

Nov. 24, 1964

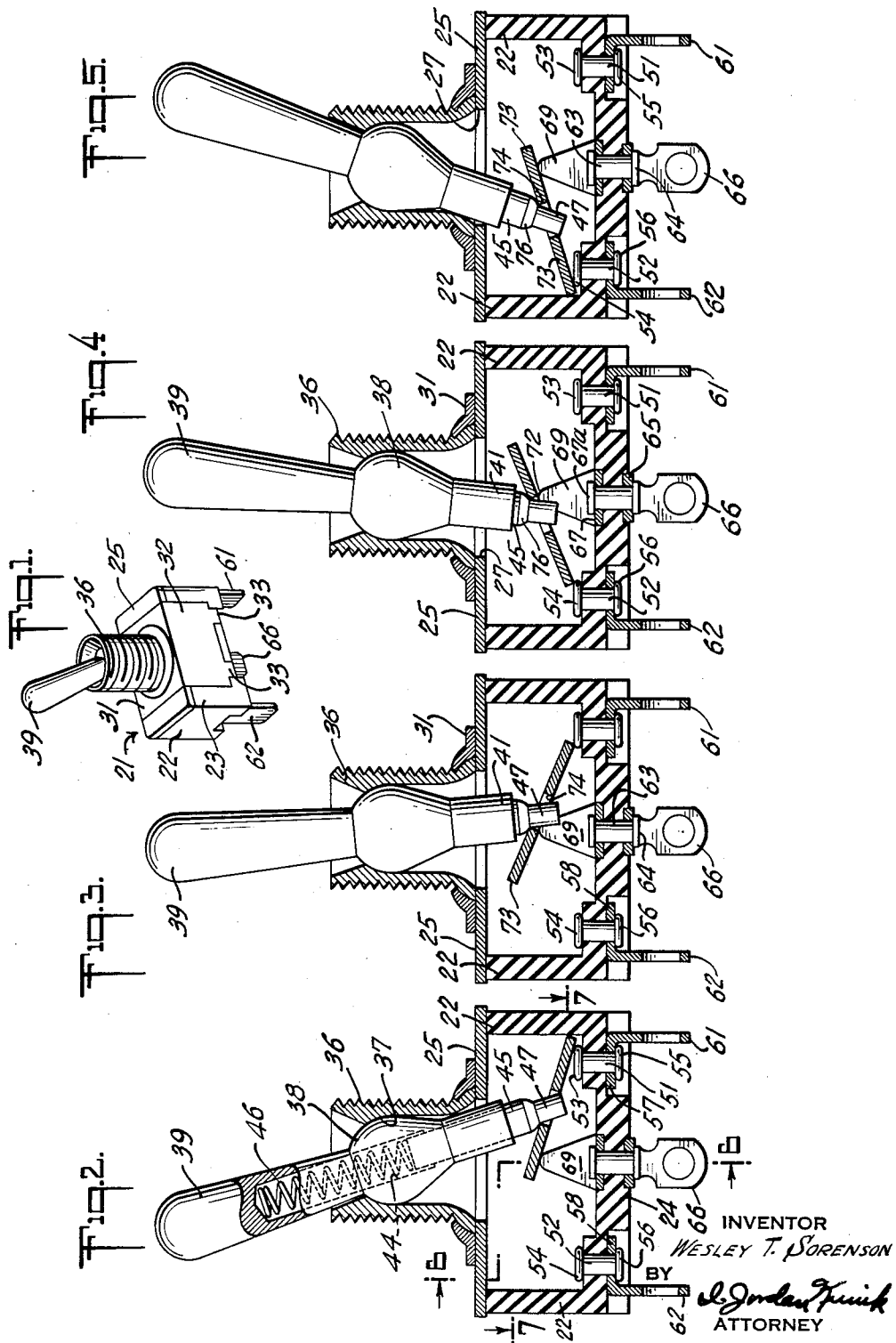
W. T. SORENSON

3,158,704

ELECTRIC SWITCH WITH FREE-FLOATING CONTACT LEVER

Filed May 18, 1962

3 Sheets-Sheet 1



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