Oct. 17, 1944. C. A. SCHAEFER 2,360,723

ELECTRIC SWITCH

Filed March 27, 1941 2 Sheets-Sheet 1

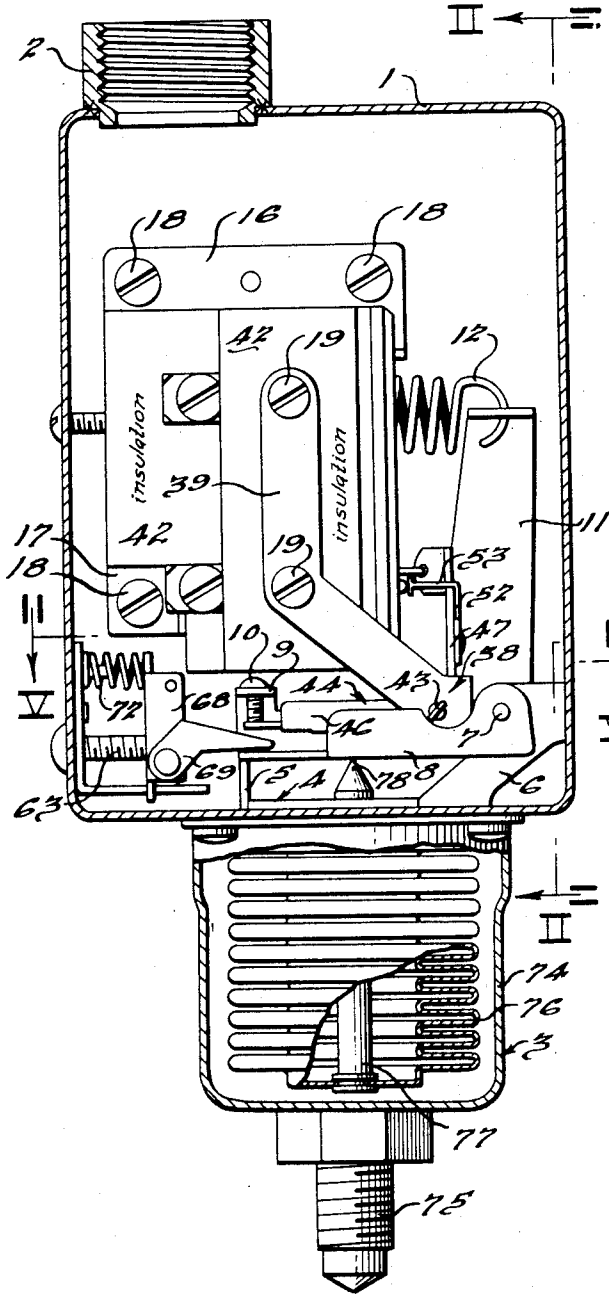


FIG. 1.

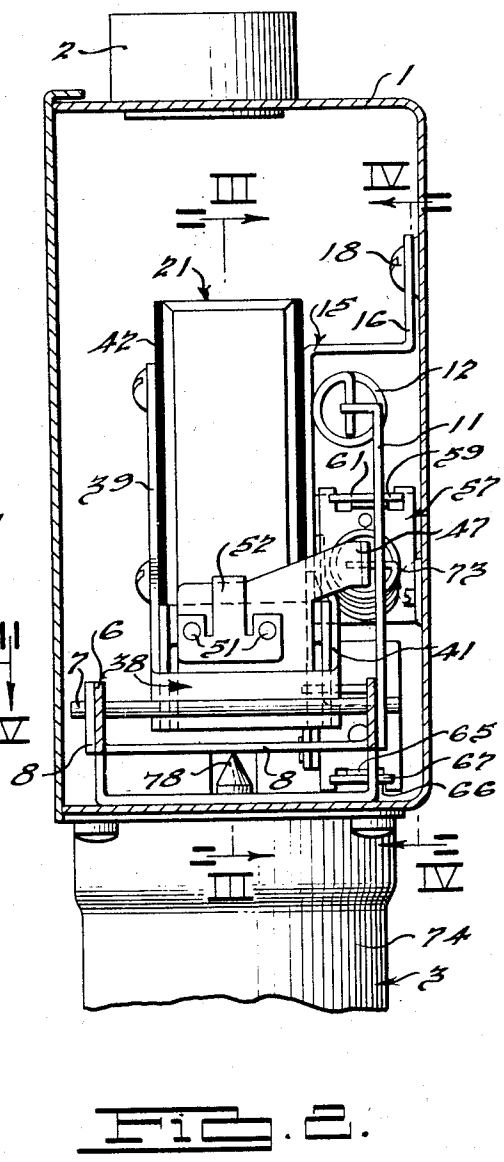


FIG. 2.

