United States Patent

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[54] PUSH BUTTON ELECTRICAL SWITCH INTERLOCKING STRUCTURE INCLUDING WASHER BLOCK-OUT MECHANISM

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[52] **U.S. Cl.** ..... **200/5 EA,** 74/483 PB

[51] **Int. Cl.** **H01h 9/26,** G05g 11/00

[58] **Field of Search** ..... 200/5 EA, 5 E; 74/483 PB

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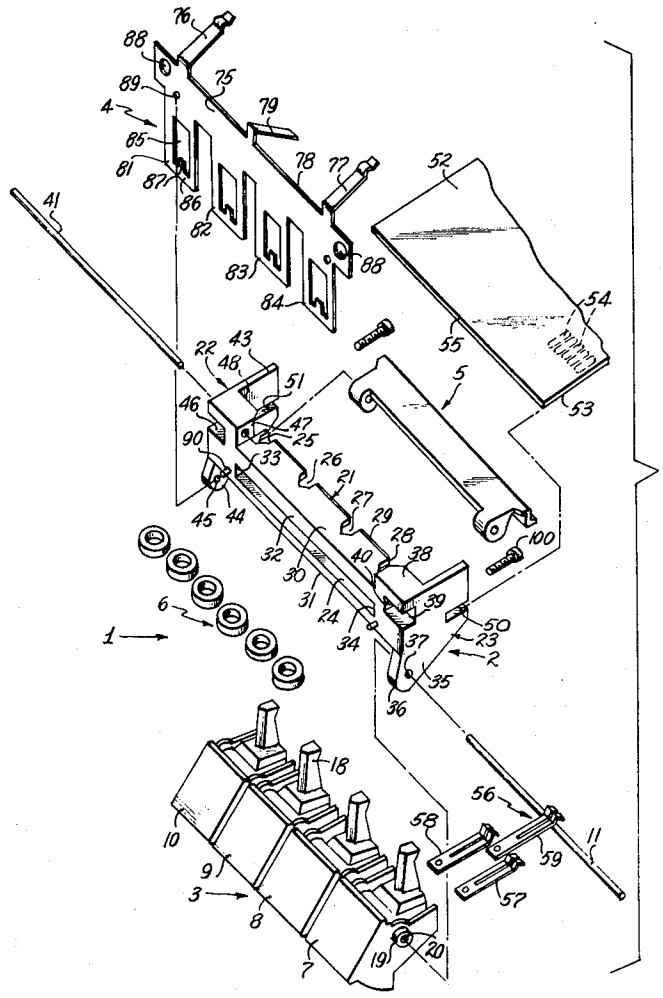
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[57] **ABSTRACT**

A push-button switch of the selective or latching type. A washer block-out mechanism co-operates with a tail portion of each push-button to positively prevent depressing more than one pivotally mounted push button to a contact make position. The push buttons are mounted in side by side relation to each other on a shaft for pivotal movement. Latching in a switch closed position is accomplished by a latch bar common to all the push buttons. Each push button carries three movable spring arm contacts, each contact having a pair of tips electrically joined to bridge stationary contacts on a printed circuit board connectable to the switch assembly. Guides are provided to properly position the circuit board so its contacts are aligned with the movable contacts carried by the buttons. A unique contact arrangement including a contact carried by each push button provides for illuminating the button when depressed.

