Sept. 24, 1968 R. A. MUKAI ET AL 3,402,620

PUSHBUTTON ELECTRIC SWITCH OPERATOR WITH MAINTAINING MECHANISM

Filed Feb. 4, 1966 2 Sheets-Sheet 1

Fig. 1

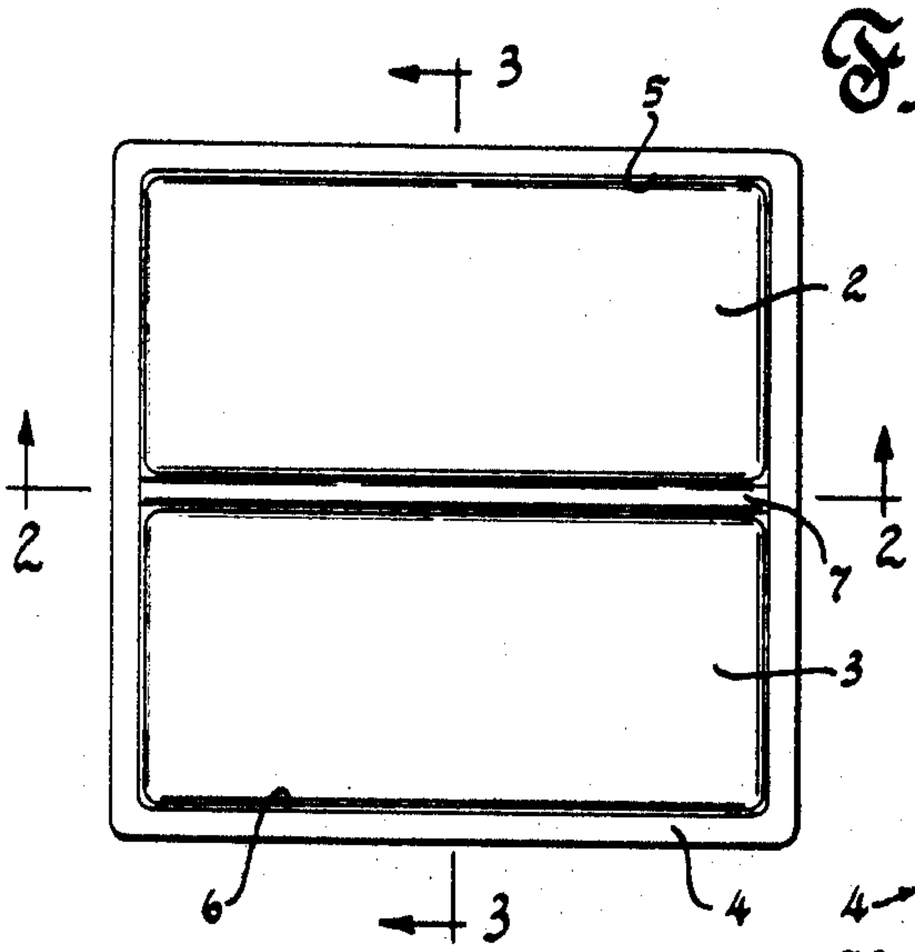


Fig. 2

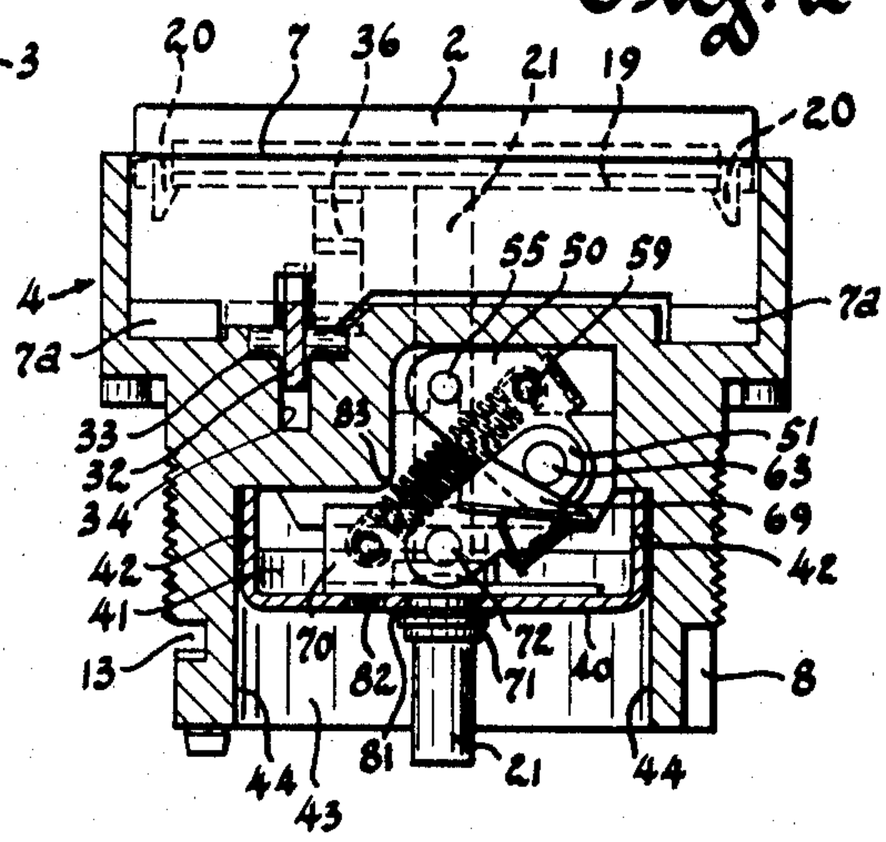


Fig. 3

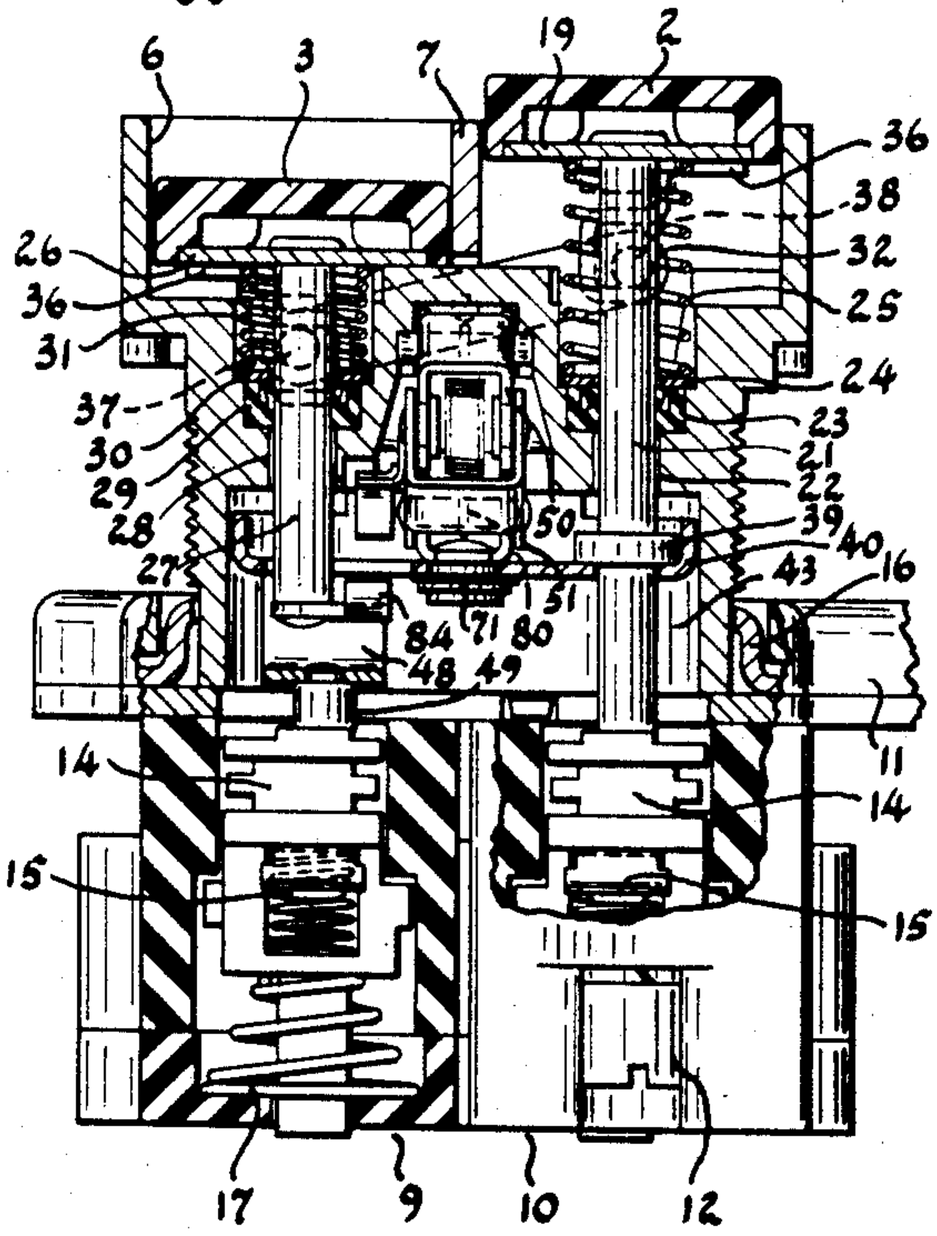
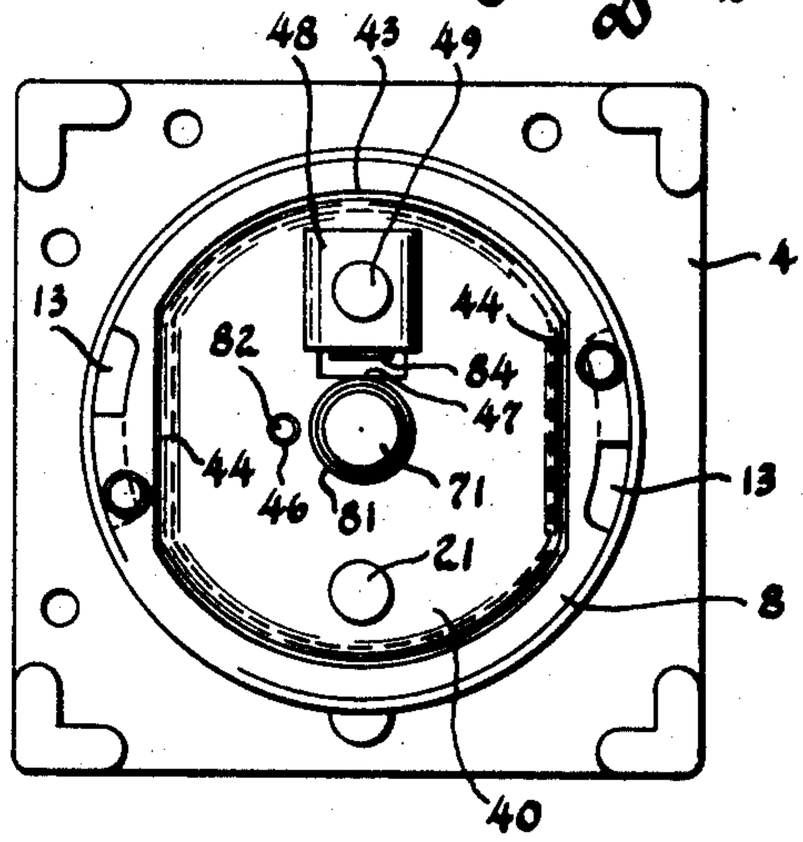


