United States Patent [19]

Kennedy et al.

[11] **3,783,204**

[45] **Jan. 1, 1974**

[54] **MULTIPLE CIRCUIT CONTROL PUSHBUTTON SWITCH ASSEMBLY WITH IMPROVED PUSHBUTTON ACTUATOR LATCH BAR MECHANISM AND MOVABLE CONTACTS**

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[73] Assignee: **Oak Industries Inc.,** Crystal Lake, Ill.

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[52] **U.S. Cl.**..... **200/5 EB,** 200/16 D, 200/153 J, 200/166 BH

[51] **Int. Cl.** **H01h 9/26**

[58] **Field of Search**..... 200/5 E, 5 EA, 5 EB, 200/16 C, 16 D, 153 J, 166 BH, 168 K, 5 R, 166 B, 159 R

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Primary Examiner—J. R. Scott

Attorney—Alfred H. Plyer, Jr. et al.

[57] **ABSTRACT**

A pushbutton switch construction utilizes a shorting bar having integral but independently flexible arms. The shorting bar is positioned in the switch plunger and arranged to electrically connect at least two contact terminals within the switch housing. The cam follower which moves within a cam slot in the switch plunger also functions as a stop preventing accidental removal of the plunger. A plurality of such switches are fastened to a channel with blockout members being slidably arranged within the channel in front of the switch housings. There are cooperating portions on each blockout member and the adjacent plungers such that only one of such plungers may be moved inwardly to an operative position. A latch bar is positioned in the channel and arranged for sliding movement adjacent the blockout members. A latch bar spring is positioned on the front of the channel and has portions extending through the channel and into cooperative relationship with the latch bar.

16 Claims, 28 Drawing Figures

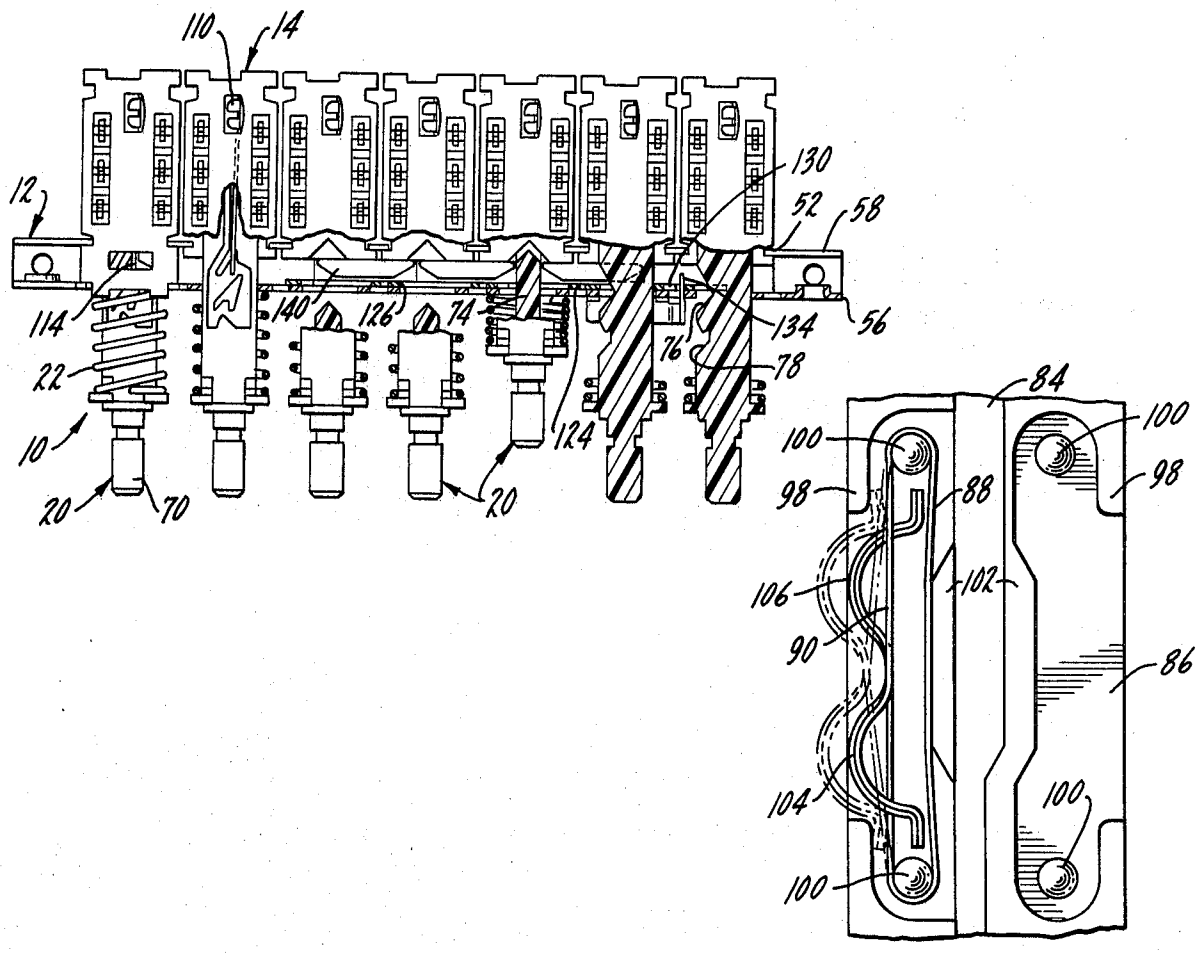
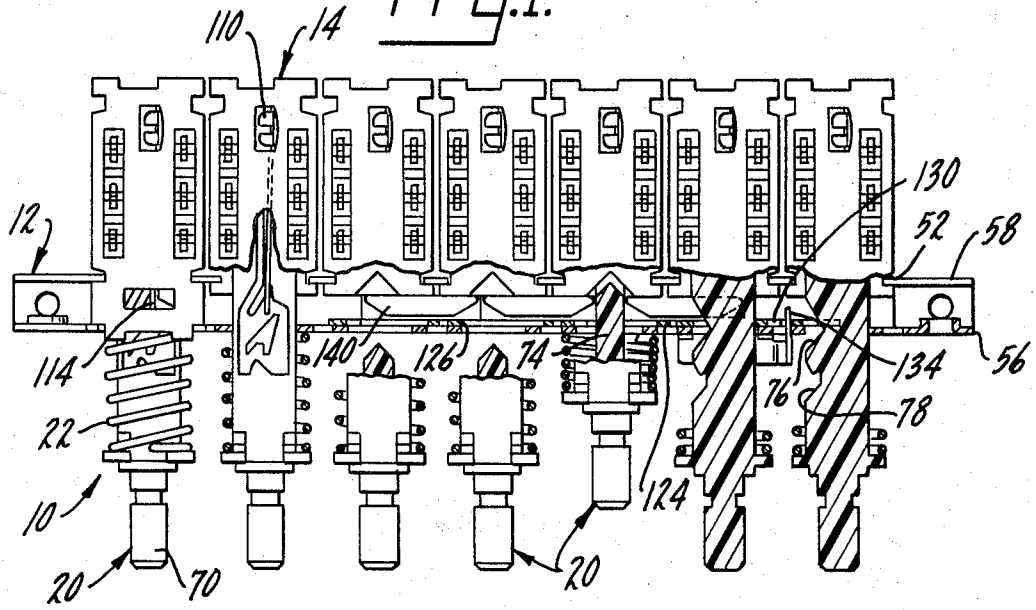


