Dec. 19, 1961 C. H. MILLERWISE 3,014,112

SWITCH AND ACTUATOR THEREFOR

Filed Dec. 28, 1959

2 Sheets-Sheet 1

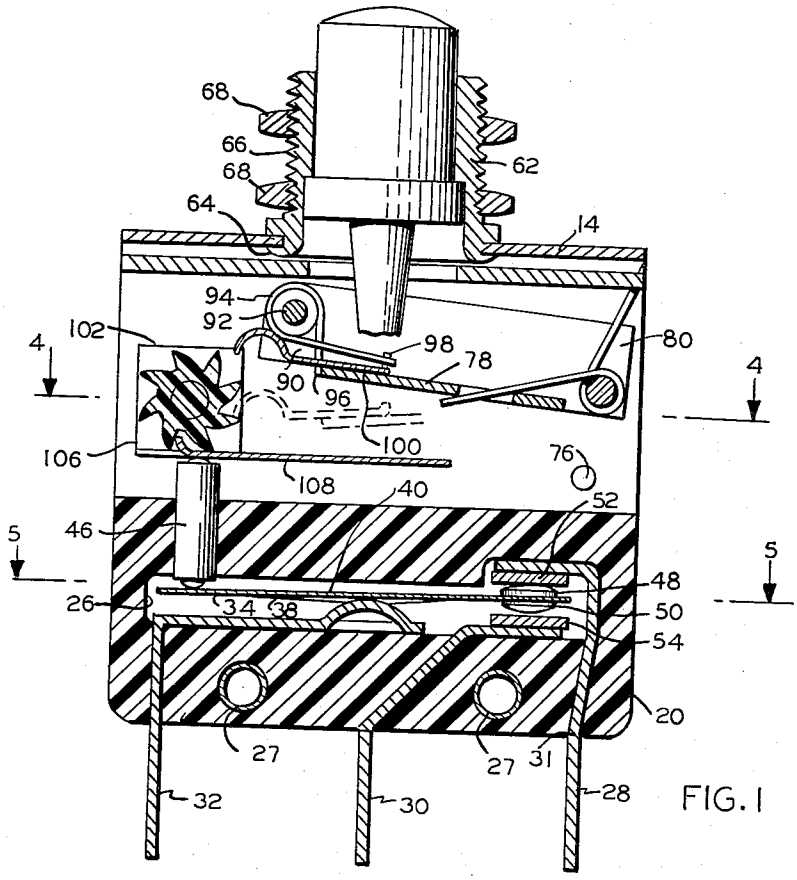


FIG. 1

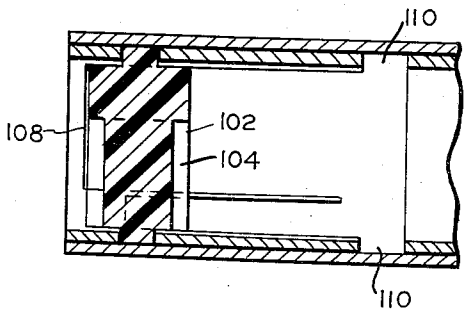


FIG. 4

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SWITCH AND ACTUATOR THEREFOR

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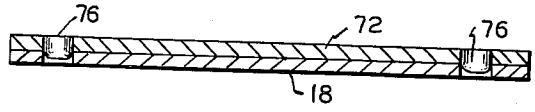