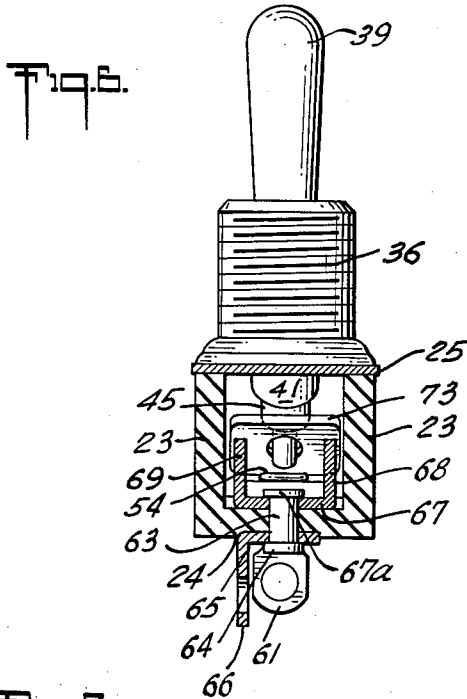
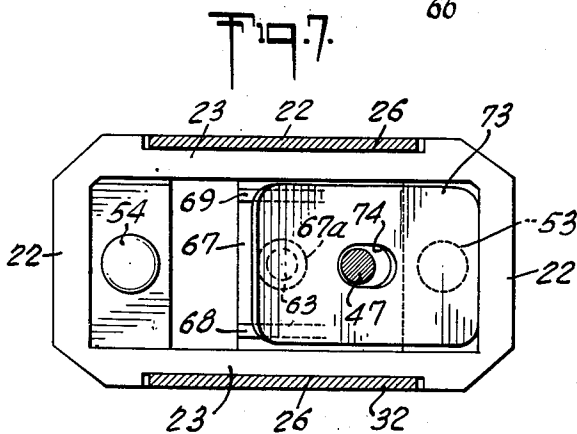
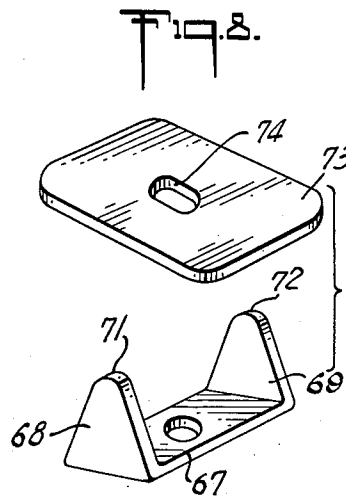
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3 Sheets-Sheet 2



