perspective of the operating components for the cap, including a mounting block for the jaw clutch mechanism;

FIGURE 3 is an exploded enlarged view in perspective of the jaw clutch mechanism;

FIGURE 4 is an assembled view in perspective of the components seen in FIGURE 2, but with the upper half of the mounting block removed;

FIGURE 5 is a part cross-sectional view of the assembly in FIGURE 4 when in the latched condition;

FIGURE 6 is a part schematic view of the jaws of the jaw clutch mechanism, illustrating their interlocking relationship in the condition of FIGURE 5;

FIGURE 7 is a view similar to that of FIGURE 5, but showing the assembly in the unlatched and post-ejected condition;

FIGURE 8 is a part schematic view like FIGURE 6, but illustrating the jaws in the condition of FIGURE 7; and

FIGURE 9 is a part elevational view of a panel arrangement using the cartridge of FIGURE 1.

Referring, firstly, to FIGURE 1, it will be seen that the cartridge is comprised of an open-ended rectangular tube 2 of plastic or metal material which serves as a container for the cap 4 and its operating components. These components are housed in a rectangular block 6 of insulative plastic material with a protruding nose 8. The block is inserted nose-first into the rear of the tube and sized to fit snugly in the tube up to a point limited by a flange 10 around the rear of the block. Interconnecting the cap with the block is an elongated connecting rod 12 which, as will be explained more fully hereafter, is slidably guided in the block to enable the cap to be inserted and withdrawn from the front of the tube. The cap carries a pair of bulbs 14, each of which is releasably engaged in a socket 16 to be removed from the cap after it has been swung into the attitude shown.

For purposes of assembling the components, the block is constructed in two half sections 6' and 6'' which join with one another in the manner seen in FIGURE 2. Each of these sections has a series of mutually parallel grooves 8'-22' which extend from the front to the back of the block in the mating faces of the sections. The grooves register with and complement one another when the sections are joined, and together form five tube-like passages 8-22 through the block, each of which has a generally cylindrical cross section, although the rearward portion 4 of the centermost passage 20 is in part square or rectangular in section. The four outer passages 18, 19, 21, 22 serve as loading tubes for four spring-biased terminal posts 26. As seen, each post has a projecting double angled head 28 which provides a fixed contact to which an electrical lead may be attached for the application of current to or through the post. The current provides means of energizing the bulbs and, for this purpose, the bulbs are inserted in the cap to depress and thus make continuous contact with the inside posts when the assembly is in the latched condition. The current is circulated through the bulbs by a brass contact plate 30 on the rear face of the cap which operates to make contact with the

outside posts and thus to close a circuit through each bulb. See FIGURE 4.

The latch and unlatch and eject components are loaded in the centermost passage 20. In addition to its square or rectangular portion 24, the centermost passage also has a cylindrical center portion 32, and a cylindrical forward portion 34 of slightly lesser diameter than the center portion. In the assembly, the forward portion 34 is loaded with an elongated carriage sleeve 36 which has the rod 12 slidably engaged therein. See FIGURES 4, 5 and 7. The sleeve is slidably guided in the mouth 40 of the passage, and can be withdrawn from the block in the manner of FIGURE 7, where a flange 38 at its rear telescopically engages with the nose of the block to limit further withdrawal. If, on the other hand, it is depressed into the block, in the manner of FIGURE 5, the flange eventually escapes the bore of the portion 34 and enters the center portion 32. This latter portion is loaded with a jaw clutch mechanism comprised of the three sleeve-like members seen in FIGURE 3. The left and right hand members 42 and 44 are equipped with interlocking male and female jaws, and operate as the slave and driver members, respectively, in a cam-ratchet device fashioned from the members. The center member 43 is slidably engaged within and between the male and female members, and operates at the instance of the sleeve 36 to unlock the members against the bias of a caged spring unit 46. The caged spring unit is loaded into the rear portion 24 of the passage, and comprised of a cube-collared cylinder block 48, and a coil spring 50 and piston-cup 54 inserted in the cylinder 52 thereof. As seen in FIGURES 5 and 7, the block 48 and the female clutch member 44 are oppositely disposed in the passage 20, and the cylindrical stem 56 of the male clutch member 42 is slidably received in the forward end of the cylindrical 52, so as to confine the spring and cup assembly. Thus, the male member 42 is urged into interlocking relationship with the female member by the spring, and the clutch release member 43 is interposed between it and the sleeve 36 to be advanced by the sleeve, against the spring, each time the flange 38 abuts its forward end.