fig.1.



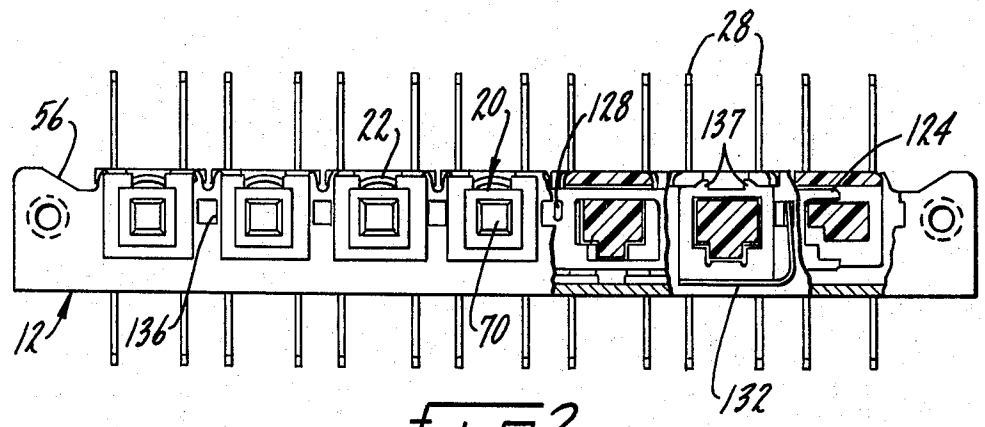


fig.2.

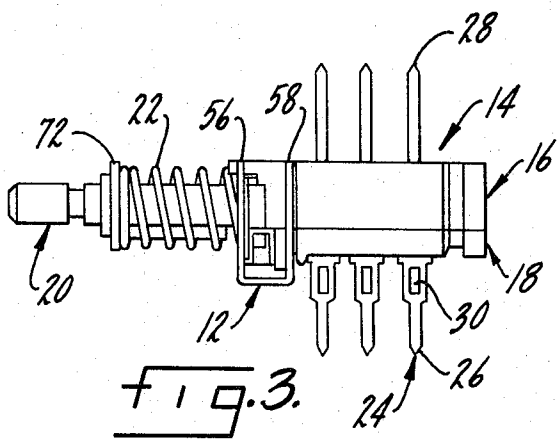


fig.3.

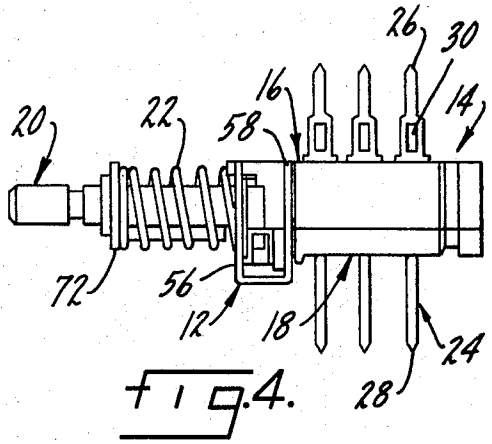


fig.4.

fig. 5.

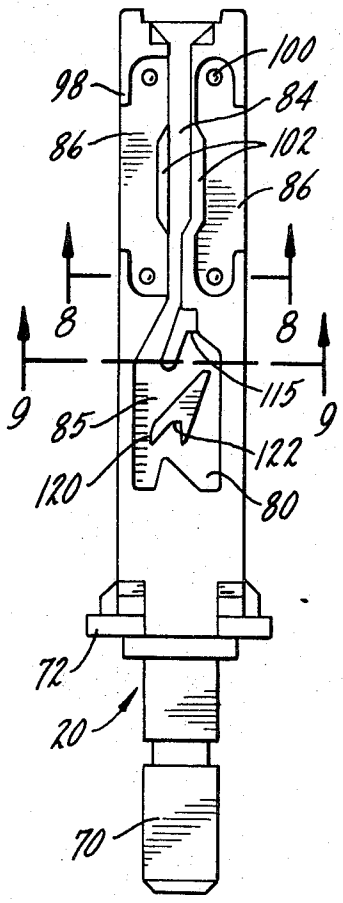


fig. 6.