Fig. 4



Sept. 24, 1968 R. A. MUKAI ET AL 3,402,620

PUSHBUTTON ELECTRIC SWITCH OPERATOR WITH MAINTAINING MECHANISM

Filed Feb. 4, 1966 2 Sheets-Sheet 2

Fig. 5

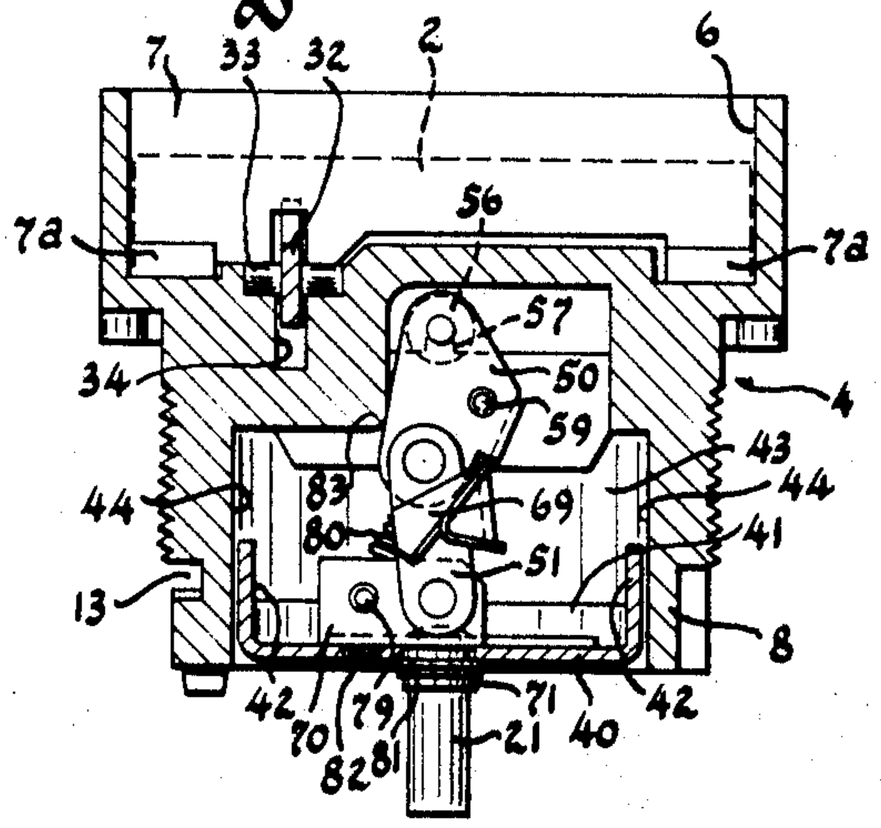


Fig. 6

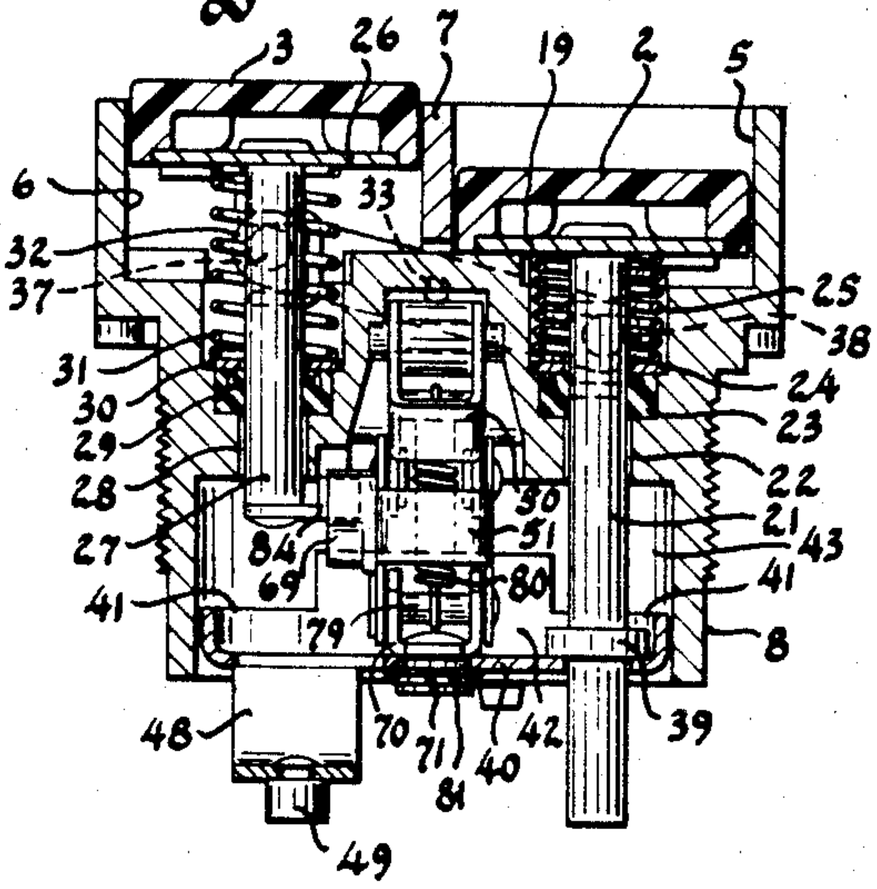
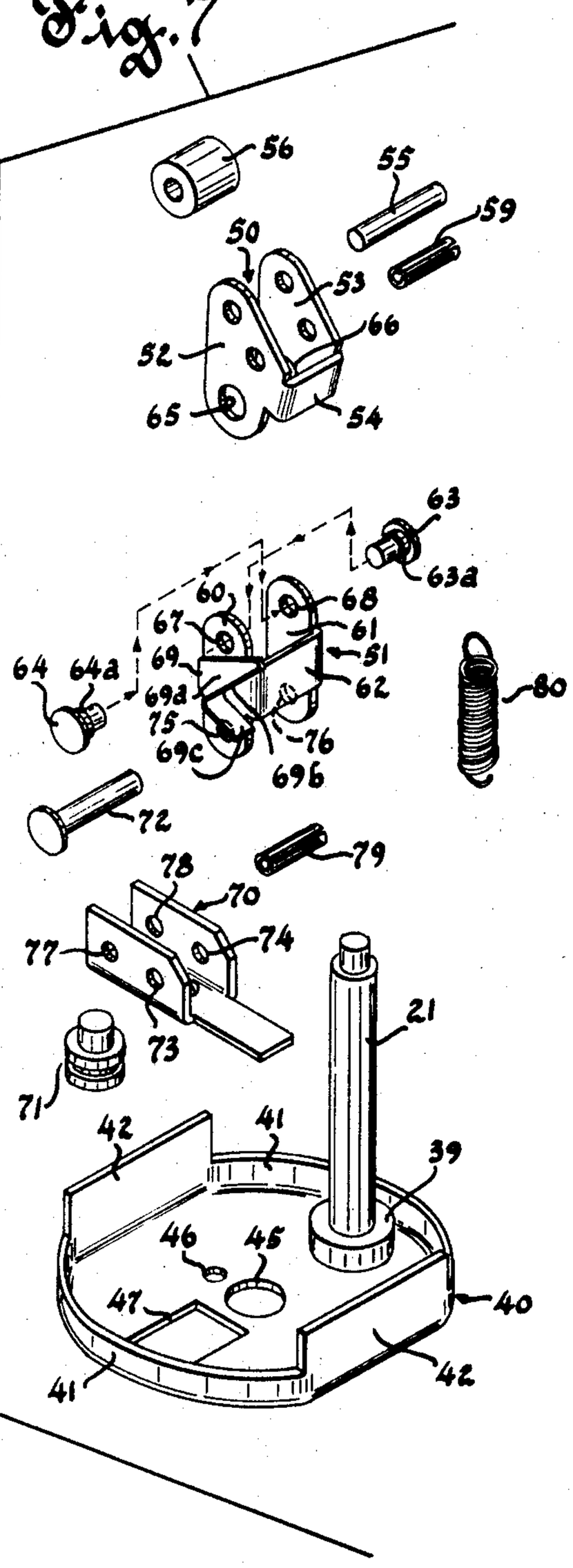