FIG.6

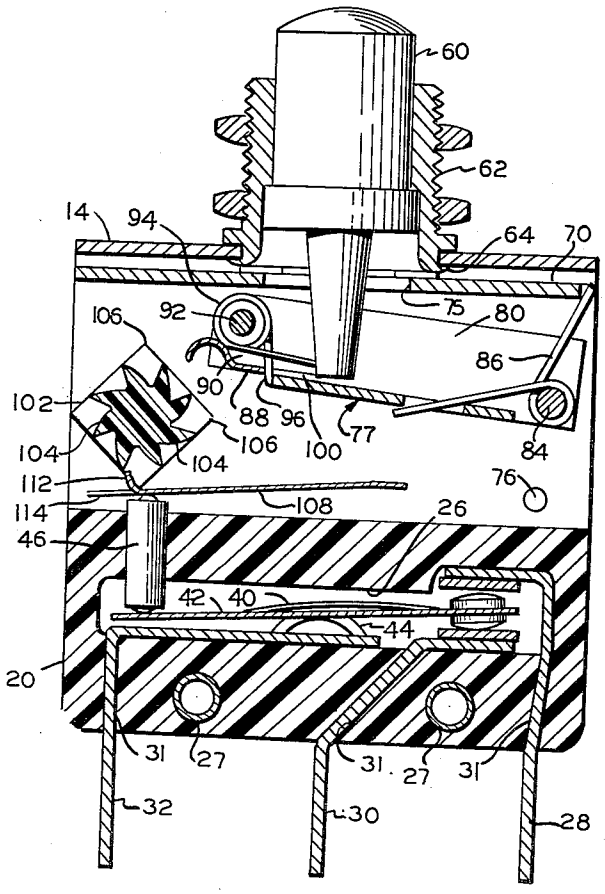


FIG.2

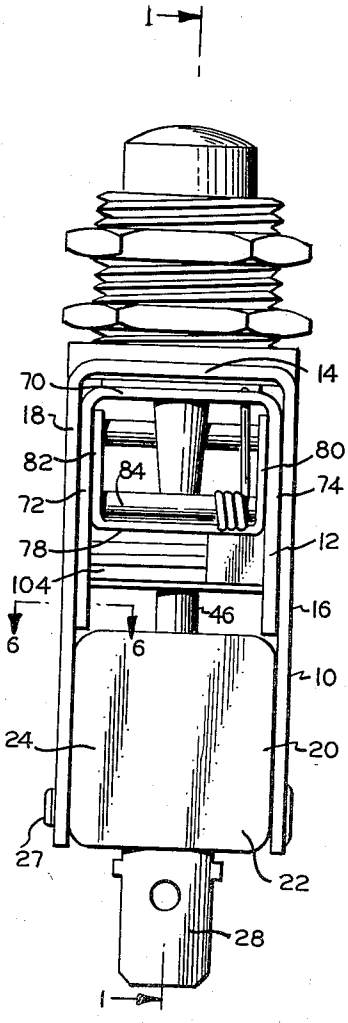


FIG.3

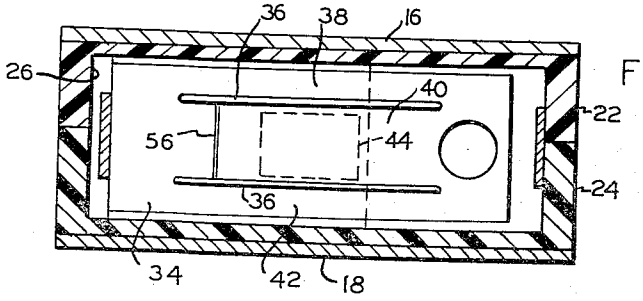


FIG.5

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SWITCH AND ACTUATOR THEREFOR

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Filed Dec. 28, 1959, Ser. No. 862,371
5 Claims. (Cl. 200—156)

This invention relates to an electric switch construction, and particularly to a switch construction having an actuator mechanism of the repetitively strokable type, the arrangement being such that on one operating stroke a particular circuit within the switch mechanism is energized and on the next succeeding stroke the circuit is de-energized.

In one particular embodiment of the invention a plunger-type actuator is utilized against the force of a contained spring means, the arrangement being such that the plunger is depressed to make a circuit, after which the contained spring means shifts the plunger back to its initial position without any effect on the circuit; on the next succeeding depression of the plunger the circuit is opened, after which the plunger is raised by the contained spring means. The switch is thus constructed so that one depression of the plunger opens the circuit and the next depression of the plunger closes the circuit, and so on with each succeeding depression of the plunger.

In switches of the above type, some disadvantages have been encountered by reason of the large forces usually required to operate the actuator, such as the plunger above specified. Also, in many cases the switches have been relatively costly to manufacture on a "complete line of switches" basis, since the switch structures have usually been complete redesigns from other types of switches so as to require extensive tooling and development charges.

It is an object of the present invention to provide switch assembly of the above-mentioned type and actuable with a relatively low operating force.

In connection with the above-mentioned object, an auxiliary object is to provide a switching arrangement incorporating a lever and pawl mechanism in connection with a switch-actuating ratchet construction, said pawl being so related to the lever and ratchet as to be easily moved over the ratchet teeth during movement of the lever during its resetting motion.

A further object of the invention is to provide a switch arrangement wherein a standard switch housing may be utilized within an improved mounting frame so as to permit different capacity switches to be operatively employed within the same type frame, the arrangement being such as to enable the manufacturer to maintain a full line of switches without necessity for manufacturing a large number of switch housing components or different operating structures for the switch blades.