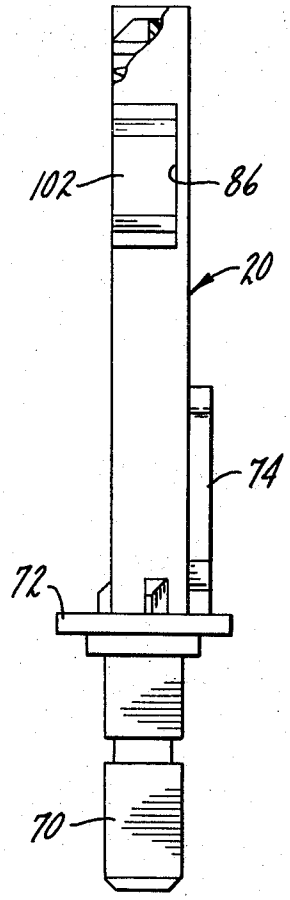


fig. 7.

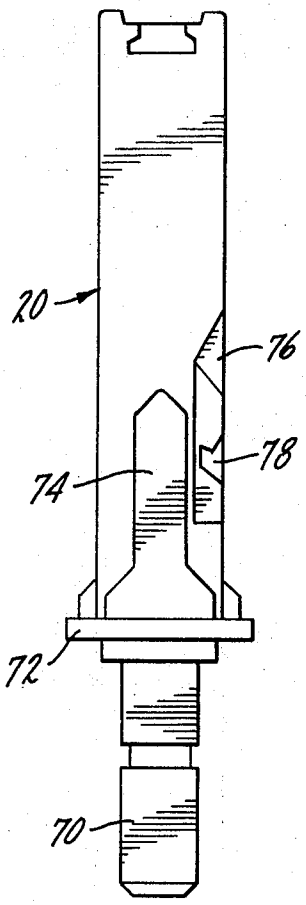


fig. 10.

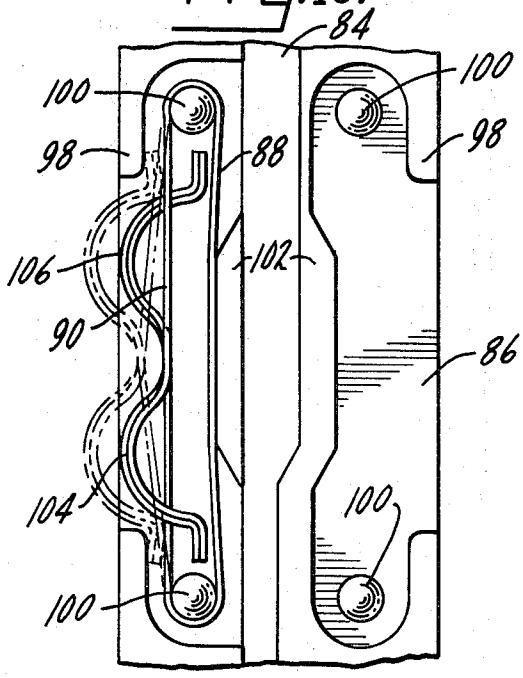
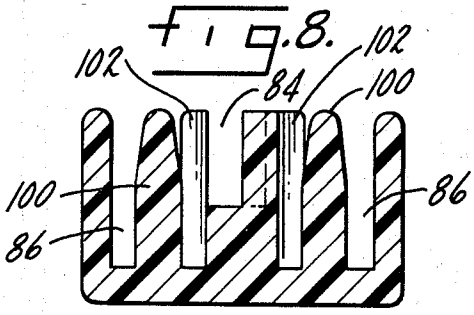


fig. 8.



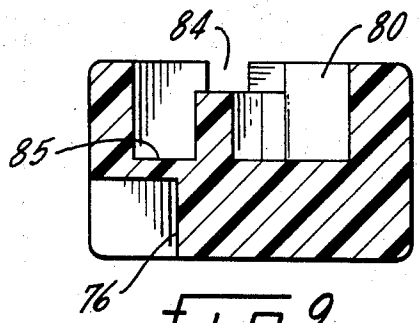


fig. 9.

fig.11.

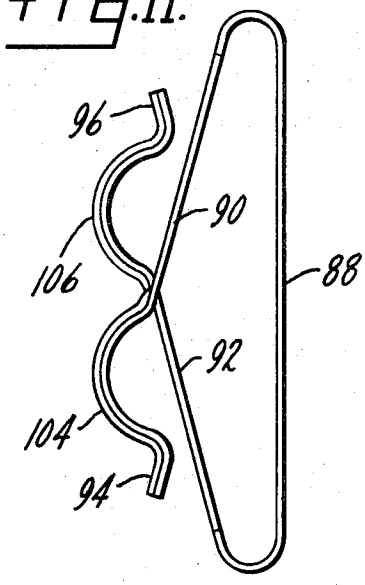
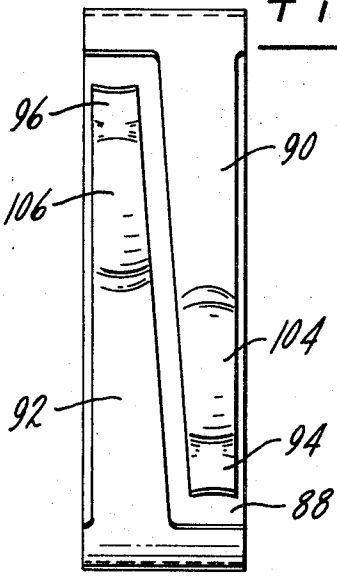


fig.12.