Fig. 7



United States Patent Office

3,402,620

Patented Sept. 24, 1968

3,402,620
PUSHBUTTON ELECTRIC SWITCH OPERATOR WITH MAINTAINING MECHANISM

Roy A. Mukai, Milwaukee, Allan P. Charbonneau, Wauwatosa, Joseph F. Waldorf, New Berlin, and Robert Pearson, Milwaukee, Wis., assignors to Cutler-Hammer, Inc., Milwaukee, Wis., a corporation of Delaware

Filed Feb. 4, 1966, Ser. No. 525,162

9 Claims. (Cl. 74—483)

ABSTRACT OF THE DISCLOSURE

A two-button, one-hole mounting assembly having switch units attached to the rear thereof for reciprocable actuation by one of the buttons. Depression of the actuating button extends a foldable over-center linkage which is biased to travel beyond the center position to abut against a stop to lock the linkage in the extended position and maintain the actuator button depressed. Depression of the second button cams the linkage back to the other side of the center position to allow the linkage to collapse and the actuator button to return.

This invention relates to operating mechanisms for pushbutton type electric switches and more particularly to switches of the oil-tight variety with separable contact blocks and operator assemblies.

An object of this invention is to provide in a compact pushbutton operator a strong and highly reliable mechanism for maintaining a pushbutton mechanism depressed.

It is another object of this invention to provide means for releasing the aforedescribed maintaining mechanism to allow the pushbutton mechanism to return to its original position.

It is still another object of this invention to provide a compact pushbutton operating mechanism in a unitary operator assembly having two pushbuttons effective to move a switching mechanism to opposite positions and having improved means for maintaining the mechanism in one of these positions.

Other objects and advantages of this invention will be evident to those skilled in the art upon reference to the following description and claims.

While the device hereinafter described is adapted to fulfill the objects stated it is to be understood that it is not intended that the invention be confined to the particular preferred embodiment disclosed since it is susceptible of various modifications without departing from the scope of the appended claims.

In the accompanying drawings:

FIGURE 1 is a front elevation view of a pushbutton adaptor for an electrical switch assembly embodying the invention;

FIG. 2 is a sectional view of the adaptor shown in FIG. 1 taken on line 2—2 of FIG. 1;

FIG. 3 is a partially sectional view of the entire switch assembly and illustrates a sectional view of the adaptor of FIG. 1 taken on line 3—3 of FIG. 1;

FIG. 4 is a rear elevation view of the adaptor of FIG. 1;

FIG. 5 is a sectional view taken on line 2—2 of FIG. 1 and is similar to FIG. 2 except that the operating mechanism is shown in another position;

FIG. 6 is a sectional view taken on line 3—3 of FIG. 1 and is similar to FIG. 3 except that the operating mechanism is shown in the position corresponding to that of FIG. 5; and

FIG. 7 is an exploded isometric view of parts of the operating mechanism.