Returning to FIGURE 3, it will be seen that the female clutch member 44 has a series of axially extending ribs 58 which are angularly spaced about the inside surface of the member. The grooves 60 formed between these ribs serve as guides for a fluted collar 62 formed around the forward end of the clutch release member 43. The latter member is thus able to slide back and forth along the axis of the clutch members between the jaw of the male clutch member and an annular lip 64 raised around the forward inside edge of the female member. The jaw of the male member has a reduced cylindrical section 66 about which there is a plurality of axially extending ribs 68, the forward ends of which project slightly to the front and are chamfered to give each of the ribs the structure of a tooth. Similarly, the rear end of each of the ribs 58 in the female member 44 is chamfered to provide teeth of matching slope so that in use the chamfered edges 70 and 72 of the members may slide over one another for the cam-ratchet action. In addition, the ribs 68 on the male member are alternately spaced with respect to those on the female member and every other groove 60 in the female member has a raised fillet portion 74, the profile face 76 of which is also chamfered to correspond with the profile face 72 of the ribs 58. The ribs 78 of the clutch release member may ride over the fillet portions 74 to seek the bottom of each groove 60; whereas the ribs 68 on the male clutch member 42 are intercepted by the fillet portions 74 so that, in effect, at every other angular position of the male clutch member, it may penetrate no further than the notches 80 (FIGS. 6 and 8) formed by the fillet portions 76 in the female member.

Referring now to FIGURES 5-8, it will be seen that when the mechanism is in the latched condition, as in FIGURE 5, the ribs 68 on the male clutch member are

engaged in the notches 80, and the ribs 78 on the clutch release member are displaced to the rear, over the fillet portions 74, to the full extent permitted by the male ribs. The rear profile edge 82 of the collar 62 around the clutch release member 43 is dentated so that the ribs 78 are chamfered over two flanks to correspond with the chamfer of the male and female ribs. When a force is applied to the carriage sleeve 36 in the rearward direction, the clutch release member 43 operates to disengage the male ribs 68 from the notches 80 against the bias of the spring 50. As soon as the chamfered edges 70, 72, 82 of the ribs 58, 68, 78 on the three members 42-44 are aligned with one another, the spring 50 has a camming effect on the male ribs 68 and they are caused to slide over the female ribs 58 and to rotate the male member into the deeper grooves 60. In these latter grooves, the male ribs again encounter the ribs 78 on the clutch release member 43 and force the latter into the position of FIGURE 8. Simultaneously, the deeper penetration of the male member 42 operates to displace it in an axial sense with respect to the female member 44. On the other hand, when the carriage sleeve 36 is applied once more to the clutch release member 43 and the male member 42 is rotated to the next relatively angular position, the fillet portions 74 produce an opposite displacement and, accordingly, it is evident that the male clutch member oscillates with respect to the female member as the mechanism is alternated between the positions of FIGURES 6 and 8.

Reference to FIGURES 5 and 7 will show how this oscillatory action is used to latch and unlatch and eject the cap. The thick cylindrical stem 56 of the male member 42 has a pair of diametrically opposed holes 84 which contain a pair of balls 86. As the male member oscillates and rotates in the center passage 20, the balls 86 are alternately caged and uncaged by the fact that the mouth of the cylinder 52 is stepped or rabbeted to form an annular recess 88 for the balls. Thus, as the male member is forced into the cylinder against the bias of the spring, the balls 86 are squeezed into their holes 84, as in FIGURE 5, but when the male member is ejected by the spring, as in FIGURE 7, the balls are released to move outwardly into the recess 88.