8 Claims, 7 Drawing Figures



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SHEET 1 OF 2

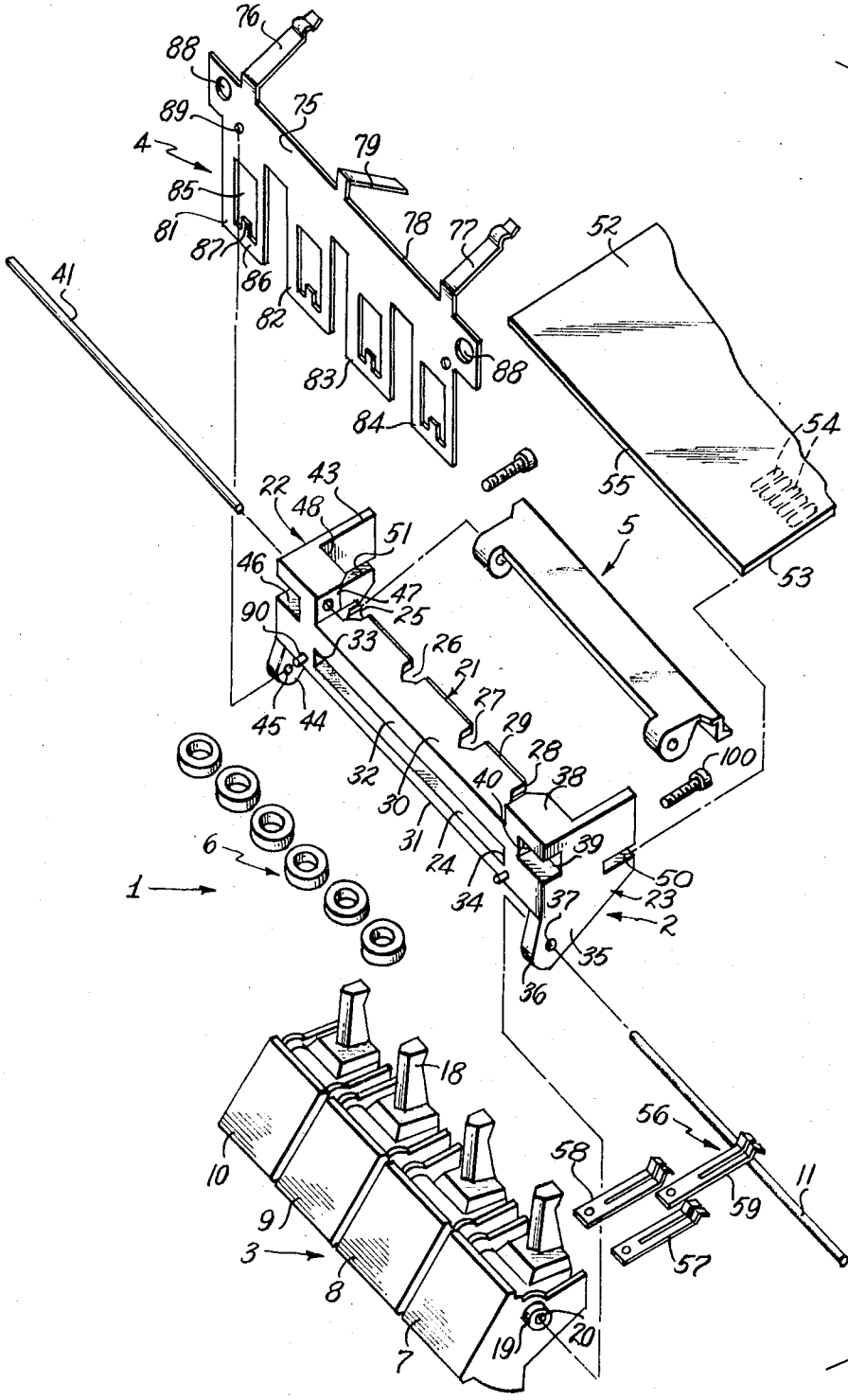


Fig. 1.

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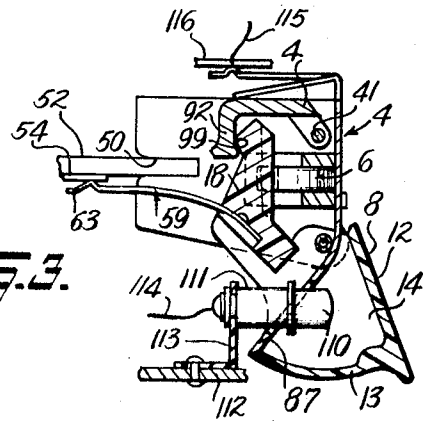


Fig. 3.

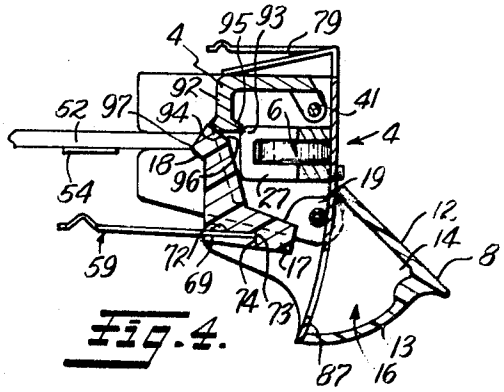


Fig. 4.