Referring to the drawings, there is shown a unitary pushbutton assembly comprising two rectangular manually operable pushbuttons 2 and 3 mounted in a frame or retainer 4. The retainer has two front facing recesses 5 and 6 formed in the front surface thereof and divided by a wall 7. Wall 7 is fastened to retainer 4 by riveting a pair of tabs 7*a* which extend perpendicular from the lower ends of wall 7. Recesses 5 and 6 loosely and slidingly accommodate pushbuttons 2 and 3, respectively, and are of the depth sufficient to allow the pushbuttons 2 and 3 to be depressed to actuate the mechanism. At the rear of the rectangular front portion of retainer 4 there is an integral cylindrical bushing 8 adapted to be inserted through a mounting hole in a panel or the like. The exterior of bushing 8 is threaded to accommodate a nut (not shown) by which the retainer 4 may be securely fastened to the panel. A pair of contact blocks 9 and 10 are fastened side-by-side to the end of bushing 8 by means of a mounting device 11. Contact blocks 9 and 10 are fastened to the device 11 by means of screws 12. The device 11 includes a rotatable latch ring 16 with a pair of lugs (not shown) which engage a pair of grooves 13 formed near the rear of bushing 8. Each contact block 10 is of a well known type having a pushrod 14 which may be reciprocally actuated to operate electrical contacts 15. A compression spring 17 provides return force to plunger 14. The structure of such contact blocks, the structure of mounting device 11 and the method of mounting the pushbutton assembly are more completely described in the copending application, Ser. No. 520,444, filed Jan. 13, 1966, by Roy A. Mukai, Allan P. Charbonneau, Joseph F. Waldorf and Robert Pearson, now United States Patent No. 3,322,926, and assigned to the present assignee.

Pushbutton 2 is fastened to a plate 19 by means of two lugs 20 (FIG. 2) which snap over the opposite ends of plate 19. A pushrod 21 is riveted to the center of plate 19 and extends downwardly and slidingly through an aperture 22 in retainer 4. A seal 23 made of rubber or similar material encircles the pushrod 21 to prevent the passage of liquids through aperture 22. A washer 24 covers seal 23. A compression spring 25 is interposed between washer 24 and plate 19 to provide a return force to pushbutton 2. Similarly, pushbutton 3 is snap fastened to a plate 26 by two lugs (not shown). A shorter pushrod 27 is riveted to the center of plate 26 and extends downwardly through a loosely fitting aperture 28 in retainer 4. A seal 29 encircles pushrod 27 to seal aperture 28. A washer 30 covers seal 29 and supports one end of a compression spring 31. The other end of spring 31 bears against the lower face of plate 26 to provide a return force to pushbutton 3.

During operation, pushbuttons 2 and 3 are interlocked by a rocker lever 32 which is pivotally supported at its center on retainer 4 by a pin 33. Lever 32 extends through a slot 34 formed in retainer 4 to cooperate at its ends with the mechanisms associated with the pushbuttons 2 and 3. Hooklike brackets 35 and 36 are welded to the lower surfaces of plates 26 and 19, respectively. Pins 37 and 38 are riveted to the opposite ends of lever 32 to loosely engage the hooks of brackets 35 and 36, respectively. Pushbuttons are thereby interlocked so that when pushbutton 2 is depressed, pushbutton 3 must rise and vice versa.

An annular shoulder 39 is formed near the lower end of the longer pushrod 22. Immediately below shoulder 39, pushrod 22 passes through an aperture in a support plate 40 and is there fastened to support plate 40. Support plate 40 is generally circular in shape with a circumferential ridge 41. Plate 40 has two oppositely positioned flattened edges with upstanding flat edges 42. Plate 40

loosely and slidingly fits within a rear recess **43** of retainer **4** and flat edges **42** cooperate with flattened surfaces **44** formed on the generally cylindrical surface of recess **43**. The front surfaces of edges **42** also serve to stop the return motion of support plate **40** by the engagement of edge **42** against the retainer **4**.

Support plate **40** has a center circular aperture **45** and an adjacent smaller circular aperture **46**. A rectangular aperture **47** is also formed on plate **40**. A U-shaped bracket **48** spans aperture **47** on the lower side of plate **40** and is welded at its ends to plate **40** at opposite edges of aperture **47**. A shoulder pin **49** is riveted to the depending bight of bracket **48**. Pin **49** and the lower end of pushrod **21** serve to simultaneously push on the pushrods **14** of the contact blocks **9** and **10**, when pushbutton **2** is depressed.