The radially oscillatory action of the balls is employed, in turn, as detent means for the rod 12 on the cap. The rod has a flanged head 90 and is of sufficient length that when the cap is inserted within the cartridge, as in FIGURE 5, its head 90 takes up a position on the opposite side of the balls from the cap. At the same time, the balls are squeezed into their holes by the relatively rearward displacement of the male member 24 into the cylinder 52 and on releasing the pressure on the carriage sleeve, the rod and thus the cap are effectively latched in the cartridge. On the other hand, when pressure is applied a second time, the relatively forward displacement of the male member into the female member enables the balls to release the rod and it can be slipped past the balls, as in FIGURE 7.

The positional relationship of the carriage sleeve 36 with the clutch release sleeve and the cap, may also serve to eject the cap from the cartridge. As seen in FIGURE 5, the carriage sleeve 36 is effectively confined between the clutch release sleeve 43 and a collar 92 on the forward end of the rod. The collar 92 flares into a spherical head 94 and this in turn is lodged in a spherical socket 96 formed in a slot 98 on the cap. See FIGURE 2. Thus, when the return action of the spring 50 thrusts the clutch release member 43 into the deeper grooves 60 of the female sleeve, the clutch release sleeve is abutted against the carriage sleeve and this in turn against the collar 92 on the rod. The travel of the male sleeve is thus transmitted to the cap and, in accord with the invention, may be sufficient to eject enough of the cap that it may be pinched between one's fingers or the jaws of a pincher tool for purposes of removing it from the cartridge. However, in the illustrated embodiment, the outside spring-biased terminal posts 26 have considerably greater travel and oper-

ate to eject the cap well beyond the mouth of the cartridge, to a point where it can be readily gripped and removed to the extent illustrated in FIGURE 7.

To maintain the interconnection between the cap and the carriage sleeve when the cap is removed to the extent illustrated in FIGURE 7, the sleeve 36 is countersunk at its rearward end 100 so that the flanged head 90 of the rod 12 may telescope within the sleeve 36.

The cartridge can be stacked on top of one another in a panel 102, as in FIGURE 9. As seen, the cartridges are vertically aligned so that the caps are substantially flush with the face of the panel and a pair of bolts 104 are passed down through pairs of superposed holes 106 in the cartridges to secure them to one another. Should there be necessity for changing one of the bulbs, the cap in which it is located can be removed in the manner of FIGURE 1 and returned to its cartridge without disturbing the remainder of the stack.

While the described embodiment is illustrative of the invention, it is evident that many changes and additions can be made in and to the embodiment without departing from the scope and spirit of the invention as defined in the following claims.

We claim as our invention:

1. In combination, a reciprocable element, and a releasable latch mechanism for the element which is comprised of a pair of axially opposed jaw clutch members which are axially shiftable and rotatable in relation to one another and yieldably biased to interlock with one another in a succession of spaced angularly related positions about their axis, a clutch release member which is operable to unlock the members against the force of their bias, there being a set of cam surfaces on the three members which cooperate under the force of the bias to rotate the unlocked clutch members in relation to one another from one angularly related position to the next, and to relock the members in such latter position, and latch means operatively interconnected with the three members to alternately latch and unlatch the element against reciprocation as the clutch members are successively unlocked and relocked with one another.

2. The combination according to claim 1 wherein the jaws of the clutch members are adapted so that in rotating and relocking with one another, from one position to the next, one clutch member is caused to shift in relation to the other member, between alternate positions spaced along the axis of the members, and the latch means are alternately actuated and deactivated by the oscillation of the one clutch member.

3. The combination according to claim 2 wherein the latch means take the form of detent means.

4. The combination according to claim 3 wherein the detent means take the form of caged balls which are alternately caged and uncaged by the oscillation of the one clutch member.

5. The combination according to claim 4 wherein the one clutch member is in the form of a sleeve having the reciprocable element received therein, and the balls are slidably guided in the sleeve to alternately latch and unlatch it from the element as the sleeve oscillates in relation to the other clutch member.

6. The combination according to claim 1 wherein the jaws of the clutch members are adapted so that in rotating and relocking with one another, from one position to the next, one clutch member is caused to shift in relation to the other member, between alternate positions spaced along the axis of the members, and the reciprocable element is operatively interconnected with the one clutch member to be displaced in the direction of the bias each time it is unlatched.