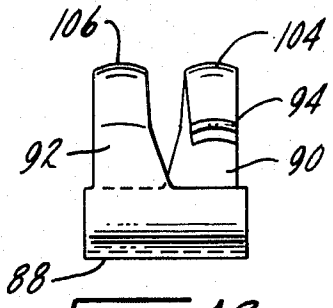
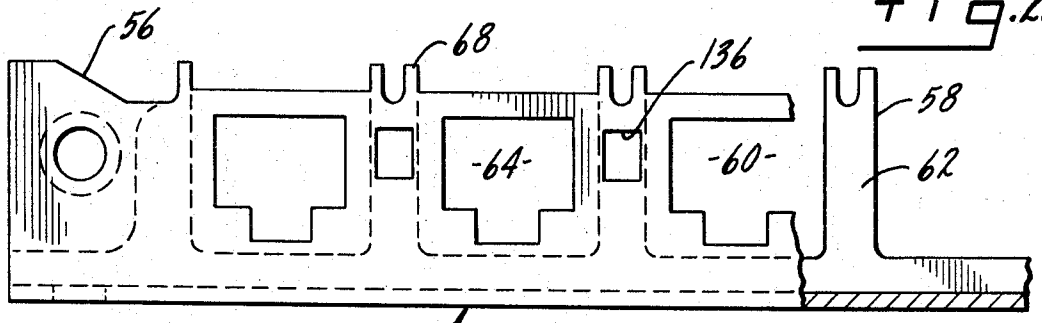


fig.13.

fig.23.



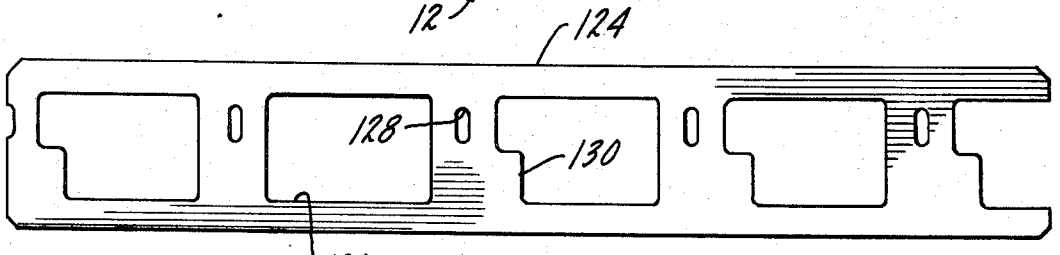


fig.24.

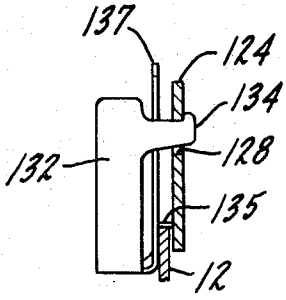


fig.28.

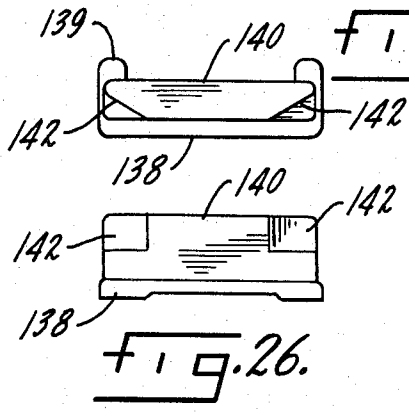


fig.25.

fig.26.

fig.27.

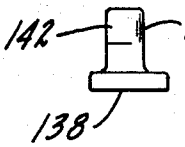


fig.14.

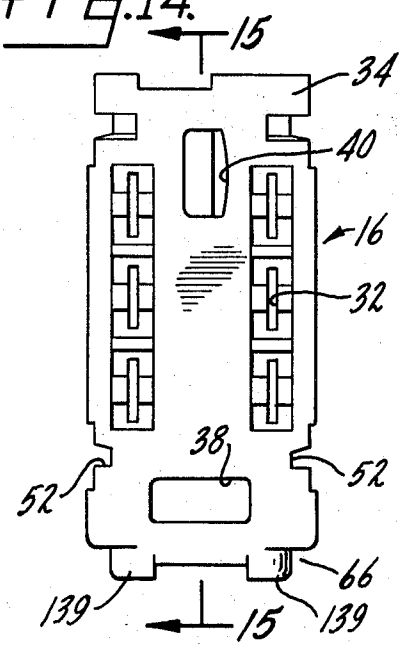


fig.15.

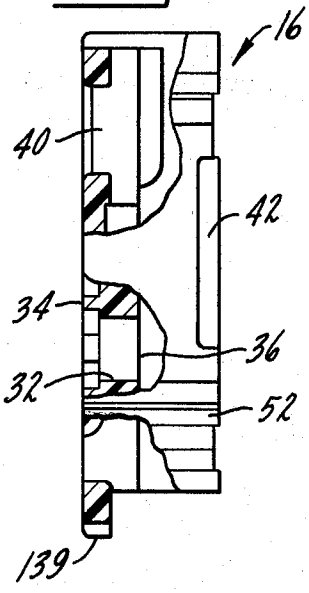


fig.16.

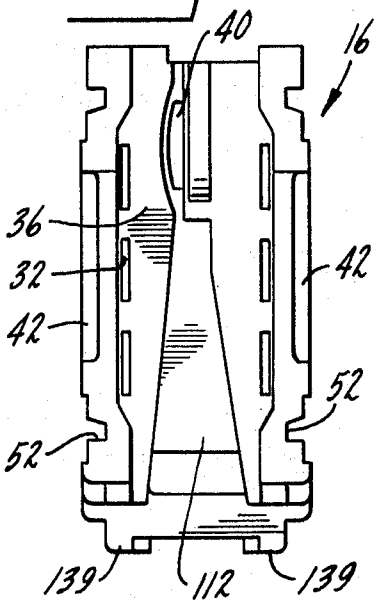


fig.17.