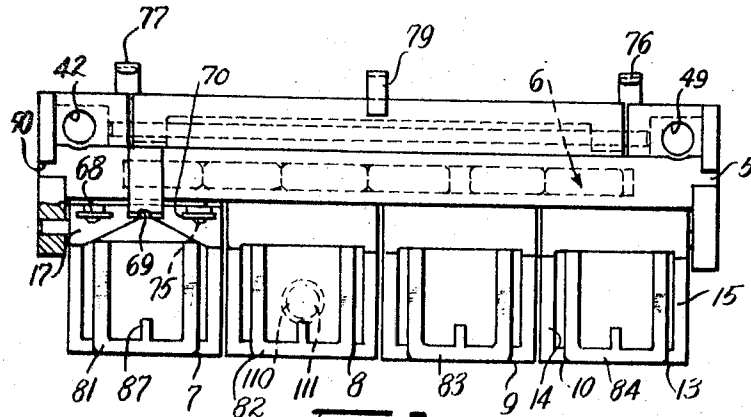


Fig. 5.

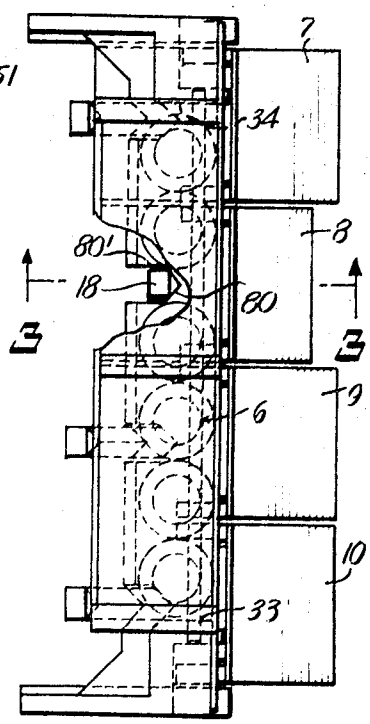


Fig. 2.

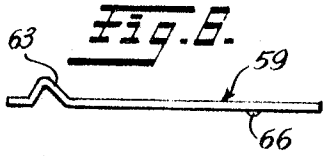


Fig. 6.

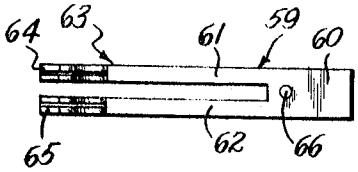


Fig. 7.

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PUSH BUTTON ELECTRICAL SWITCH INTERLOCKING STRUCTURE INCLUDING WASHER BLOCK-OUT MECHANISM

This invention relates generally to a push button switch having a plurality of pivotally mounted push buttons in side-by-side relation to each other, a latch bar common to all push buttons, and a block out arrangement to prevent depressing a second push button to make contact position while a first push button is in a depressed make contact position.

More specifically, the invention relates to a push button switch having particular utility with a printed circuit board switch arrangement wherein, the switch body includes guides to accurately position the body relative to the circuit board, one or several wiper type contacts are connected to each push button, the push buttons are mounted in side-by-side relation for pivotal movement about a common axis, an integral leaf spring assembly is effective to bias all the push buttons to a no contact position, and the push buttons assembly includes a unique arrangement for illuminating a depressed push button.

While push button switches of the selective OR type in which depressing one push button release an already depressed push button, are well known in the art, and while exclusive OR push button switches having a blockout mechanism which permits depressing only one push button at a time, are also well known in the art, these prior art push buttons switch arrangements have many disadvantages including expensive, difficult to manufacture parts and high assembly costs in order to provide a reliable switch. A majority of the prior art push buttons switches with these features are of the linearly movable push button type, include a laterally slidable latch bar to accomplish the selective OR function, and also include a blockout mechanism usually associated with an added leg of the linearly movable push button to provide an exclusive OR function. Such arrangements require multiple precision parts which must be accurately assembled in proper relation to each other to provide a switch having reliable operating characteristics. In addition, the known prior art switches of the selective OR type generally include numerous detents and latch mechanisms, and in the event it is desirable to indicate which of a plurality of buttons is depressed by means of an illuminated indicator, the prior art arrangements become even more complicated and expensive.