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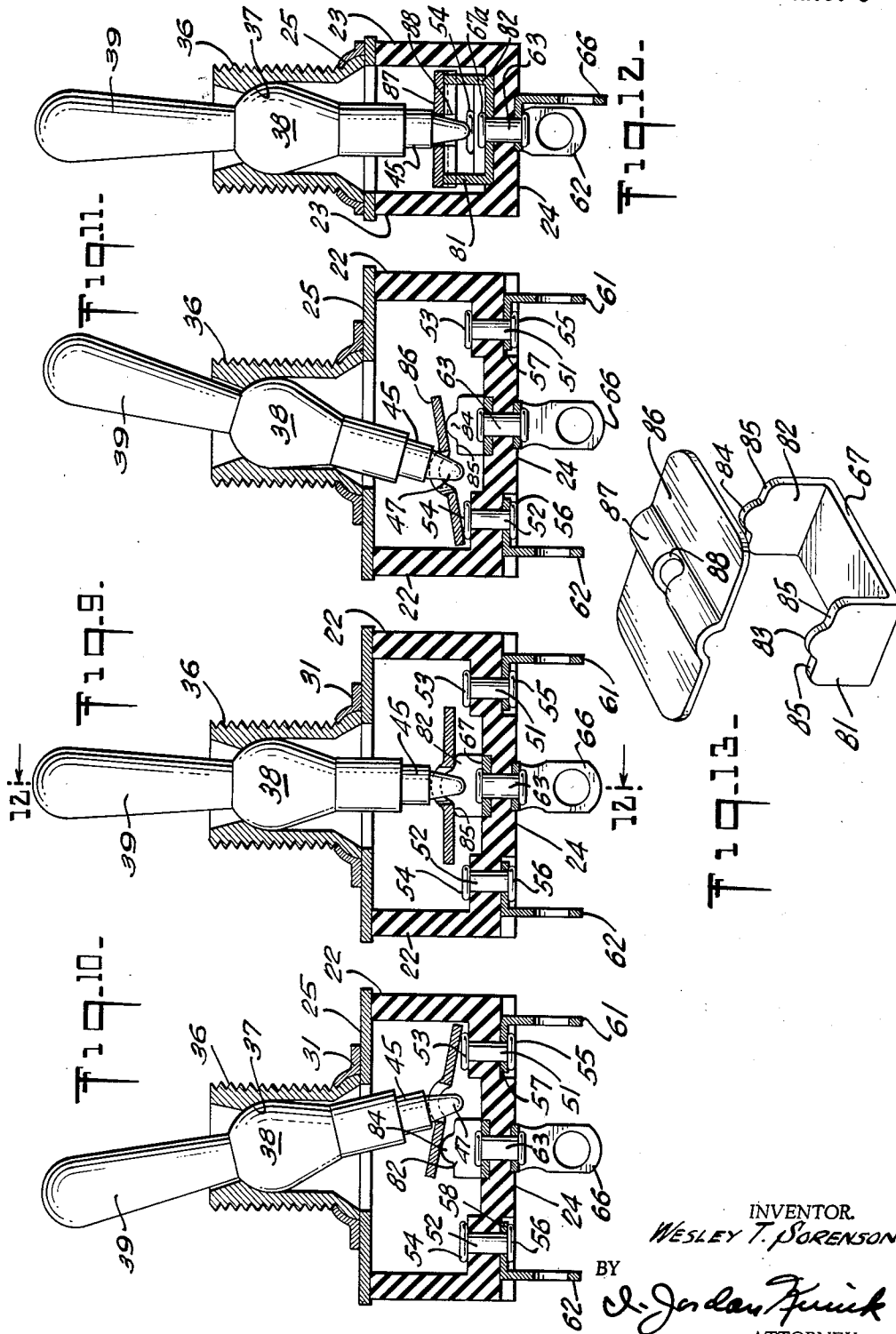
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ELECTRIC SWITCH WITH FREE-FLOATING CONTACT LEVER

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3 Sheets-Sheet 3



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3,158,704

ELECTRIC SWITCH WITH FREE-FLOATING CONTACT LEVER

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13 Claims. (Cl. 200-67)

This invention relates to electric switches, and more particularly to a switch having a free-floating and contact wiping lever operated by a toggle element.

An important feature of the improved switch of the present invention resides in the provision of a free-floating contact lever that is pivoted by means of toggle action into either one of two contact positions for controlling a pair of circuits operated by said switch. When the contact lever is moved into circuit closing position with either circuit contact, it produces a frictional wiping action thereon, whereby carbon buildup and heat-rise, usually experienced in contact switches, are greatly minimized, or eliminated.

The operation of the contact lever and its dynamic action are brought about without any integral mechanical linkages by means of a novel pivot support and by means of a spring biased element on the toggle handle which loosely engages an aperture in said lever for imparting rectilinear motion to the latter. As the lever moves over the support from one position to the other, it rides over the double fulcrum of the support element and pivots into circuit closing position with a respective circuit contact element. The end of the lever first comes in contact with a side portion of the contact head surface and while still in motion, the lever end frictionally wipes across the surface of the contact head until it comes to rest thereon. This sliding contact function serves to keep the contact head surface clean.

By slightly modifying the structure of the pivot fulcrums and of the contact lever, a three position, "center off" switch may be constructed within the purview of the present invention.

By providing a pair of spaced apart double fulcrums for the pivoting and rectilinearly moving contact lever, the actuating element that protrudes through said lever passes freely between said fulcrums and imparts the requisite motion for the lever. By means of the improved structure herein, as compared with prior art devices, it is now possible to produce a contact wiping pivot lever switch with a reduced number of parts which are considerably simpler in structure and which are far less expensive to manufacture and easy to assemble.

Still other objects and advantages of the invention will be apparent from the specification.