In order that pushbutton **2** may be maintained in its depressed postion to thereby maintain the contact blocks **9** and **10** actuated, an over-center linkage mechanism is provided between plate **40** and retainer **4**. This linkage consists of two pivotally connected links, an upper link **50** and a lower link **51**. This linkage is shown in its folded or collapsed position in FIGS. 2 and 3 and is in its locked extended position in FIGS. 5 and 6. Upper link **50** comprises two similar parallel side portions **52** and **53** rigidly connected by an integral strip **54**.

Link **50** is pivotally fastened to retainer **4** by a pin **55** which fits loosely through a pair of alined apertures in sides **52** and **53**. A cylindrical spacer **56** fits over pin **55** and between sides **52** and **53**. The ends of pin **55** are held within a pair of opposed slots **57** and **58** within retainer **4**. The material of retainer **4** adjacent the edges of slots **57** and **58** is peened over to securely retain pin **55**. Another pair of alined apertures are formed in sides **52** and **53** to tightly accommodate a spring holder pin **59**.

Link **51** comprises a pair of similar opposite sides **60** and **61** rigidly joined by an integral strip **62**. Link **51** is pivotally connected to link **50** by means of rivets **63** and **64** which pass through a pair of apertures **65** and **66** of link **50** and a corresponding pair of apertures **67** and **68** in link **51**. Apertures **65** and **66** fit loosely over the shoulders **63***a* and **64***a*, respectively, on rivets **63** and **64**. The smaller ends of rivets **63** and **64** are riveted over to securely engage the inner faces of sides **60** and **61**. A trip member **69** having three portions **69***a*, **69***b* and **69***c* is welded to side **60**. Portion **69***a* is welded to side **60**. Portion **69***b* extends perpendicular to portion **69***a* and away from side **60**. Portion **69***c* is also in a plane perpendicular to side **60** and is bent from portion **69***b* to form a roughly V-shaped member extending from the side **60** of link **51**.

A support channel assembly comprising a channel **70** and a post **71** riveted thereto is pivotally fastened to link **51** by means of a rivet **72** which passes through the apertures **73** and **74** in channel **70** and apertures **75** and **76** in link **51**, when alined. Another pair of apertures **77** and **78** are formed in channel **70** to accommodate another spring holder pin **79**. A tension spring **80** extends between pins **59** and **79**. Post **71** passes through aperture **45** in plate **40** and is therein secured by a spring ring **81** which engages a circumferential groove in post **71**. A small nib **82** is formed on the lower surface to index with aperture **46** in plate **40** and thereby prevents undesired rotation of channel **79**.

It can be seen that as pushbutton **2** is depressed against the force of spring **26** and the return force of the contact blocks **9** and **10**, the linkage of links **50** and **51** is extended against the force of spring **80**. When the linkage reaches the center position in which pin **55**, rivets **63** and **64** and rivet **72** are aligned, the tension of spring **80** causes rivets **63** and **64** to move over-center until the edge of link **50** abuts the corner **83** of retainer **4** as shown in FIG. 5. The compressive force tending to force rivet **72** toward pin **55** is then ineffective to cause return movement of the mechanism. As a result plate **40** is locked in its depressed position and the contact blocks **9** and **10** are maintained in an actuated position.

In order that the mechanism may return to its original unactuated position, the linkage comprising links **50** and **51** must be unlocked. To this end, a cam member **84** is firmly affixed to the lower end of the shorter pushrod **27**. Cam **84** is of sheet metal construction and extends away from pushrod **27** toward link **51** to cooperate with trip member **69** when the link **51** is in its extended position. At the edge of cam **84** which faces the intersections of portions **69***b* and **69***c*, a tab **84***a* is bent upwardly. It can be seen that when pushbutton **3** is depressed from the position of FIG. 6, through that movement allowed by the looseness in the connections of interlock lever **32**, cam **84** strikes portion **69***b* of trip member **69** to force links **50** and **51** over-center. Thus released, the mechanism is free to return to its original unactuated position under the influence of interlock lever **32**, return spring **25** and the return force of contact blocks **9** and **10**. In this connection it is to be noted that spring **25** is made to have a considerably greater return force than spring **31** of the opposite pushbutton **3**. Rectangular aperture **47** and bracket **48** are formed to accommodate the downward movement of pushrod **27** and cam **84**.