In accordance with this invention, applicant provides a push button switch of the selective OR type including a blockout mechanism which prevents depressing more than one push button at a time. In addition, the push button switch of this invention includes a unique arrangement for illuminating a depressed push button (in which instance the push button is formed from a translucent material) by virtue of a unique contact arrangement associated with the return spring for the push buttons.

Further, in accordance with this invention, the push buttons and the body of the switch are formed from a plastic or other material having good electrical insulating properties, and the use of an insulating material for at least these parts of the switch assembly vastly simplifies the switch construction, the mounting of the movable contacts, and the mounting of the lamp bulbs for illuminating a push button when depressed.

Correspondingly, an object of this invention is a unique push button switch including pivotally mounted push buttons in side-by-side relation to each other, and a pivotally mounted latch arm which cooperates with tail portions of the push buttons to provide a selective OR function.

Another object is a selective OR function push button switch having a latch arm common to the tail portions of all push buttons; and wherein movable contacts for the switch assembly are carried by the push buttons for engagement by mating stationary contacts on a circuit board, the assembly including a guide to assure accurate positioning of the circuit board relative to the switch body.

A further object is a selective OR push button switch including pivotally mounted push buttons of insulating material mounted on a body of insulating material wherein the only

metallic parts of the assembly are pivot shafts, contacts, and a one-piece leaf spring which functions as a return spring for all the push buttons and includes an integral spring arm cooperating with a latch arm of electrically insulating material to normally urge the latch arm toward a push button latching position.

A further object of the invention is a unique push button switch including pivotally mounted push buttons to provide a desired switching function wherein, the primary mechanical operating parts of the assembly are formed from a molded plastic material to provide for use of a vastly simplified contact arrangement having particular utility with a printed circuit board, a unique spring arrangement including an integrally formed leaf spring assembly normally urges all the push buttons toward a released position, and selected portions of the integral leaf spring provide for illuminating a depressed button by completing a circuit between a lamp bulb behind the button and a power supply to energize the bulb.

Numerous other objects, features, and advantages will become apparent with reference to the drawings which form a part of this specification, and in which:

FIG. 1 is an exploded pictorial view showing the various parts of the push buttons switch of this invention;

FIG. 2 is a top plan view of the switch of FIG. 1 assembled with portions of the latch bar cut away for purposes of illustration;

FIG. 3 is a view in section taken along line 3—3 of FIG. 2 and showing a push button latched;

FIG. 4 is a view corresponding to FIG. 3 but with the push button in the released position;

FIG. 5 is a rear view in plan of the switch;

FIG. 6 is a side view in elevation of a contact used with the switch;

FIG. 7 is a top plan view of the contact of FIG. 6.

Referring now to the drawings in detail and particularly to FIGS. 1–5, there is shown the push button switch assembly of this invention. Push button switch assembly 1 includes a molded body portion 2 which supports the various elements of the push button switch including a plurality of push buttons 3, a one-piece leaf spring 4, a latch bar 5, and a group of blockout washers 6 which prevent depressing more than one push button to a contact make position.

In the preferred embodiment, there are four identical push buttons 7–10 which are mounted in side-by-side relation to each other for pivotal movement on a rod 11 supported by body 2. Each push button is molded from a plastic material having good electrical insulating characteristics and includes a front wall 12 (FIGS. 1 and 4) which is flat, an arcuately curved bottom wall 13 and opposed flat side walls 14 and 15 (FIG. 5) which integrally join the front wall 12 and bottom wall 13 to provide a generally triangularly shaped cavity 16 within the front of a push button. Side walls 14 and 15 each extend rearwardly and integrally join a generally horizontal rear wall 17 from which an integral tail 18 projects upwardly as shown at FIG. 3. Side walls 14 and 15 extend upwardly above the rear wall and have integrally molded bosses with aligned openings 20 therethrough via which shaft 11 pivotally mounts a push button on the body 2.