The features of novelty which are believed to be characteristic of the invention are set forth herein and will best be understood, both as to their fundamental principles and as to their particular embodiments, by reference to the specification and accompanying drawings, in which:

FIGURE 1 is a perspective view of a typical switch assembly embodying the present invention;

FIG. 2 is a greatly enlarged, central vertical section view of the device shown in FIG. 1, some parts being shown in elevation, and showing the toggle handle in the extreme left position and the circuit lever in a position where one of the two electrical circuits is closed;

FIG. 3 is similar to FIG. 2 wherein the toggle handle has been moved to an intermediate position and shows the circuit lever in a position just prior to its being pulled away from the first contact element;

FIG. 4 is similar to FIG. 3, wherein the circuit lever is shown first making contact with the contact element of

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the other circuit controlled by the switch, while the toggle handle has been moved slightly to the right;

FIG. 5 is similar to FIG. 2, wherein the toggle handle has been moved completely to the right and shows the circuit lever in contact with the contact head of the second terminal;

FIG. 6 is a view taken on line 6-6 of FIG. 1;

FIG. 7 is a view taken on line 7-7 of FIG. 1;

FIG. 8 is a greatly enlarged, exploded perspective view of the pivot support elements and the circuit lever;

FIGS. 9, 10 and 11 are vertical section views of a switch embodying the modification of the pivot elements and contact lever;

FIG. 12 is a view taken on line 12-12 of FIG. 10, and

FIG. 13 is a greatly enlarged exploded perspective view of the pivot support elements and circuit lever shown in FIGS. 9 through 12.

Referring now to the drawings in detail, the switch of the present invention comprises a box-like molded case, generally designated 21, made of a suitable electrically insulating material such as synthetic resin, Bakelite, or the like, and having a pair of opposing end walls 22, and a pair of side walls 23. The bottom of case 21 is enclosed by a floor 24.

The open top of case 21 is covered by a top plate 25 made of a suitable material such as sheet metal, or the like, and whose ends are substantially co-extensive with the outer surfaces of respective end walls 22. The sides of top plate 25 are recessed to coincide with recesses 26 in the outer surfaces of side walls 23 of case 21. See FIG. 7. Top plate 25 has a central aperture 27 through which the switch actuating element extends as will be described hereinafter.

Positioned over top plate 25 is a bracket 31 of sheet metal, which has a central, circular aperture coaxial with aperture 27 in plate 25. Bracket 31 has a pair of opposed downwardly extending leaves 32 which fit within respective recesses 26 of side walls 23. (FIG. 7.) The lower end of each leaf 32 is provided with a pair of spaced apart lugs 33 which tensionally grasp respective recesses, not shown, in the bottom surface of floor 24 to cause bracket 31 to secure top plate 25 firmly on the top of case 21.

A tubular threaded bushing 36 is secured at its lower end by suitable means, such as a force fit or the like, between top plate 25 and bracket 31 at their inner peripheral areas surrounding their respective central apertures for firm connection to case 21.

The interior wall of bushing 36 has an inwardly curving annular shoulder 37 with which said toggle or actuator element 38 cooperates, a portion of whose surface is curved to mate movably with said shoulder, whereby said toggle may operate pivotally relative to case 21. Toggle 38 has an upwardly extending handle 39 for manual operation, and a lower tubular extension 41. Handle 39, toggle 38, and tube 41 have a common bore 44, longitudinally accommodating an elongated control pin 45 which is normally urged outwardly from bore 44 by captive spring 46 therein.

Control pin 45 is made of a suitable electrically insulating material, such as Bakelite, nylon, or the like, and has an outer end of somewhat reduced diameter in the form of a nib 47 extending downwardly to actuate the movable circuit contact lever of the switch, as will be described hereinafter. While nib 47 is being urged downwardly to cooperate with the circuit lever, spring 46 acting upon the inner end of bore 44 urges toggle 38 upwardly and snugly against shoulder 37 without preventing pivotal motion of said toggle relative to bushing 36.

Positioned in floor 24 of case 21 is a pair of spaced apart, electrically conducting studs 51 and 52 which extend through said floor and are secured therein by means

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of molding or the like. Stud 51 has an electrically conducting contact head 53 and stud 52 has an electrically conducting contact head 54, both heads extending into the interior of case 21. The lower ends of said studs on the outer surface of floor 24 have rivet heads 55 and 56, respectively, to which are firmly secured electrically conductive brackets 57 and 58. Brackets 57 and 58 have downwardly extending electrically conducting lugs 61 and 62, respectively, which serve as terminals to which separate electrical circuits are connectible.