A further object of the invention is to provide an arrangement of the above-mentioned type wherein a standard switch housing can be employed within a mounting frame, thereby enabling the manufacturer to secure the benefits of the invention without extensive testing or development work on the switch per se.

A further object of the invention is to provide an assembly wherein each of the components will operate for extended periods of time through a large number of operating cycles without parts jamming, parts slippage, or other malfunctioning.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

In the drawings:

FIGURE 1 is a sectional view of one embodiment of the invention taken on line 1—1 in FIG. 3;

FIG. 2 is a sectional view taken on the same line as FIG. 1, but illustrating the switch blade and operating ratchet during a different point in the operating cycle;

FIG. 3 is a right end elevational view of the FIG. 1 embodiment;

FIG. 4 is a sectional view taken substantially on line 4—4 in FIG. 1;

FIG. 5 is a view taken substantially on line 5—5 in FIG. 1; and

FIG. 6 is a sectional view taken on line 6—6 in FIG. 3.

Before explaining the present invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Referring to the drawings, there is disclosed a switch mechanism including a metallic frame structure defined by the main frame 10 and the sub-frame 12. Main frame 10 comprises web 14 and two walls 16 and 18 extending at right angles thereto.

Positioned between walls 16 and 18 in the space remote from web 14 is the dielectric switch housing 20. Housing 20 is conveniently formed in two half sections 22 and 24, each internally recessed to define the cavity generally indicated by numeral 26 (FIGS. 1 and 2). Mounting of the switch housing may be conveniently effected by the use of rivets 27 extended through suitable openings in the housing sections and frame walls. Cavity 26 of the housing mounts the three brass strips 28, 30 and 32 which extend outwardly through suitable slots 31 formed in the housing sections to form externally accessible terminals for reception of leads (not shown).

Strip 32 cooperates with strip 28 to define one circuit through the switch housing, and strip 32 cooperates with the strip 30 to define a second circuit through the switch housing. A switch blade 34, preferably of beryllium copper, is mounted within the housing to control current flow in the two defined circuits. As shown in FIG. 5 the switch blade is provided with two parallel slots 36 which define three connected longitudinal blade sections 38, 40 and 42. The blade is operatively seated within cavity 26 by positioning it so that its section 40 engages the hump portion 44 formed on strip 32. The left end portion of the blade is engaged by an operating plunger 46, and the right end portion of the blade is provided with the contact buttons 48 and 50 arranged in registry with the opposed contacts 52 and 54 which are carried on respective ones of strips 28 and 30. In the manufacture of the switch blade the center section 40 is crimped as at 56, so that the center section is placed in tension and the end sections 38 and 42 are placed in compression.

In operation, when plunger 46 is in its FIG. 1 position the tension in section 40 is effective to draw the blade upwardly such that contact 48 engages the contact 52, thereby placing the strip 32 in circuit with the strip 28.

Depression of plunger 46 to its FIG. 2 position is effective to depress the left end portion of the switch blade such that the sections 38 and 42 are moved downwardly alongside of the hump 44. As the downward movement takes place the direction of action of the pressure forces in sections 38 and 40 is changed such that the right end of blade 34 is snapped downwardly to place its button 50 in pressure engagement with the contact 54; as a result a circuit is completed from strip 32 to strip 30.

When the operating force (e.g., three ounces) on the upper face of plunger 46 is reduced by a predetermined amount (e.g., to one ounce) the switch blade is snapped back to its FIG. 1 position with button 48 in engagement with the contact 52. It will be understood that plunger 46 is primarily a force-directing member for controlling the direction of application of the built-in force provided by the crimping of the blade 34. The arrangement is such that a relatively small operating force on plunger 46 is effective to operate the switch blade from its FIG. 1 to its FIG. 2 position.

In order to apply the operating force onto plunger 46 there is provided a lever-ratchet-cam assembly in the space between housing 20 and the web wall 14. This assembly is controlled by a plunger 60 slidably mounted in the guide sleeve 62. As shown in FIG. 1 the guide sleeve is suitably secured to the web wall 14 of the frame structure 10 by flanging operations as at 64. The external surface of sleeve 62 is threaded at 66 to receive the nuts 68, the arrangement being such as to enable mounting of the entire assembly on a supporting panel (not shown) extending in the space between the two nuts 68.