Body 2 is integrally formed from a plastic material having good electrical insulating characteristics. The body is of somewhat complex shape and includes a main or central body portion 21 with integral end portions 22 and 23, the end portions being the mirror image of each other.

Central portion 21 of the body forms a housing for washers 6 and has a horizontal slot 24 formed therein which extends rearwardly and communicates with notches 25–28 which extend vertically through the rear wall 29 as well as top wall 30 and bottom wall 31. Walls 29–31 define the slot. Slot 24 opens forwardly through front face 32 of the body. The slot terminates at side edges 33 and 34 which define the respective ends of the slot. Disposed within slot 24 are washers 6. As will be observed with reference to FIG. 2, the length of slot 24 as measured between side edge 33 and side edge 34 equals six

times the diameter of one of washers 6 plus the thickness of a tail 18 of one of the push buttons 3. The manner in which the washers 6 perform their blockout function will subsequently be described in detail.

End portions 22 and 23 are enlarged relative to central body portion 21. With reference to end 23, this end includes a wall 35 with a flat outside surface, the wall including a downwardly and forwardly extending nose 36 with an opening 37 formed therein to receive pivot shaft 11 with its axis lying approximately in the plane of front surface 30 but below the bottom of wall 31 of central body portion 21. End 23 also includes an integral generally parallelepiped block portion 38 which joins side wall 34 with central body portion 21. Block 38 has a forwardly and sidewardly opening box-shaped notch 39 to provide an inner wall 40 which extends above top wall 30 of the body and which wall has an opening therethrough to receive a pivot shaft 41 for pivotally mounting latch bar 5. Notch 39 also defines a rear wall having a bore 42 extending therethrough in a fore and aft direction relative to the switch assembly 1. Bore 42 provides for mounting the switch assembly on an instrument casing by passing a screw through the bore.

End 22 is the mirror image of end 23 and includes an end wall 43 having a nose 44 with an opening 45 aligned with opening 37. There is also a notch 46 having a wall 47 with an opening formed therein which is aligned with the opening in wall 40 and which openings receive pivot shaft 41. A rear wall 48 of the notch has an opening 49 parallel to bore 42 to receive a threaded fastener for securing the switch body in position. When suitable threaded fasteners with enlarged heads are inserted through bores 42 and 49, pivot shaft 41 is retained against any substantial endwise movement.

Walls 35 and 43 each extend rearwardly and have formed therein respectively rearwardly opening shallow slots 50 and 51 to receive the front end of a printed circuit board 52.

Formed on the bottom surface of 53 of printed circuit board 52 are a plurality of contacts 54. Contacts 54 are formed on the circuit board in accordance with the usual printed circuit board techniques. The contacts are each elongated and extend in a row transversely of the board in spaced-apart relation to each other. The row is so spaced from front edge 55 of the board that when the board is fully seated in slots 50 and 51, the contacts 54 are in a proper aligned position for engagement with movable contacts 56 which are carried by the respective push buttons and which will now be described in detail.

As shown at FIG. 1, there are three movable contacts 57–59 which are carried by each push button. As shown at FIGS. 6 and 7, for the contact 59, each contact is elongated and is formed from a spring material with good electrical conducting characteristics. The contact includes an end portion 60 and a pair of parallel arms 61 and 62 integral with the end portion. The contact tips 63 of each arm are bifurcated by forming a narrow slit 64 in each tip, which slit extends parallel to the length of the arms 61, 62 and divides each tip into a pair of parallel fingers 65. By virtue of the slit 64 and the relatively thin material from which contact 57 is formed, fingers 65 are each resiliently flexible and readily deformable when tips 63 are moved into engagement with a pair of adjacent stationary contacts 54 of the circuit board. As shown at FIG. 6, each tip 63 is of generally inverted V-shaped configuration which provides for engagement of a contact 54 when a push button is depressed without danger of damaging the fragile foil or other material from which contact 54 is formed. Each contact 57 is provided with a struck out dimple 66 which cooperates with a similarly formed depression in the push button in which the contact is mounted and prevents endwise movement of the contact.

As shown at FIG. 5, the rear wall 17 of each push button is relatively thick vertically and has formed therein three contact receiving slots 68–70 which open through the rear face of the wall and which are generally horizontal when the switch of this invention is in the operating position of FIG. 4.