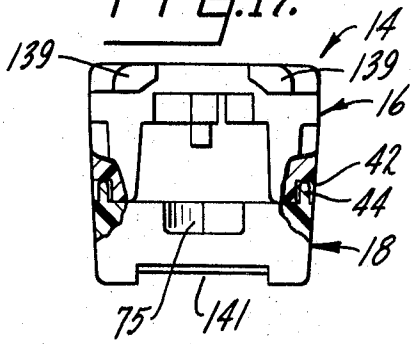


fig.18.

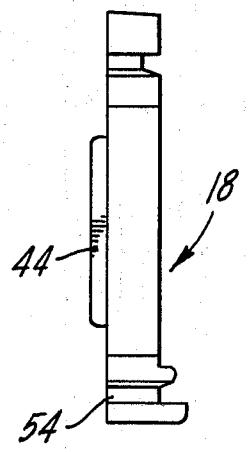


fig.19.

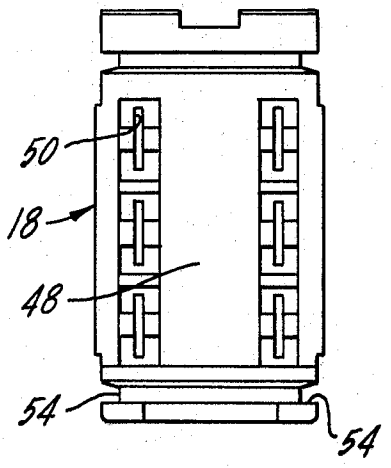


fig.20.

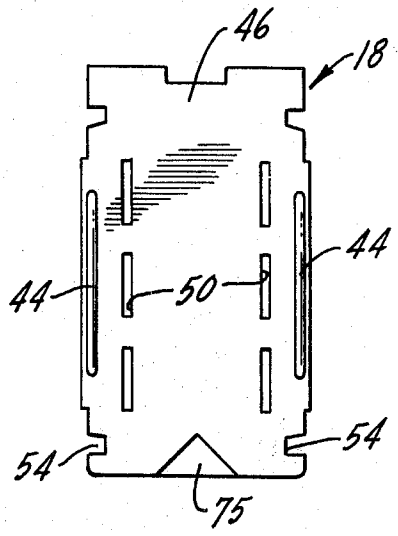
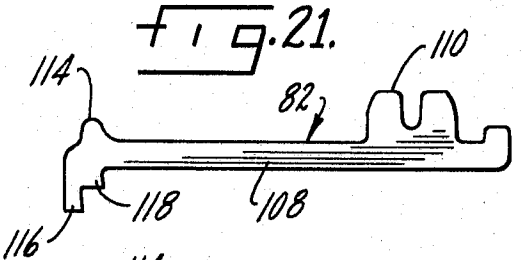


fig.21.



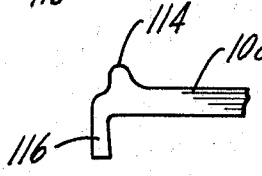


fig.22.

MULTIPLE CIRCUIT CONTROL PUSHBUTTON SWITCH ASSEMBLY WITH IMPROVED PUSHBUTTON ACTUATOR LATCH BAR MECHANISM AND MOVABLE CONTACTS

SUMMARY OF THE INVENTION

The present invention relates to pushbutton switches and in particular to certain improvements thereon.

One purpose of the invention is a pushbutton switch in which the shorting bar fixed to the plunger has independently flexible, but yet integral, arms.

Another purpose is a simply constructed reliably operable pushbutton switch of the type described.

Another purpose is a pushbutton switch in which the cooperative cam means on the plunger and housing cam follower are effective to provide a stop preventing outward movement of the plunger.

Another purpose is a pushbutton switch of the type described in which the contact terminals have an intermediate portion within the housing and generally symmetrically arranged terminals extending outside of the housing such that the terminals may be positioned in either of two symmetrical arrangements relative to the housing.

Another purpose is a pushbutton switch construction in which a plurality of switches are fastened, at the front, to a generally U-shaped channel, with the channel containing a latch bar and blockout members slidably positioned relative to each other.

Another purpose is a pushbutton switch construction utilizing a plurality of independent switches attached, at the front of each pushbutton housing, to a generally U-shaped channel.

Another purpose is a pushbutton switch construction of the type described utilizing independent blockout members positioned between adjacent plungers to prevent inward operative movement of more than one of such adjacent plungers.

Another purpose is a pushbutton switch construction of the type described in which a slidable latch bar moves within a U-shaped channel positioned at the front of a plurality of pushbutton switches, with the spring biasing the latch bar being placed at the front of the channel and having portions extending through it.

Another purpose is a pushbutton switch construction of the type described having provision for more than one latch bar, each with an independent spring.

Other purposes will appear in the ensuing specification, drawings and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is illustrated diagrammatically in the following drawings wherein:

FIG. **1** is a plan view of a pushbutton switch construction illustrating a plurality of individual pushbutton switches attached to a frame,

FIG. **2** is a front view with portions removed, of the construction of FIG. **1**,

FIG. **3** is a side view of a pushbutton switch,

FIG. **4** is a side view of the switch of FIG. **3**, with the contact terminals reversed,

FIG. **5** is an enlarged top plan view of the plunger,

FIG. **6** is a side view of the plunger,

FIG. **7** is a bottom view of the plunger,

FIG. **8** is a section along plane **8—8** of FIG. **5**,

FIG. **9** is a section along plane **9—9** of FIG. **5**,

FIG. **10** is an enlarged top plan view of a portion of the plunger,

FIG. **11** is a side view of the shorting bar,

FIG. **12** is a top view of the shorting bar,

FIG. **13** is an end view of the shorting bar,

FIG. **14** is a view of the outside of one of the housing sections,

FIG. **15** is a section along plane **15—15** of FIG. **14**,

FIG. **16** is a view illustrating the inside of the switch section of FIG. **14**,