The previously mentioned ratchet-cam-lever assembly is mounted as shown in FIG. 1 by means of the previously mentioned sub-frame 12. This sub-frame includes a web wall 70 and two generally parallel flanges or walls 72 and 74 extending within and alongside of respective ones of walls 16 and 18 as shown in FIG. 3. The sub-frame 12 may be mounted within the frame 10 by means of small pins 76 carried in walls 72, 74 and adapted to snap into the openings in walls 16 and 18 as shown in FIG. 6. The arrangement is such as to promote easy and convenient manufacture of the various components without interference by certain of the components during assembly of the other components. In this connection it will be seen that sleeve 62 can be installed onto the main frame 10 by the flanging operation at 64 prior to assembly of the sub-frame 12 into the main frame, and that when the sub-frame is installed in place the web wall 70 thereof constitutes a stop for limiting the downward movement of plunger 60.

The lower end portion of plunger 60 is of reduced cross section so as to project through an opening 75 in wall 70 in a manner to engage a lever 77. Lever 77 is preferably formed as a channel member having web wall 78 and the parallel flanges 80 and 82, the arrangement being such that flanges 80 and 82 serve to reinforce the lever and guide it during its pivotal movement around the pivot shaft 84.

In order to normally bias the lever upwardly to its FIG. 2 position there is provided a hairpin spring 86, the intermediate portion of which is trained around the shaft 84, and the end portions of which are anchored in openings formed in respective ones of walls 70 and 78.

The left end portion of lever 77 pivotally mounts a pawl element 88, said element being provided with two upstanding ears 90 having openings for reception of the pivot shaft 92 carried on the lever flanges 80 and 82. Normally the pawl is biased in a clockwise direction by the light hairpin spring 94, said spring being trained around shaft 92 and having one of its end portions 96 abutting against the left edge of lever wall 78. The other end of spring 94 is engaged in a notch 98 formed on the right end portion of the pawl, the arrangement being such that the pawl is yieldably urged by the spring to a position wherein the wall 100 thereof abuts against lever wall 78. When the assembly is employed in an upright position spring 94 is not necessary since the pawl is preferably constructed to have its center of gravity located to right of shaft 92 such that it is automatically biased to a position with walls 100 and 78 abutting together.

The pawls registers with the cam-ratchet assembly generally designated by numeral 102. This assembly may be formed in a number of separate pieces, although it also can be formed as a single plastic molding. Whatever the exact manner of formation, the assembly is constructed to have stub shafts at its opposite ends journaled within openings formed in the walls 72 and 74 of the sub-frame 12, the arrangement being such as to permit rotation of the assembly by downward movement of lever 77. The ratchet portion of the assembly defines a series of pawl-engaging teeth 104, and the cam portion of the assembly provides a number of lobes 106, it being noted that in the illustrated embodiment there are provided eight ratchet teeth and four cam lobes. Thus, the number of ratchet teeth is twice the number of cam lobes.

Each downward movement of the lever 77 about its pivot shaft 84 is effective to place one of the cam lobes in or out of pressure engagement with the switch actuator 46, the next subsequent downward movement of the lever 77 serving to place another one of the cam lobes in or out of pressure engagement with the actuator 46. In operation, during downward movement of the lever by plunger 60 to its dotted line position it will be noted that pawl 88 is effective on the ratchet teeth 104 to move the assembly 102 from the FIG. 1 position to the FIG. 2 position. On release of the pressure on plunger 60 the spring 86 is effective to reverse the direction of motion of lever 77 and return it to the FIG. 1 full line position. During this movement the pawl 88 automatically slips along the back edge of the engaged tooth 104. The light spring 94 is of comparatively low strength, and it does not appreciably interfere with movement of the lever 76 by the spring 86.

Assembly 102 is prevented from substantial reverse movement by means of the flexible arm 108, said arm having the wing portions 110 at its right end for mounting of the arm in slots formed in the walls 72 and 74 of the sub-frame 12. A section of the left end portion of arm 108 is turned upwardly as at 112 to form a detent for prevention of substantial reverse motion of assembly 102. Thus, as lever 77 is moved upwardly by spring 86 any tendency of the pawl 88 to rotate the assembly 102 in the counterclockwise direction is resisted by engagement of detent 112 with the ratchet teeth. Of course arm 108 offers substantially no resistance to movement of assembly 102 in the clockwise direction, since the detent 112 is automatically shifted out of the path of the teeth by the camming action of the lobe 106 on the flat portion 114 of the flexible arm.