Slots 68–70 are horizontally aligned with each other and have generally open central portions as shown at FIG. 5. To provide a rigid connection for tail 18, slot 69 opens downwardly whereas slots 68 and 70 open upwardly. With reference to FIG. 4, the spherical recess 72 of slot 69 is located midway between the side edges of the slot and is so positioned that dome-shaped projection 66 of a contact 59 disposed in slot 69 engages in recess 72 when contact 59 is in the fully seated position of FIG. 4 with its end edge 73 engaging rearwardly facing stop surface 74 of wall 17. Slots 68 and 70 are each similar to slot 69 in that they each have an end face vertically aligned with end face 74 and have spherical depressions 75 located mid way between the sides of the slot. However, in the case of slots 68 and 70, depressions 75 open upwardly rather than downwardly as explained for the depression 72 of slot 69.

With contacts 57–59 inserted in the respective slots the contacts are in a generally horizontal position as shown for the contact 59 of FIG. 4. When push button 8 is depressed, the push button and contacts are moved to the position shown at FIG. 3, in which the tips 63 of arms 61 and 62 respectively engage adjacent contacts 54 on circuit board 52. By virtue of the flexibility of arms 61 and 62 and the resilience of fingers 65, the fingers 65 flex and slide along contacts 54 during engagement to provide a self cleaning action which assures good electrical engagement between the fixed and movable contacts. As a result, a circuit is completed between the fixed contacts via arms 61 and 62 and end 60 of each movable contact.

Leaf spring 4 takes the form shown at FIG. 1. The leaf spring is formed from thin metal with good spring characteristics which also advantageously is a good electrical conductor for a purpose which will subsequently be described. Spring 4 has an elongated body portion 75 and a pair of spring fingers 76 and 77 which extend upwardly and then rearwardly from points adjacent the opposite ends of the top edge 78 of the body. The fingers 76 and 77 are parallel with each other and are each slightly spaced from the respective ends of body 75. There is also a centrally located spring leg 79 which extends first upwardly from rear edge 78 and is then bent rearwardly and downwardly at an acute angle as shown at FIGS. 1 and 4. Leg 79 engages latch bar 5 to constantly urge the latch bar toward the position shown at FIG. 3 where tail 18 is held in a latched position to maintain a particular push button in a depressed position.

Extending downwardly from body 75 are four identical generally box-shaped leaf springs 81–84 which are integral with body 75. The springs 81–84 are parallel with each other and each of the springs has an opening 85 formed therein. Projecting upwardly from the center of the bottom leg 86 of each of springs 81–84 is a contact finger 87 which is used to make ground contact with a bulb mounted within a push button to illuminate the bulb when the button is depressed. As shown at FIG. 5, spring arms 81–84 are so spaced from each other that the contact tips 87 of the respective springs are generally centered transversely of each push button.

Formal in body 75 are a pair of openings 88 which are spaced apart the same distance as the bores 42 via which the switch assembly is mounted on an instrument or other electrical apparatus. In addition, there are a pair of locating bores 89 spaced apart the same distance as locating pins 90 which project forwardly of front wall 32 of the switch body. Pins 90 and bores 89 provide for precise positioning of the spring 4 relative to the body and other parts of the switch assembly.

As shown at FIGS. 1 and 4, latch bar 5 is elongated and extends between end portions 22 and 23 of the switch body. Latch bar 5 includes a rear wall 92 which, with the latch bar pivotally mounted to the switch body, projects downwardly toward and engages central body 21 at edge 93 to limit the downward pivotal movement of the latch. The spring leg 79 engages the top of latch bar 5 to normally urge the latch bar toward the position of FIG. 4. The bottom of wall 92 includes a flange 94 terminating at inside surface 95 of the wall.

As previously explained, tail 18 of each push button extends upwardly from rear wall 17. The upwardly facing end of tail 18 includes cam faces 96 and 97. When a push button is depressed, cam face 96 engages surface 94 of the latch bar to lift the latch bar against the action of spring 79 and thereby permit the tail 18 of push button 8 to enter notch 27.

As shown at FIGS. 1 and 2, tail 18 of each push button has a V-shaped front surface 80, and the width of the tail is slightly narrower than the width of each of notches 25–28. Front surface 80 merges with parallel side surfaces 80' of the tail.

