DUAL PLUNGER ACTUATED SEALED COMBINATION SAFETY AND INTERLOCK SWITCH MECHANISM

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ABSTRACT

A pair of plunger actuated switches which are disposed in one portion of a sealed housing and the terminal connections for the switches are disposed in another portion of the sealed housing separate from the first portion. The switches are selectively actutable by a pair of opposite co-axial aligned plungers which extend into the switch body portion of the housing; the plungers are oppositely biased outwardly and are interconnected by a slidable rod whose ends are inserted within both of the plungers in such fashion that, when one plunger is depressed the opposite plunger is locked against actuation; the inner ends of both plungers are chamfered and in contact with rollers on the switch actuation levers so that when either plunger is depressed the switch actuator roller rides up on the chamfered end of the plunger to close switch contacts within each of the switches; the terminal strip in the terminal body portion of the housing is provided with a plurality of terminals; the terminal strip can be independently removed from the housing for rewiring or replacement without disturbing the arrangement in the plunger body portion of the housing.

5 Claims, 4 Drawing Figures
DUAL PLUNGER ACTUATED SEALED COMBINATION SAFETY AND INTERLOCK SWITCH MECHANISM

BACKGROUND AND SUMMARY OF THE INVENTION

The present invention relates to switch means and more in particular to plunger actuated switch means such as are used in reciprocating machinery, cam actuating mechanisms or the like.

Switches of the above described type, sometimes referred to as limit switches, are known and widely employed in the industry. They are adapted to be actuated by a movable member to close, respectively open, one or more circuits to initiate subsequent functions or operations of other members with which the movable member is associated, or other functions of the same member, as for instance in return stroke mechanisms. These fast acting switches are particularly useful in automated machinery, but are also employed in other installations involving movable members adapted to close, respectively open, switches by contact with a pivoted switch actuating lever.

The present invention provides an improved switch arrangement and switch actuating mechanism of the type herein referred to.

A pair of switches are disposed back to back in a sealed housing, which also includes a terminal strip for electrical connection to the switches and to the components to be actuated by the switches. Each of the switches is provided with a pivotal switch actuator lever actutable by chamfered surfaces on a pair of oppositely disposed axially aligned plungers which are normally oppositely spring biased in inactive position. Portions of the plungers extend outwardly of the housing for contact by a movable member with which the switch assembly is associated. In addition to the spring means, the plungers are interconnected within the housing by means of a spring guide rod which has the dual function of guiding the spring between the plunger ends, as well as providing a safety interlock to prevent one switch from being actuated when the other switch is actuated. The switches may have multiple switch contacts for consecutive closing or selective closing of either contact as determined by the degree of advance of the respective plunger inwardly of the housing. Similarly, the terminal strip is provided with a plurality of terminals corresponding to the number of switch contacts of both switches. The terminals may be connected to mechanisms to be operated by actuation of the switches or to indicator lights or the like. The housing embodying the switches, plunger mechanism and terminal strip is completely sealed. The terminal strip may be removed to access the internal components.

DETAILED DESCRIPTION OF THE INVENTION

With continuing reference to the drawings, FIG. 1 illustrates a switch housing 10 which, as shown, is composed of body portion 12 which includes the bottom of the housing, and body portion 14 superimposed thereon. The open end of body portion 14 is closed by a cover 16. The adjoining interfaces between body portions 12 and 14 of housing 10 are sealed by a gasket member 18. Similarly, the interfaces of the body portion 14 and cover 16 are sealed by gasket 20. Thus, the switch housing 10, in assembly, is completely seal tight to effectively exclude dust and moisture from the housing.

As illustratively, and for example, shown in FIG. 1, the switch housing 10 may be attached to a machine part 22 which may be the rod end of a fluid cylinder or the like. However, it should be understood that it is immaterial in what kind of installation the switches of the present invention are ultimately to be used.

As most clearly illustrated in FIG. 1, the body portion 14 of the housing 10 is provided with an inner wall portion 24 from the rear side of which extends a boss portion 26 partly into body portion 12 of housing 10. Mounted on boss portion 26 within body portion 12 are a pair of electrical switch units 28 and 30 mounted side by side and fastened to boss portion 26 by means of fasteners 32.

With further reference to FIG. 2, each of the switch units 28–30 is provided with a depressible normally spring loaded switch button 34 and 36.