Positioned intermediate studs 51 and 52 is an electrically conducting stud 63 which also extends through floor 24 and is secured therein by means of molding or the like. The lower end of stud 63 extends downwardly to the exterior of case 21 and has a rivet head 64 which firmly secures an electrically conductive bracket 65 to the bottom of said case. Bracket 65 has a downwardly extending lug 66 which serves as a common terminal for the two circuits that are controllable by the switch. The upper end of stud 63 extends into the interior of case 21 and through a central aperture in the base of an electrically conducting horizontal support bracket 67. Stud 63 has a rivet head 67a which secures bracket 67 to the floor 24 of case 21.

Bracket 67 has a pair of integral, upwardly extending, electrically conductive, spaced apart pivot elements 68 and 69, somewhat triangular in shape, and terminating at their upper ends in smooth, rounded slide fulcrums 71 and 72, respectively.

Contact lever 73 is made of a rectangular piece of electrically conductive metal, such as brass, or the like, and is sufficiently wide to extend over both pivot elements 68 and 69 simultaneously. See FIG. 7. Lever 73 has a central, slightly elongated slot 74 which freely accommodates nib 47 which extends therethrough as shown in FIGS. 2 through 6. As toggle handle 39 is moved from one position to the other, nib 47, being urged against either of the opposite end portions of slot 74, causes lever 73 to move rectilinearly from one end of case 21 to the other and to move pivotally, while slidably riding over both rounded fulcrums 71 and 72.

Formed between nib 47 and the main portion of pin 45 is an annular beveled shoulder 76 which is wider than slot 74 and which, under the action of spring 46, constantly urges lever 73 against fulcrums 71 and 72, regardless of the position of said lever. Support elements 68 and 69, and concomitantly, fulcrums 71 and 72, are spaced apart sufficiently to permit the free reciprocating movement of nib 47 therebetween when it is operated to move the contact lever from one position to another.

Contact heads 53 and 54 are spaced a predetermined distance apart from fulcrums 71 and 72, whereby the end of contact lever 73, pivotally moving into circuit closing position with a respective contact head, first touches the nearest portion thereof. This first contacting position is achieved when toggle handle 39 just passes its vertical position in either direction, as shown in FIGS. 3 and 4.

Further movement on the part of toggle handle 39 causes nib 47 to move contact lever 73 in such a manner that its contacting edge frictionally moves across and wipes the top of the respective contact head, or with which it establishes a closed circuit whereby the accumulation of deleterious matter on the contact surfaces is effectively prevented. The extent of the follow-through movement can be observed by comparing the intermediate positions of contact lever 73 in FIGS. 3 and 4 on the one hand, and in FIGS. 2 and 5 on the other hand, where the contact lever is in its final rest position for establishing alternate circuit closing conditions for terminal lugs 61 and 62, respectively.

The frictional contact wiping action not only takes place during the closing of a circuit when lever 73 comes into engagement with either of the contact heads 53 and 54, but also produces the wiping action when said lever moves into the open circuit position in respect of a partic-

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ular contact head. This is manifest by noting that the positions of lever 73 in FIGS. 3 and 4 are equally indicative of initial circuit closing conditions or final circuit opening conditions depending upon the direction in which toggle handle 39 is moved.

In the alternative embodiment of the invention shown in FIGS. 9 through 13, wherein similar parts have the same reference numerals as in FIGS. 1 through 7, the fulcrum elements integral with support bracket 67 are now in the form of generally rectangular vertical spaced apart electrically conductive brackets 81 and 82. Formed integrally in the top edge of each bracket 81 and 82 intermediate the vertical edges thereof is a small arcuate protuberance or boss 83 and 84, respectively, bounded on each side by a pair of shoulders 85.

Mounted on brackets 81 and 82 jointly is a substantially rectangular, electrically conductive contact lever 86 which, intermediate its ends, has a lateral arcuate deformation 87, the bottom surface of which has a curvature substantially equal to that of bosses 83 and 84, to form mating and indexing surfaces therewith. The central portion of boss 87 has an aperture 88 which loosely accommodates nib 47. As shown in FIG. 9, when toggle handle 39 is in the vertical neutral or central position and nib 47 is urged downwardly by spring 44, contact lever 86 assumes a substantially horizontal position by virtue of the mating of boss 87 with bosses 83 and 84, and of the support given by shoulders 85 to those portions of contact lever 86 on either side of boss 87.