The switch is assembled with the parts in the relative positions shown at FIG. 1. The manner of assembly will now be explained. First, contacts 57–59 are inserted in the respective slots 68–70 of each of push buttons 7–10. Next, the push buttons are positioned between ears 36 and 44 and pivot rod 11 is extended the openings in ears 36 and through the openings 20 of the respective push buttons to pivotally mount the push buttons. Next, washers 6 are inserted through the front of slot 24 and then, spring 4 is seated on front face 32 with locating pins 90 extending through the locating openings 89 in the spring. Suitable threaded fasteners are extended through openings 88 of the spring and bores 42 in the respective ends 22 and 23 to hold the spring in position on the front face of the switch body. The screws may also be used to secure the switch in position on the apparatus with which it is used.

The switch assembly 1 is advantageously used with an instrument having a casing wherein circuit board 52 is supported independently of the switch assembly. In such an arrangement, an opening is formed in the front of the casing (not shown) of the instrument and the switch assembly is merely inserted through the opening whereupon screws such as the screws 100 are used both to hold the switch assembly in position as well as to hold the spring 4 in position. The slots 50 and 51 guide switch assembly 1 into the proper position relative to the circuit board and assure that stationary contacts 54 on the circuit board are in the proper position relative to movable contacts 56 of the switch assembly.

In some instances, it is desirable to illuminate a depressed push button. The switch of this invention readily adapts itself for illumination of the buttons. As shown at FIG. 3, the illuminated version of the switch includes a bulb 110 inserted in a socket 111. Socket 111 is mounted on a board or support 112 of the instrument with which the switch is used. The mounting includes a connecting element 113 of electrically insulating material to assure that the socket is normally electrically insulated from the frame of the instrument. Electric power is supplied to one side of the bulb via a wire 114 whereas the other side of the bulb is connected to the outside of the socket 111. A second wire to energize bulb 110 is connected to a grounding plate 116 of the instrument at such a location that contact legs 76 and 77 engage this plate when the switch is properly positioned in the instrument.

As shown at FIG. 5 in phantom lines for the button 8, bulb 110 and socket 111 are positioned with their axes in a vertical plane including the contact finger 87. Turning now to FIGS. 3 and 4, it will be observed that contact finger 87 is moved when push button 8 is depressed so the contact finger engages the shell of socket 111. When finger 87 engages socket 111 a circuit is complete from wire 114 through the filament of the bulb 110, contact finger 87, the metal of spring 4, contact arm 76, plate 116 and wire 115. Hence, with wires 114 and 115 connected to a suitable power source, bulb 110 is illuminated when a button, for example the button 8, is depressed. Advantageously, when bulb and socket arrangements are provided within each button to illuminate the button, the button is made of a semi-transparent or translucent plastic material so the button itself will be illuminated as viewed by the operator at the front of the switch assembly. As previously mentioned, push buttons 7–10, switch body 2, and latch bar 5 are all formed from plastic material having good electrical insulating characteristics. The only metal parts of the assembly are the spring 4, pivot shafts 11 and 41, washers 6, and contacts 56.

OPERATION

The switch of this invention provides a selective OR mode of operation. In this regard, block out washers 6 cooperate with tails 18 of the several push buttons to positively prevent depressing one push button to a contact MAKE position while another push button is already in a contact MAKE position. As shown in FIG. 3, push button 8 is in a depressed condition in which the tail 18 is inwardly of wall 92 of latch bar 4, and in this position wall 92 engages rear face 99 of tail 18 to latch the push button in the down position. In this down position of the push button, contact 59 engages stationary contact 54 and by virtue of the length and springiness of the spring arms 61, 62, the contact tips 63 make good electrical contact with stationary contacts 54. Where bulb 110 and socket 111 are provided, resilient contact finger 87 engages the metallic socket and completes a circuit to light lamp 110 so button 8 is illuminated.