In order to actuate switch units 28–30 by depression of switch buttons 34–36, a pair of identical switch actuator assemblies 38 are provided within body portion 12 of housing 10. As seen from FIG. 2, switch actuator assemblies 38 are mounted in reverse position relative to each other and each comprising a lever 40 pivotally supported on a pivot pin 42 adjacent each of the switches units 28–30. As seen in FIG. 1, pivot pin 42 for each of the levers 40 is supported at one end within the wall 13 of body portion 12 and at the other end within boss portion 26 of overlying body portion 14 and, thus, simultaneously provide an additional function of alignment of body portion 14 relative to body portion 12 during assembly. The lower ends of each of the switch actuating levers 40 are each provided with a roller 44.

With more particular reference now to FIGS. 2 and 4, the lower section of body portion 12 has opposite side wall portions 46 and 48 respectively of increased cross-section which each are bored through to each receive a bushing 100 of identical configuration. Bushings 95 are stationarily retained within bores 45 and 47 by means of lock pins 52 which extend through correspondingly aligned bores 54 in the lower part of body portion 14 (FIG. 1).

Each of the hardened bushings 95 is adapted to receive a reciprocable plunger 56 and 58, respectively, which have a portion normally extending outwardly from the side walls of body portion 12. Plungers 56 and 58 are axially reciprocable within their respective bushing 50, the bore of each of the bushings being sealed by means of sealing members 60. Inwardly of body portion 12, each of the plungers 56 and 58 is provided with an enlarged head portion 62 and 64, respectively, which provide shoulders for abutment against the inner ends of bushings 95 to thereby limit outward movement of plungers 56 and 58. The front end of each of the enlarged head portions 62 and 64 of both plungers is tapered as at 66 to provide inclined surfaces 68 in contact with the respective rollers 44 of switch actuating levers 40, as shown in FIG. 2.

As more in particularly illustrated in FIG. 4, plunger 56 is axially bored through from end to end providing a bore 70 which inwardly of the plunger body extends into a widened counter-bore 72. Counter-bore 72 is adapted to receive one end of an elongated expansion spring 74 which extends outwardly from plunger 56 through the enlarged head portion 62 and 64. The bore 70 of plunger 56 is adapted to receive a rod 76 which extends axially through the elongated spring 74 and likewise outwardly of the inner end of plunger 56. The outer end of through bore 70 of plunger 56 after the rod 76 has been inserted is thereafter closed by means of a set screw 78 to retain the rod 76.
Referring back to FIG. 2, the inner end of the opposite plunger 58 is provided with a blind bore 80 co-axially aligned with bore 72 in plunger 56. Bore 80 is adapted to receive the opposite end of elongated expansion spring 74 as well as the end of the guide rod 76 as shown. It will be noted from FIG. 2 that in the rest position of both plungers 56-58 guide rod 76 does not extend all the way into bore 80 in the opposite plunger 58 but ends a distance from the bottom of the bore, corresponding to the distance of individual maximum plunger movement inwardly of body portion 12, for a purpose to appear better.

With reference now to FIG. 3 in conjunction with FIG. 1, the body portion 14, which is superimposed in assembly upon body portion 12 of housing 10, retains in addition to switch units 28-30 which project into body portion 12 as shown in FIG. 1 at terminal mounting plate 82 mounted upon the bottom wall 24 by means of fasteners 84. Terminal plate 82 is provided with a plurality of terminal connections 86 of which selected ones or all may be connected to the respective switch units 28-30 by means of connectors 88. As mentioned previously, switch units 28-30 are independent units and may be internally constructed differently from each other and may contain multiple switch contacts from 1 up to the number of terminal connections 86 provided on terminal plate 82, so as to provide a plurality of switching combinations, the switch units being selectively normally opened, normally closed or both normally opened or normally closed. In this way, the switch housing 10 incorporates a plurality of entirely different and isolated switching circuits in a variety of combinations depending on the particular switch unit incorporated in a particular application. The various circuit combinations which are possible by means of incorporation of the present improved assembly, do not form a part of the present invention, and their detailed description according to requirements is not required.

Both opposite sides of body portion 14 are provided with tapped apertures 90 adapted to receive electrical cable connectors for connection to the terminals 86 of terminal plate 82, or, selectively, and as exemplarily illustrated, a pair of indicator lights 92-94 respectively may be conventionally connected to selected terminals 86. In the present example the indicator light 92 is electrically connected to switch unit 28 and indicator light 94 is electrically connected to switch unit 30.