FIG. **17** is an end view of the switch housing,

FIG. **18** is a side view of another section of the switch housing,

FIG. **19** is a view of the outside of the switch housing section of FIG. **18**,

FIG. **20** is a plan view, similar to FIG. **19**, showing the inside of the switch housing section of FIG. **18**,

FIG. **21** is a plan view of the cam follower,

FIG. **22** is a partial plan view of a modified form of cam follower,

FIG. **23** is a front view of the mounting channel, with portions removed,

FIG. **24** is a plan view of the latch bar,

FIG. **25** is a top view of the blockout member,

FIG. **26** is a front view of the blockout member,

FIG. **27** is an end view of the blockout member, and

FIG. **28** is a side view of the latch bar return spring.

The present invention relates to improvements in a push-button switch and improvements in means for utilizing a series of such switches. In the switch itself the improvements relate to a shorting bar fastened in the plunger and having independent flexing contacts which are integral with each other and confined in their movement by the plunger. In addition the cam follower which functions as a means for controlling movement of the plunger is a stop preventing plunger removal.

In prior art pushbutton switches the shorting bar fastened to the plunger was a single element. By separating the single element shorting bar of the prior art into a pair of integral, but yet independently flexible contacts, each of the flexible portions of the shorting bar is biased against one of the terminals thus providing a more positive electrical contact.

In the use of a plurality of such pushbutton switches the improvements relate to a blockout member which is positioned between adjacent plungers for preventing more than one of such plungers being placed in an operative position at any one time. The blockout members are positioned, between adjacent plungers, in a U-shaped channel at the front of the switch. The latch bar which may be used with the blockout members is positioned in the same channel and moves in a path parallel with the blockout members. The spring biasing the latch bar is positioned in front of the channel and extends through the channel and into operative relationship with the latch bar.

Prior art blockout members have generally been placed at the back of the switch and there has been a separate channel for such blockout members. The present invention has a single channel, at the front of the switch and the blockout member is thus positioned at the front of the switch. Each blockout member is a separate captive element functioning with adjacent plungers. Other blockout members may be placed in the same switch array, but the blockout members do not have to be adjacent each other.

The latch bar spring extends into operative relationship with the latch bar from the front of the channel. Customarily, in the prior art, latch bar springs have been placed at either one end or the other of the channel. By using a spring positioned at the front, there may be more than one latch bar for a particular switch array and the latch bars do not have to be related to each other. There may be several combinations of pushbutton switches operated from independent latch bars.

In FIGS. 1 and 2 a plurality of pushbutton switches 10 are shown mounted to a channel 12. The switches, although all positioned in the same array, may be arranged for different types of operation. For example, one or more of the switches may be of the momentary type, one or more of the switches may be arranged for push-push operation, others may be arranged for interlock, with still others arranged for interlock with blockout.

Each of the pushbutton switches includes a housing 14 made up of two housing sections indicated at 16 and 18. Housing section 16 is shown in FIGS. 14–16, whereas housing section 18 is shown in FIGS. 18–20. The housing sections may conveniently be formed of plastic and held together in any suitable manner, as shown in FIG. 17. Each pushbutton switch 10 also includes a plunger 20, detailed in FIGS. 5–10, and a coil spring 22 which biases the plunger to the out position of FIGS. 3 and 4. Contact terminals indicated at 24 have portions positioned within each of the housings 14 and have contact portions 26 and 28 which extend outwardly from opposite sides of the housing for connection into an electrical circuit. Each of the terminals 24 may have an opening 30. Generally equal lengths of the contact portions 26 and 28 extend outwardly from the housing such that the terminals may be inserted from either side of the housing. In this way either side of the switch can be placed flush against a printed circuit board. FIGS. 3 and 4 illustrate the switch with the contact terminals positioned in two different symmetrical arrangements.

In FIGS. 14–16, the housing section 16 is shown to have a plurality of openings 32, each of which is formed and adapted to receive a contact terminal 24. The openings 32 extend from the outside surface 34 of housing section 16 through the housing section, to the inside surface 36. An opening 38 generally at one end of the housing section 16, is formed and adapted to receive a portion of the cam follower to be described hereinafter. An opening 40, generally adjacent the opposite end of the housing section 16 will receive the opposite end of the cam follower which may be bent over or in some manner attached to the housing section 16 to mount cam follower to the switch. Opposite sides of housing section 16 may have longitudinally extending grooves 42, illustrated particularly in FIGS. 15 and 16, which are used to align the housing sections together. The housing section 18 has mating projections 44 on each side thereof which fit within the grooves 42 when the housing sections are assembled together as a unit. Note particularly FIG. 17 which is an end view of the assembled housing sections.

The lower housing section 18 has an inner surface 46 and an outer surface 48. Openings 50 extend through the housing section and again are formed and adapted to receive the contact terminals 24.

The front of the housing sections 16 and 18 have aligned slots 52 and 54 which are used in fastening each of the pushbutton switches to the channel 12. Note particularly FIG. 1. As shown in FIG. 23 the channel 12 has a front portion 56 and a rear portion 58, with the portions 56 and 58 together defining a U-shaped member. The rear portion 58 has openings 60 with bars 62 spacing the openings one from another. The switch sections 16 and 18, when fastened together, fit within the openings 60, with each bar 62 being positioned within the aligned slots 52 and 54.