It will be understood that the illustrated embodiment is characterized by an ability to be manufactured as a construction having a very small operating force. Thus, the resistance to downward movement of plunger 60 is the total of the resistances offered by spring 86 and the switch blade 34, together with any slight frictional resistances in the pivots for the various shafts and plungers. Spring 86 can be made as a relatively light spring, since the construction of lever 77 enables it to be formed with a relatively low mass and since the arrangement of pawl 88 is such that its spring 94 does not appreciably interfere with upward movement of the lever. In this connection it will be noted from FIG. 2 that the stop provided by pawl portion 100 is effective to limit the clockwise movement of the pawl so that its left end portion engages only the outer edge areas of the ratchet teeth 104. As a result the pawl does not have to be pivoted to a very great extent during upward movement of the lever 77 and frictional drag forces are minimized. Thus the spring 94 does not have to be very strong. In actual practice the spring 94 can be eliminated entirely in those situations where the switch assembly is utilized in an upright position as shown in the drawings.

The assembly can be located and used in various different installations, and the housing 20-blade 34 assembly can be removed, replaced or reinstalled as desired in accordance with different current capacities, contacts, contact arrangements, etc. Housing 20 is a standard item, and the entire assembly can therefore be manufactured with minimum tooling and developmental expenses.

The invention has been described with reference to a specific embodiment thereof, but it will be appreciated that various modifications may be incorporated without departing from the spirit of the invention as defined in the appended claims.

I claim:

1. The combination comprising a frame structure including a web and two substantially parallel walls extending right angularly therefrom; a tubular guide structure extending right angularly from the web and away from the parallel walls; a reciprocable plunger slidably mounted in said guide structure and having a portion thereof projecting into the space between the parallel walls; a separate switch housing carried between the parallel walls at a location spaced from the web and having an operating button projecting therefrom into the space between the housing and web; switch structure within the separate housing including button-controlled switch blade means and contacts operated thereby; a plunger-engaged lever of rigid inflexible character pivotally mounted in the space between the web and separate switch housing; ratchet-cam means rotatably mounted in the space adjacent the lever and having its cam portion in pressure engagement with the aforementioned operating button; and a pawl separately formed from the lever and freely pivotally mounted thereon, said pawl having a portion thereof registering with the ratchet teeth for effecting its operation.

2. The combination of claim 1 wherein the lever is of generally channel cross section.

3. The combination of claim 1 wherein the frame structure includes a main frame and a separately formed sub-frame, said sub-frame including two parallel walls extending along the first-mentioned walls and having an interconnecting wall portion thereon; said lever and ratchet-cam means being pivotally mounted on the sub-frame parallel walls.

4. In an electric switch structure of the repetitively strokable type, including a housing having first and second ends and a plunger mounted on said first end and a two-position switch mounted in the second end of said housing, the switch having an actuating button movable between first and second positions, the improvements comprising an actuator mechanism including a lever pivotally mounted in said housing and having a portion thereof

positioned in engageable relation to the plunger, said lever having a pawl pivotally mounted thereon, a unitary, cam-ratchet, said cam-ratchet being journaled in said housing for rotary movement, said pawl being adapted to engage the ratchet portion of said cam-ratchet upon movement of said lever to rotate the cam in a forward direction, a resilient arm secured at its one end to the housing and having its other free end interposed between said cam and the switch actuating button, said arm having a detent formed thereon and engageable with said ratchet to prevent reverse rotation thereof, whereby stroking of said plunger is effective to move said lever to cause said pawl to engage said ratchet and rotate said cam to move said resilient arm and said actuating button to one of its two positions with the detent being effective to prevent reversal of said cam-ratchet.

5. An electrical switch assembly of the repetitively strokable type, comprising an elongated housing having first and second ends and an interior chamber, a reciprocable plunger mounted on said first housing end and movable into said chamber, an electric switch located in the second end of said housing and having an actuating button movable into said chamber from a first to a second position, a lever pivotally mounted in said housing with its body engageable by said plunger and adapted to be pivotally moved thereby, a pawl pivotally mounted on said lever, a unitary cam-ratchet, said cam-ratchet being journaled in said housing for rotary movement, said pawl being adapted to engage the ratchet upon movement of said lever by said plunger to rotate said cam in a forward direction, a resilient arm secured at its one end to the housing and having its other free end interposed between said cam and said actuating button, said arm having a pawl detent formed thereon and engageable with said ratchet to prevent reverse rotation of said cam, whereby stroking of said plunger is effective to move said lever to cause said pawl to engage said ratchet and rotate said cam to move said resilient arm and said actuating button to one of its two positions.

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