With the button depressed as shown at FIGS. 2 and 3, tail 18 enters notch 27 and V surface 80 forces blocking washers 6 to the position shown at FIG. 2 in which the outermost washers are against the respective end walls 33 and 34 of slot 24. With the washers in this position, any attempt to depress a second push button to a make contact position is blocked by those portions of the respective washers which obstruct the remaining notches 25, 26 and 28. Hence, if the operator of the switch inadvertently attempts to simultaneously depress two buttons, or to depress a second push button while he is holding a first push button down, such action is prevented by the blockout washer arrangement.

In a normal switching operation, a down push button is released in response to the initial travel of the tail of a second push button, as the second push button is depressed. Such initial travel of the tail of the second push button causes the cam face 96 to engage surface 94 of the latch bar to pivot the latch bar upwardly around pivot rod 41. As latch bar 4 is pivoted upwardly, cam face 97 of the down push button engages the lower edge of surface 95. Since the depressed push button is urges to a released position by the action of the spring 4, latch bar 5 is forced upwardly by the depressed push button as soon as cam face 97 engages the lower edge of the face 95. This causes release of the depressed push button before the newly depressed button reaches a position in which its contacts engage the fixed contacts of circuit board 52.

Hence, it can aptly be stated that the push button arrangement is such that when a push button in a down position is latched with its contact closed, a second push button cannot be moved to the down position to close its contacts until the first button is released and its contacts are open, and a second push button cannot be depressed to a MAKE contact position so long as a first push button occupies a down position in which its contacts are closed.

While a preferred embodiment of the switch assembly, in accordance with this invention, has been shown and described herein, it is contemplated that numerous changes can be made without departing from the scope of this invention as disclosed in the specification and defined in the appended claims.

What is claimed is:

1. A push button switch arrangement comprising a plurality of push button elements each movable between depressed and released positions; a latch common to said plurality of button elements said latch comprising a bar mounted for pivotal movement to a first position in which a depressed button element is latched and to a second position in which a depressed button element is released; means on each button element for moving said bar to said second position in response to movement of a button element from a released position toward a depressed position; means urging said bar toward said first position; block-out means separate from said bar and responsive to movement of one button element to a fully depressed position to prevent moving a second button element to a fully depressed position until said one button element is released;

and means constantly urging each of said push button elements toward a released position.

2. A push button switch according to claim 1 wherein said means urging said bar toward said first position includes a first portion of a spring; and said means urging said buttons toward a released position includes a spring integral with said aforementioned spring.

3. A push button arrangement according to claim 1 wherein the arrangement further includes, means mounting said plurality of push button elements for pivotal movement about a common axis between said depressed and released positions.

4. A push button arrangement according to claim 3 wherein each of said plurality of push button elements is formed from an electrically insulating material, and at least one contact is carried by each push button element for pivotal movement therewith.

5. A push button arrangement according to claim 1 wherein each of said plurality of push buttons has a tail portion, said bar is of generally L-shaped cross-sectional configuration, said tail portion of a latched push button is engaged by an inside surface of the base leg of the L-shaped portion, and said means on each button element for moving the bar to the second position includes a cam face on said tail portion engageable with the end edge of said base leg of the latch bar and effective to pivot said latch bar to said second position in response to movement of a button element toward a depressed position.

6. A push button switch according to claim 1 wherein, each push button has a tail presenting a generally V-shaped surface, and said block-out means includes a plurality of members in side by side relation to each other, housing means mounting said members for limited linear movement in a direction transverse to the direction of travel of a tail portion of a push button; said housing means including notch means, one in the path of travel of each tail portion of a push button, said notch means extending into the path of movement of said members and permitting a tail portion of a depressed button to move said members to notch obstructing positions whereby only one button can be fully depressed.

7. A push button switch according to claim 1 wherein each button has a plurality of rearwardly facing slots and a movable spring arm contact is positioned in each slot, each contact extending rearwardly of said button; and a plurality of fixed contacts are mounted in the path of travel of said movable contacts for engagement by the movable contacts upon movement of a button to a depressed position.

8. A push button switch according to claim 1 wherein, a portion of an integral leaf spring extends behind each button to normally urge each button to a released position, said portion including an upwardly extending contact tip adjacent the bottom of the button; a lamp bulb is positioned behind the front face of each button; and a second contact is positioned behind the face of each button in the path of travel of said upwardly extending contact, said upwardly extending contact and second contact cooperating to complete a circuit to energize said lamp bulb whenever a button is depressed.

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