The front portion 56 of the U-shaped channel 12 has openings 64. In like manner, the front of the upper housing section 16 has reduced portions 66 which will receive projections 68 positioned on opposite sides of the front openings 64. Normally the projections 68 as well as the upper end of the bars 62 will be staked over, as shown in FIG. 2, to permanently attach each pushbutton to the channel.

The plunger 20 includes an outer end portion 70 which may conventionally receive a button suitable for manual operation. Just behind the outer end portion 70 is a wall 72, which functions as a seat to hold the coil spring 22 in position as shown in FIGS. 3 and 4. The opposite end of spring 22 seats against the front portion 56 of the channel 12. Behind the wall 72, on the bottom of the plunger as shown in FIG. 7, is an arrow-shaped guide 74 which cooperates with the blockout members, as described hereinafter, to provide a blockout function. The guide 74 also cooperates with triangular opening 75 on the housing section 18 to stop inward movement of the plunger. Also on the bottom of the plunger, and adjacent one side are shallow grooves 76 and 78 which cooperate with the latch bar, again as described hereinafter.

The top of the plunger, as shown in FIG. 5, has a cam way 80, irregularly shaped to cooperate with the cam follower 82 shown in FIGS. 21 and 22. The cam way 80 has an elongated portion 84 which extends from the larger area 85 of the cam way back to the rear of the plunger and opens at the rear of the plunger so that the plunger may be removed from the housing. On either side of the elongated cam way portion 84 are recesses 86 which hold the shorting bars.

FIGS. 11–13 detail the shorting bar. Each shorting bar has a base 88 and two integral independently flexible arms 90 and 92. The arms 90 and 92 extend toward each other and are arranged in a side-by-side fashion. The outer ends of each of the arms 90 and 92 have projecting end portions 94 and 96 which, in the assembled position shown in FIG. 10, underlie or are confined by portions 98 of the plunger adjacent the recesses 86. Each of the shorting bars is positioned within a recess with opposite ends of the shorting bar being held by pins 100 positioned at opposite ends of the recess. The long side of each of the recesses have outwardly extending elongated projections 102 which serve to flex the base 88 of the shorting bars to thus assist in holding the shorting bars within the recesses 86.

When the plunger is moved into the housing, the thickened convex contact portions 104 and 106 of the independently flexible arms 90 and 92 will be moved inward as they strike the interior portions of the contact terminals, thus providing an electrical short between adjacent terminals. Of advantage is the fact that there are independently flexible arms which are an integral part of the shorting bar. Thus, one terminal within the housing will cause one of the flexible contact arms to be pushed inward, against its natural outward

bias, while the adjacent terminal will cause the other of the independently flexible contact arms to also be moved inward against its naturally outward bias. By having two arms, and having them independently flexible, each contact terminal provides a bias on a separate arm and thus provides a more positive electrical contact between the shorting bar and the terminals.

The cam follower as shown in FIG. **21** has an elongated portion **108** with upwardly extending projections **110** at the rear end thereof. The projections **110** will pass through the opening **40** in the upper housing section **16** and may be conveniently bent over to fasten the cam follower to the housing. The inside surface **36** of housing section **16** has a tapered slot **112** which permits lateral or swinging movement of the cam follower **108** within the housing. The front end of the cam follower **82** has an upwardly extending projection **114** which extends through opening **38** in the housing section **16** and a downwardly extending projection **116** which will move in the cam way **80** of the plunger.

As the plunger moves in and out of the housing, projection **116** will follow the cam way and functions as a stop. Surface **115** in the camway **80** provides a stop for projection **116** to retain the plunger in the housing. Projection **114** functions as a stop release premitting disengagement of the plunger from the housing. When the plunger is to be removed, projection **114** of the cam follower is moved to one side so that the lower projection **116** may pass into the elongated portion **84** of the cam way which opens to the rear of the plunger. Thus, the plunger may be outwardly removed from the housing as long as the lower projection **116** is in passage **84** of the cam way.

FIG. **22** shows a modification of the cam follower **82.** The portion **118** of the lower projection **116** has been removed from the cam follower. In the construction of FIG. **21,** the dimension of the cam follower and its position within the housing causes the portion **118** of the projection **116** to bear against an upstanding projection **120** within the cam way **85.** Thus, a plunger using the cam follower of FIG. **21** is suitable for momentary or interlock latch bar operation in that the cam follower cannot bear against the projection **120** to hold the plunger in an inward position. To the contrary, the cam follower of FIG. **22** has the portion **118** removed such that the projection **116** may catch within groove **122** of the projection **120** within the cam way **85** to hold the plunger in an in or operative position. The cam follower of FIG. **22** will be used in any pushbutton switch construction in which it is desired to independently hold plungers in an in position.

The latch bar **124** is illustrated in detail in FIG. **24** and has a series of large openings **126** with smaller openings **128** positioned therebetween. A portion **130** of the latch bar **124** projects into the left-hand opening **126** with the third from the left opening having the same configuration. The second from the left opening **126** is generally rectangular in configuration. Those latch bar openings having a projection **130** provide for interlock operation of a particular pushbutton switch, whereas those latch bar openings without the projecting portion **130** do not cooperate with the latch bar **124** in an interlock operation. Referring particularly to FIG. **1,** the two right-hand switches illustrate the bottom of the plunger. Note the slots **76** and **78** which cooperate with the projecting portion **130** of the latch bar openings **126.** When the plunger is in the in position, projecting portion **130** is interlocked with slot **78.** When the plunger is in the out position, as shown in FIG. **1,** the projecting portion is at least partially within slot **76.** Thus, if one of the plungers is interlocked, with the projecting portion **130** being positioned within a slot **78,** the depression of any other plunger which is a part of the interlock arrangement will cause the latch bar to be moved to the left, releasing all other depressed plungers so that the return springs **22** will move the plungers to the out position.