The assembly of switch housing 10 is completed by attachment of a cover plate 16 upon body portion 14. As seen in FIGS. 1 and 3, cover plate 16 is likewise provided with a tapped bore 96 by which electrical connection may be provided with terminal plate 82 for electrical components or mechanisms to be actuated by either of the switch units 28-30. This may in addition to the indicator lights 92-94 or, conversely, tapped bore 96 may likewise be provided only with an indicator light.

It shall be understood that either of the three tapped bores 90, 92 and 94 may selectively receive electrical cable connectors for actuation of mechanisms or, indicator lights as illustrated or any other suitable electrical components for connection with the terminals 86 of terminal plate 82 as dictated by any particular requirement. Thus, this arrangement provides a plurality of combinations of electrical circuits for operation of a variety of components by selective actuation of either switch unit 28-30 and their respective multiple contacts incorporated within the switch units. The multiple contacts included within each of the switch units 28-30 are consecutively closed or opened depending on the degree of depression of switch buttons 34-36 in conjunction with the degree of depression of either plunger 56 or 58, causing the rollers 44 to ride up the inclined surface 68 of the tapered plunger ends 66. Plunger movement inwardly, of course, can be limited to any desired degree by means of appropriate design of the movable member, causing depression of either plunger to a predetermined degree so as to accordingly limit depression of switch buttons 34-36 at the desired contact opening or closing position within the respective switch units 28 or 30.

In operation: for illustration and for simplicity of description, the switch actuating mechanism of the present invention is shown to selectively operate a pair of indicator lights 92-94. In this example, indicator light 92 defines a green safety light and indicator light 94 defines a red safety light. Each of the opposite plungers 56 or 58, depending on the operational characteristic of the machinery or other apparatus with which the switch assembly 10 is associated. Conversely, the switch assembly 10, due to its construction as a single unit, may be attached to a moving member, such as a reciprocating carriage in an automated load handling device or the like, having appropriate stationary or adjustable stops at opposite ends of the stroke of the reciprocating member. It is also contemplated that the present improved switch assembly could be incorporated in mechanisms employing can means disposed at opposite sides of the present improved switch assembly, having cams adapted to intermittently and at intervals depress either plunger member 56 or 58 in accordance with the operational characteristic of the mechanism concerned.

In the simplified example illustrated herein, when plunger member 56 is depressed inwardly of switch assembly housing 10 by a member of the apparatus or mechanism with which the present improved switch assembly is associated, the roller 44 of switch actuating lever 40 of switch unit 28 is caused to ride up on the inclined surface 68 of the tapered inner end portion 66 of plunger 56, thereby pivoting lever 40 around pivot pin 42 towards the switch unit 28. This results in subsequent depression of switch button 34 inwardly of switch unit 28, a distance corresponding to the distance that plunger member 56 is depressed, that is, the distance which roller 44 is caused to move upward on the inclined surface 68 of tapered plunger end 66.

During depression of plunger 56 inwardly, elongated expansion spring 74 will be further compressed and guide rod 76 will be moved further inwardly of bore 80 within the opposite plunger member 58.

Upon maximum compression of plunger member 56 inwardly of body portion 12 of housing 10 to the point where roller 44 of actuating lever 40 has completely engaged movement on inclined surface 68 towards the cylindrical head portion 62 of plunger member 56, spring 74 is compressed to its maximum capacity between both plunger members and the end of guide rod 76 is moved all the way into bore 80 of opposite plunger member 58. Movement of plunger button 34 inwardly of switch unit 28 causes closing (or opening) of a specific circuit (not forming part of the present invention) suitably connected to terminal plate 82. In the present simplified example, when plunger member 56 is depressed inwardly the maximum designed distance to cause roller 44 of switch actuating lever 40 to be disposed on cylindrical surface 62 on the head portion of plunger 56, the green safety light 92 is energized, indicating continuing safe operation of the apparatus, machinery or other mechanism with which the switch assembly 10 is associated. In that position, indicated by phantom lines in FIG. 2, the center guide rod 76 will be disposed all the way within blind bore 80 of the opposite plunger member 58, thereby preventing actuation of plunger member 58 as long as plunger member 56 remains in actuated position.