It can be seen from the foregoing description that the depression of pushbutton **3** actuates contact blocks **9** and **10** and the linkage of links **50** and **51** maintains pushbutton **3** depressed. Depression of pushbutton **3** releases the mechanism to return to its unactuated position. The over-center linkage of links **50** and **51** provides an extremely strong maintaining latch which enables the mechanism to reliably withstand the return forces of a great number of stacked contact blocks such as contact blocks **9** and **10**, or similar devices. The relatively low friction in the over-center linkage mechanism enables the latch to be easily and reliably tripped or released under relatively high loading.

We claim:

1. A manually operable mechanism for causing actuation of reciprocally actuable electrical switch units comprising:

a supporting frame;

a manually operable reciprocatory means supported by said frame having a first position and a second position for actuating at least one reciprocally actuable electrical switch unit when moved to its second position;

means for biasing said reciprocatory means to its first position;

latching means comprising an over-center linkage between said frame and said reciprocatory means having two pivotally connected links, one of said links pivotally attached to said frame and the other of said links pivotally connected to said reciprocatory means, said linkage having a center position in which all of its pivot points are in line;

means for limiting movement of said linkage to one side of its center position to assume a locked extended position in which said linkage is locked against compressive force to thereby hold said reciprocatory means in its second position, said linkage further having a collapsed position on the other side of said center position in which said linkage folds to permit movement of said reciprocatory means to its first position;

and manually operable trip means for moving said linkage from its locked extended position past its center position to allow said linkage to fold and allow said reciprocatory means to move to its first position.

2. The invention as defined in claim **1** in which said trip means comprises a second reciprocatory means supported by said frame.

3. The invention as defined in claim **2** in which said second reciprocatory means comprises cam means for

forcing said linkage from its locked extended position past its center position.

4. The invention as defined in claim **1** together with spring means acting on said linkage to bias said linkage from said center position to said locked extended position.

5. The invention as defined in claim **2** in which each of said reciprocatory means comprises manually operable pushbutton means.

6. The invention as defined in claim **5** in which said frame is adapted to be mounted within a single hole in a supporting panel with said pushbutton means accessible from one side of said panel and with at least one reciprocally actuable switch unit attached to and supported by said frame on the other side of said panel.

7. The invention as defined in claim **2**, together with interlocking means for interlocking the operation of said first mentioned reciprocatory means and said second reciprocatory means whereby said trip means is forced to a reset position when said first mentioned reciprocatory means is moved to its second position, and wherein said trip means is subsequently operable from said reset position to move said linkage.

8. A pushbutton operated switch assembly of the one-hole mounting variety comprising:

a frame adapted to be mounted within a single hole in a support panel and having a front side and a rear side;

at least one reciprocally actuable switch unit attached to the rear side of said frame;

first reciprocatory means supported by said frame having a released position and a depressed position comprising manually operable pushbutton means operable from the front side of said frame, said first reciprocatory means communicating at the rear side of said frame with said switch unit to cause actuation of said switch unit when moved to its depressed position;

means for biasing said first reciprocatory means to its released position;

latching means comprising an over-center linkage between said frame and said first reciprocatory means having two pivotally connected links, one of said links pivotally attached to said frame and the other link pivotally connected to said first reciprocatory means, said linkage having a center position in which all of its pivot points are in line;

means for limiting movement of said linkage to one side of its center position to assume a locked extended position in which said linkage is locked against compressive force to thereby hold said reciprocatory means in its second position, said linkage further having a collapsed position on the other side of said center position in which said linkage folds to permit movement of said first reciprocatory means to its first position;

second reciprocatory means supported by said frame comprising manually operable pushbutton means operable from the front side of said frame;

trip means connected to said second reciprocatory means for moving said linkage from its locked extended position past its center position to allow said linkage to fold and allow said first reciprocatory means to move to its first position.

9. The invention as defined in claim **8** in which said second reciprocatory means has a released position and a depressed position and said trip means moves said linkage from its locked extended position when said second reciprocatory means is moved to its depressed position, together with;

interlocking means for interlocking the movements of said first and second reciprocatory means so that when said first reciprocatory means is moved to its depressed position, said second reciprocatory means is forced to its released position and vice versa.

References Cited

UNITED STATES PATENTS

1,424,402	8/1922	Hartman	200—5
2,369,362	2/1945	Marziani	74—520
2,255,905	9/1941	Somers et al.	74—483
3,182,160	5/1965	Zavertnik et al.	200—172
3,201,557	8/1965	Poulton	200—172

FRED C. MATTERN, JR., *Primary Examiner.*

W. S. RATLIFF, *Assistant Examiner.*