7. The combination according to claim 6 wherein the one clutch member and the clutch release member are in the form of axially aligned sleeves having the reciprocable element received therein, and the clutch release member is operatively interconnected with the reciprocable ele-

ment to unlock the clutch members in response to the application of force on the reciprocable element in the direction opposed to the bias.

8. The combination according to claim 1 wherein the three members are in the form of axially aligned sleeves having the reciprocable element received therein, and the jaws of the clutch members are adapted so that in rotating and relocking with one another, from one position to the next, one clutch member is caused to shift in relation to the other member, between alternate positions spaced along the axis of the members, said latch means being in the form of caged balls which are alternately caged and uncaged, and correspondingly alternately latched and unlatched from the reciprocable element as the one clutch member oscillates, and the clutch release member being operatively interconnected with the reciprocable element to unlock the clutch members in response to successive applications of force on the reciprocable element in the direction opposed to the bias, and conversely on discontinuing each applied force, to displace the reciprocable element in the direction of the bias, to an extent which varies in accord with the oscillation of the one clutch member.

9. The combination according to claim 8 wherein the reciprocable element is housed in a cartridge and slidably guided to be shifted between alternate positions relatively within and without the cartridge as the force is successively applied to the element from a point outside the cartridge in the direction relatively inward of the same.

10. In combination, a cartridge having a cap in one end thereof which is slidably guided to reciprocate between alternate positions relatively within and without the cartridge, and yieldably biased in the direction relatively outward of the cartridge, and a latch and unlatch and eject mechanism in the cartridge which is responsive to successive applications of force against the bias on the cap, to alternately latch the cap against reciprocation at its position relatively within the cartridge, and then unlatch and eject the cap to its position relatively without the cartridge, the cap having an elongated catch element which is received in the latch and unlatch and eject mechanism, and slidably guided to remove the entire body of the cap from the cartridge after it has been ejected to its position relatively without the same.

11. The combination according to claim 10 wherein the cap is pivotally connected with the catch element to be swung into transverse positions after the body of the same has been removed from the cartridge.

12. The combination according to claim 11 wherein the cartridge has an electrical contact element therein for contact with the cap at its position relatively within the cartridge, and there is an electrically operated device in one or the other of the cap and the cartridge which is actuated by such contact.

13. The combination according to claim 12 wherein the contact element takes the form of a yieldably biased terminal post which is mounted in the cartridge to bias the cap in the direction relatively outward of the cartridge.

14. In combination, a first reciprocable element, and means for alternately latching and unlatching said first

reciprocable element against reciprocation, including a pair of interlocking axially opposed and relatively axially shiftable members, means including a second reciprocable element which is responsive to successively applied unidirectional forces to unlock and relock the members at alternate positions spaced along the axis thereof, detent means advanceable and retractable with respect to said first reciprocable element, into and from engagement therewith, and means responsive to the relatively oscillatory motion of the members, between the alternate positions thereof, to alternately advance and release the detent means into and from engagement with said first reciprocable element.

15. The combination according to claim 14 wherein the axially opposed members are relatively rotatable about the axis thereof, and have interlocking jaws thereon which are adapted so that as the members relock with one another, from one axially spaced position to the next, the jaws cause them to rotate in relation to one another between angularly related positions spaced about the axis thereof.

16. The combination according to claim 14 wherein the detent means is slidably guided in one of the members and said one member is reciprocable in relation to the other member, and housed in a stepped cage which alternately advances and releases the detent means, into and from engagement with the element, as the one member reciprocates therein.

17. The combination according to claim 14 further comprising means for displacing the reciprocable element in one direction of its reciprocation, each time that the detent means is released from engagement therewith.

18. The combination according to claim 17 wherein one of the members is yieldably biased to interlock with the other member, and operatively interconnected with the reciprocable element to displace the element in the direction of the bias, each time that the detent means is released from engagement therewith.

19. The combination according to claim 14 wherein the unlocking and relocking means are responsive to unidirectional forces successively applied along the axis of the members.

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