As soon as the load is removed from plunger member 56, the force of elongated expansion spring 74 will cause plunger member 56 to be moved outwardly of housing 10, thereby unlocking plunger member 58 retraction of guide rod 76 with outward movement of plunger 56. By way of design of the machinery or apparatus with which the switch assembly 10 is associated and in timed sequence, the opposite plunger 58 will...
be depressed by means of abutment of a movable member or the like to actuate switch unit 30, causing energization of the opposite indicator light 94, which in the present example is a warning light indicated by red color. Thus, when plunger 58, which is associated with switch unit 30, is depressed the red warning light 94 will be energized to indicate that opposite plunger member 56 is locked into place by means of abutment of the inner end of guide rod 76 within the bottom of blind aperture 80 of the plunger member 58, preventing movement of plunger member 56 until the load on plunger member 58 is removed.

As repeatedly mentioned in the foregoing specification, tapped apertures 90–96 may be utilized for attachment of electrical cable connections instead of indicator lights 92–94 or a combination of both may be provided. The cables, if used, may have a plurality of leads for attachment to terminals 86 of terminal plate 82. Likewise, either one or both switches 28–30 may be provided with multiple contacts for electrical connection to terminal plate 82 to thereby provide a plurality of different circuits, as may be required.

Due to the construction of the switch housing 10 and internal arrangement of the components therein, and as described and shown in the drawings, housing portion 14 which supports all electrical components, including switches 28–30 and terminal plate 82, can be quickly removed from housing portion 12 for replacement of any of the electrical components in case of malfunction or for quick rewiring if different circuits are desired.

Thus, it is obvious from the preceding description in connection with the appended drawings, that the present improved dual switch arrangement substantially facilitates assembly and disassembly and rewiring for different circuits or quick replacement of any of the electrical components without disturbing the mechanical switch actuator assemblies.

The present improved dual switch actuator assemblies are constructed such as to function in coacting relationship with each other, providing a safety interlock feature to prevent one switch actuator assembly from being actuated when the other switch actuator assembly is in actuated position, thereby considerably increasing the safety aspects of automated equipment.

The present invention may be embodied in certain other forms without departing from the spirit and essential characteristics thereof, therefore, the present embodiment is to be considered in all respects as illustrative only and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description.

I claim:

1. A switch and switch actuating assembly adapted for actuation by a movable member, said switch assembly comprising a housing defining a first body portion and a second body portion removably attached thereto; said second body portion being provided with a cover; first and second switch units mounted on said second body portion for extension into said first body portion in substantially parallel alignment with each other; said first and second switch units each having a depresible contact button extending outwardly therefrom; and first and second switch actuator assemblies supported in said first body portion in reverse position to each other and each including a switch actuating lever pivotally attached at one end within said first body portion and in contact with said switch contact buttons of said first and second switch units; roller means mounted on the other ends of each of said switch actuating levers; first and second plunger means reciprocably supported in said first body portion in opposite axially aligned position to each other and each having a portion extending inwardly of said first body portion and a portion extending outwardly from said first body portion; said inwardly extending portion of said first and second plunger means having a tapered end for engagement with said roller means of said switch actuating levers; means cooperatively connecting said first plunger means to said second plunger means comprising a rod retained within said first plunger means for extension outwardly therefrom and axially into said second plunger means so that, upon depression of said first plunger means, said rod will be moved a predetermined distance further into said second plunger means into engagement against an internal abutment thereof; means retaining said rod in fixed position within said first plunger means; and resilient bias means to normally force said plunger means in opposite direction outwardly of said first body portion.

2. In the switch and switch actuating assembly as defined in claim 1, said second body portion being provided with means to mount a terminal plate; said terminal plate having a plurality of connector means for electrical connection with said first and second switch units and a plurality of terminals; means on said second body portion for mounting of electrical equipment thereto adapted for connection to said terminals of said terminal plate; said second body portion mounting said first and second switch units and said terminal plate being mounted such upon said second body portion as to be independently removable therefrom without disturbing the arrangement of said switch actuator assemblies and said plunger means.

3. In the switch and switch actuator assembly as defined in claim 2, first gasket means disposed between said first and said second body portions at the interface thereof to seal said switch housing against entrance of moisture and dirt.

4. In the switch and switch actuator assembly as defined in claim 3, second gasket means disposed between said cover and said second body portion at the interface thereof.

5. In the switch and switch actuating assembly as defined in claim 1, said resilient bias means comprising an expansion coil spring surrounding said rod, the opposite ends thereof being supported within said first and second plunger means.