In actuality, there is a mutual interaction of the parts whereby the interengagement between bosses 83 and 84 with boss 87 establishes the position of contact lever 86, and, concomitantly, stabilizes toggle 38 in a vertical "central off" position whereby both circuits controlled by the switch are in the open circuit condition.

When toggle handle 39 is moved to the left as shown in FIG. 10, nib 47 engaging an edge of aperture 88 causes lever 86 to move to the right whereby it closes an electrical circuit with contact head 53. In bringing about the movement of lever 86, the disengagement between boss 87 and bosses 83 and 84 is permitted by the yieldability of spring 44 with only a small modicum of force being exerted upon toggle handle 39.

In FIG. 11 the toggle handle 39 has been moved to the right, while contact lever 86 has been moved to the left to close the circuit with contact head 54.

In FIGS. 10 and 11 the respective positions of contact lever 86 is shown in its final resting place in respect of the two closed circuits. It is to be understood, however, that the dimensions of support brackets 81 and 82 and of bosses 83, 84 and 87 are such that when contact lever 86 first closes the circuits with respective contact heads 53 and 54, the respective edges of said lever make contact with said contact heads in the same manner as shown in FIGS. 3 and 4, whereby the frictional contact wiping action takes place in order that the contact element heads remain clean. This wiping action is operative both on the making and on the breaking of the circuit between lever 86 and contact heads 53 and 54, respectively.

Although the apparatus has been illustrated and described as providing a toggle for producing the contact lever motion, it is understood that the toggle element may be replaced by other suitable actuating mechanisms such as slides, pushers, tipplers, or the like, which contain a spring biased element for yieldably engaging the contact lever for moving the latter into any of the selected circuit positions thereof.

It is claimed:

1. An electric switch comprising a case, a pair of spaced apart contacts in said case, a pair of spaced apart fulcrums in said case intermediate said contacts, a contact lever made of a single piece of electrically conductive metal, said lever being movable slideably and pivotally on both of said fulcrums simultaneously, a slot in said lever, and a spring biased actuating element mounted mov-

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ably in said case, a portion of said actuating element extending through said slot and moving freely between said fulcrums, the movement of said actuating element causing said lever to move rectilinearly in respect of said case and pivotally in respect of said fulcrums.

2. An electric switch comprising a case, a pair of spaced apart contacts in said case, a pair of spaced apart fulcrums in said case intermediate said contacts, a contact lever made of a single electrically conductive piece of metal, said lever being movable slideably on both of said fulcrums simultaneously for rectilinear action in respect of said case and for pivoting action in respect of said fulcrums, a spring biased actuating element mounted pivotally in said case, and a slot in said lever through which said actuating element extends, the movement of said actuating element producing said rectilinear and pivoting motions on the part of said lever, said actuating element passing freely between said fulcrums as said lever changes its position relative thereto.

3. An electric switch comprising a case, a pair of spaced apart contacts in said case, a pair of spaced apart fulcrums in said case intermediate said contacts, a contact lever made of a single piece of electrically conductive metal, said lever being movable slideably and pivotably on both of said fulcrums simultaneously, a slot in said lever, and a spring biased actuating element movably mounted in said case, a portion of said actuating element extending through said slot and being movable between said fulcrums when said actuating element is moved to cause said lever to move rectilinearly in respect of said case and pivotally in respect of said fulcrums, and alternately to make contact with either of said contacts, said contacts and said fulcrums being disposed in relation to each other whereby each end of said lever passes frictionally over the surface of a respective contact while closing and opening the electrical circuit therebetween.

4. An electric switch comprising a case, a pair of spaced apart contacts in said case, an electrically conductive support element in said case intermediate said contacts, a pair of integral spaced apart upwardly extending pivot elements on said support element, the upper ends of said pivot elements forming a pair of fulcrums, a contact lever made of a single piece of electrically conductive material, said lever being movable slideably and rectilinearly within said case on both of said fulcrums and pivotable thereon, a slot in said lever, and a spring biased actuating element on said case, said actuating element extending through said slot and movable between said fulcrums when said lever moves in its rectilinear and pivoting actions.