The latch bar **124** is biased to the right, as shown in FIG. **2,** by a latch bar spring **132.** The latch bar spring is generally U-shaped and has an inwardly directed arm **134,** as shown in FIG. **28.** A rearward projection **135** on spring **132** bears against the latch bar, with upward projections **137** being positioned in grooves **139** on either side of the housing **14,** as shown in FIG. **2,** thus preventing vertical and horizontal movement of spring **132.** The return springs **22** assist in holding spring **132** in position. The arm **134** passes through the openings **136** in the front of the U-shaped channel and then interlock with openings **128** in the latch bar. Thus, the latch bar is normally held in a predetermined position relative to the plungers such that the projecting portions **130** of the openings **126** will be at least partially within slots **76.** When any one plunger is moved inward, the projecting portion **130** will interlock with slot **78.** When another plunger is depressed, such inward movement cams the latch bar to the left, releasing all other operated plungers.

Of importance relative to the latch bar spring **132** is the fact that it is positioned in front of the frame mounting the switches. Thus, there may be a plurality of latch bars in any total switch array and each may have its own independent spring. Not all plungers positioned adjacent a latch bar will be arranged for interlock operation, but only those plungers having the projection portion **130.**

The blockout member is shown in FIGS. **25–27.** Each blockout member fits within the channel **12** directly behind the latch bar **124.** There is a base portion **138** which seats upon the bottom of the frame **12,** and a wedge portion **140** above the base **138.** The base **138** has rearward projections **139** which move within grooves **141** in the housing (FIG. **17**) to interlock the blockout members with adjacent housings. The wedge portion **140** has slanted sides **142** which interact with the guides **74** on the bottom of the plunger. Note the guide as shown in FIG. **7** and the interaction as illustrated in FIG. **1** by the third from the right plunger. When a plunger is depressed, adjacent blockout members are moved in opposite directions away from the plunger by the guide **74.** Thus, as illustrated in FIG. **1,** the adjacent plunger cannot be depressed as the guide would then strike one of the slanted surfaces **142** of the blockout member.

Of advantage in the blockout arrangement is the fact that there are independent blockout members, each of which is associated with two adjacent plungers. Thus, any combination of switches may be arranged for blockout or for use without blockout merely by inserting blockout members between adjacent plungers. When there are adjacent blockout members, shifting of one blockout member by a push rod will cause a shifting of the other blockout members within a continuous line of blockout members.

Whereas the preferred form of the invention has been shown and described herein, it should be realized that there may be many modifications, substitutions and alterations thereto.

We claim:

1. In a pushbutton switch construction, a housing, a plunger reciprocal in said housing, contact terminals having portions positioned within said housing, and a shorting bar fixed to said plunger and positioned to provide an electrical connection between two contact terminals, said shorting bar including a base, independently flexible and integral arms extending away from said base and generally toward each other and arranged in a side-by-side manner, a slot in said plunger, said shorting bar being positioned in said slot, with portions of said plunger adjacent said slot overhanging the ends of each of said independently flexible and integral arms, and posts positioned at opposite ends of said slot, with said flexible arms pivoting about said posts.

2. The structure of claim 1 further characterized by and including means positioned within said slot, intermediate the posts, for holding said shorting bar within said slot.

3. In a pushbutton switch construction, a housing, a plunger reciprocal in said housing, contact terminals having portions positioned within said housing, a shorting bar fixed to said plunger and positioned to provide an electrical connection between two contacts, latching cam means formed on said plunger and a latching cam follower attached to the housing and having a portion within said housing which cooperates with said latching cam means to control movement of said plunger relative to said housing, a portion of said latching cam follower forming a stop preventing disengagement of said plunger from said housing.

4. The structure of claim 3 further characterized by and including spring means positioned between a portion of said plunger and a portion of said housing normally biasing said plunger outwardly from said housing.

5. The structure of claim 3 further characterized in that said latching cam means includes an irregularly shaped groove in said plunger, with said latching follower having a portion thereof positioned to extend within said groove.

6. The structure of claim 5 further characterized in that a portion of said groove extends axially and opens at the inward end of said plunger to permit release of said latching cam follower from said plunger.

7. The structure of claim 5 further characterized in that said portion of the latching cam follower positioned within said groove prevents said latching cam follower from moving in portions of said groove.

8. The structure of claim 3 further characterized in that said contact terminals extend outwardly from opposite sides of said housing, with each contact terminal having an intermediate portion positioned within said housing and terminal portions positioned outside of said housing.

9. The structure of claim 8 further characterized in that said terminal portions are generally symmetrically arranged relative to said intermediate portion.

10. The structure of claim 8 further characterized by and including an opening in one of said terminal portions.

11. In a pushbutton switch construction, a frame, a plurality of switch housings fastened to said frame, a reciprocal plunger for each housing, with each plunger having an operating portion extending through said frame, said frame defining a channel, with openings in said channel for independently mounting each housing, a latch bar positioned for sliding movement in said channel, and a spring extending through the front of the frame and into cooperative relationship with said latch bar to bias said latch bar in one direction within said channel.

12. The structure of claim 11 further characterized by and including openings in said latch bar, with each opening being in alignment with a plunger, areas of the latch bar adjacent said openings having portions positioned to cooperate with portions of a plunger such that inward movement of one plunger releases other plungers.

13. The structure of claim 12 further characterized in that each of said plungers has slots positioned to cooperate with said portions of a latch bar.

14. The structure of claim 11 further characterized in that the portions of said spring extending through said channel are on opposite sides of a plunger.

15. The structure of claim 14 further characterized by and including at least one blockout member positioned for sliding movement in said channel adjacent said latch bar, said blockout member being positioned between adjacent plungers.

16. The structure of claim 11 further characterized by and including cam surfaces on each plunger positioned to cooperate with a portion of said sliding latch bar.

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