5. An electric switch comprising a case, a pair of spaced apart contacts in said case and an electrically conductive support element in said case intermediate said contacts, a pair of spaced apart upwardly extending pivot elements formed integrally on said support element, the upper ends of said pivot elements forming a pair of fulcrums, a contact lever made of a single piece of electrically conductive metal, said lever being movable slideably and rectilinearly within said case on both of said fulcrums and pivotable thereon, a slot in said lever, and a spring biased actuating element in said case extending through said slot and at least partially into the space between said fulcrums, the rectilinear motion of said actuating element producing the rectilinear and pivoting motion of said lever, said contacts and said fulcrums being disposed in relation to each other whereby each end of said lever passes frictionally over the surface of a respective contact while closing and opening the electrical circuit therebetween.

6. An electric switch comprising a case, a pair of spaced apart contacts in said case, a pair of spaced apart fulcrums in said case intermediate said contacts, a contact lever movable slideably and pivotably on both of said fulcrums simultaneously, a slot in said lever, and an actuating element mounted movably in said case, a portion of said actuating element extending completely through said slot

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from the top side of said lever beyond the bottom side thereof, the portion of said actuating element extending beyond the bottom of said lever being movable freely in the space between said two fulcrums when said lever moves slideably and pivotably on said fulcrums.

7. An electric switch comprising a case, a pair of spaced apart contacts in said case, a pair of spaced apart fulcrums in said case intermediate said contacts, a contact lever movable on both of said fulcrums simultaneously for both rectilinear and pivoting action in respect thereto, an actuating element mounted movably in said case and engaging said lever to produce said rectilinear and pivoting motions, said actuating element passing freely between said two fulcrums as said lever changes its position relative thereto, a boss on each of said fulcrums, a deformation in said lever accommodating both of said bosses simultaneously for indexing said lever in an open circuit position relative to both of said contacts.

8. An electric switch comprising a case, a pair of spaced apart contacts in said case, a pair of spaced apart fulcrums in said case intermediate said contacts, a contact lever movable on both of said fulcrums simultaneously for both rectilinear and pivoting action in respect thereto, an actuating element mounted movably in said case and engaging said lever to produce said rectilinear and pivoting motions for bringing said lever alternately into contact with either of said contacts with a wiping action, said actuating element passing freely between said two fulcrums as said lever changes its position relative thereto, a boss on top of each fulcrum, each of said bosses being bounded by a pair of shoulders on its respective fulcrum, a deformation of said lever accommodating both of said bosses simultaneously when said actuating element is in a neutral position, said shoulders cooperating with said contact lever on both sides of said deformation for maintaining said lever in an open circuit position relative to both of said contacts when said actuating element is in a neutral position.

9. An electric switch comprising a case, a pair of spaced apart contacts in said case, a pair of spaced apart fulcrums in said case intermediate said contacts, a contact lever movable on both of said fulcrums simultaneously for both rectilinear and pivoting action in respect thereto, an actuating element mounted movably in said case and engaging said lever to produce said rectilinear and pivoting motions, said actuating element passing freely between said two fulcrums as said lever changes its position relative thereto, means on each of said fulcrums and means intermediate the ends of said lever cooperating with each other to locate said lever in an open circuit position relative to both of said contacts when said actuating element is in a neutral position.

10. A switch according to claim 9 wherein said actuating element is spring biased and urges said lever against said fulcrums, the means on said fulcrums and the means on said lever being disengaged from each other against the action of said spring when said actuating element is moved selectively in opposite directions for causing said lever to close an electrical circuit with either of said contacts.

11. A switch according to claim 9 wherein the means on each of said fulcrums constitutes an integral arcuate boss and said means on said lever constitutes an arcuate deformation which mates with both of said fulcrums.

12. A switch according to claim 9 wherein said contacts and said fulcrums are disposed in relation to each other and the length of said lever is determined to cause the latter to pass frictionally over the surface of a respective contact while closing and opening the electrical circuit therebetween when said actuating element is moved in either of two opposite directions relative to said neutral position.

13. A switch according to claim 9, and further comprising spring biasing means connected to said actuating element, said spring biasing means being operative upon

said lever to cause, in one position of said actuating element, the yieldable interengagement between the means on said fulcrums and the means on said lever, said spring biased interengagement in turn producing an indexing action upon said actuating element.

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