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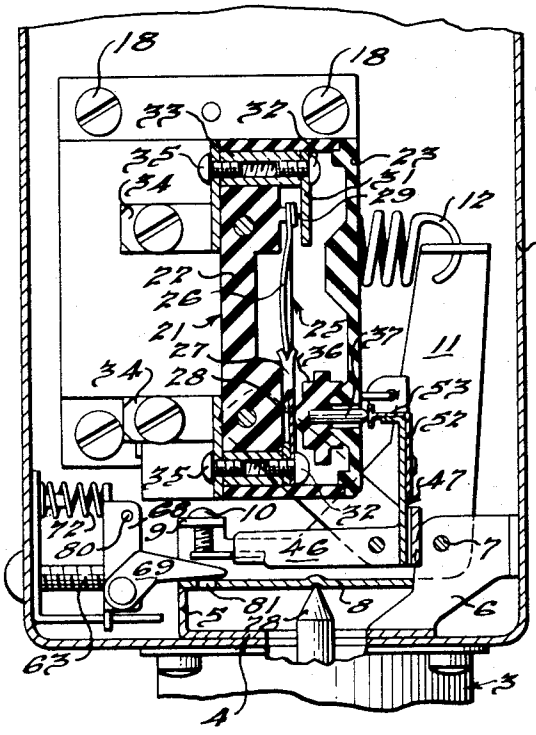
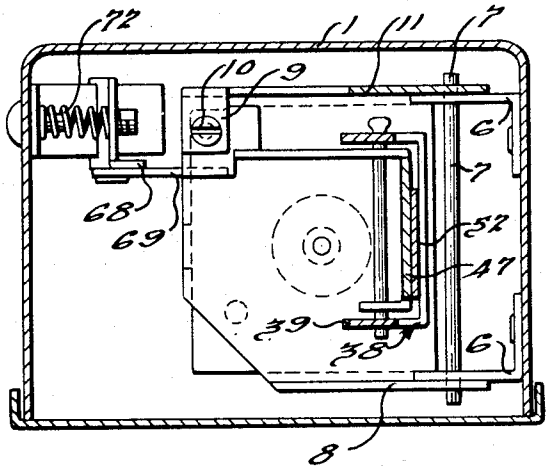


Fig. 3.



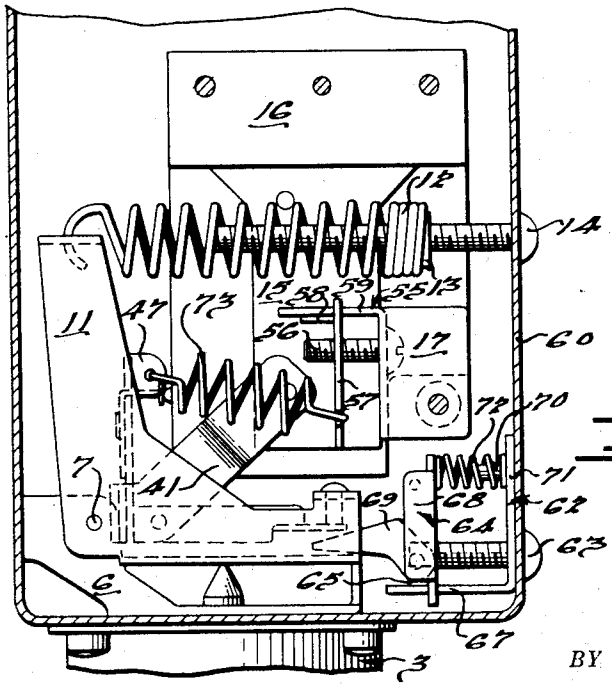


Fig. 5.

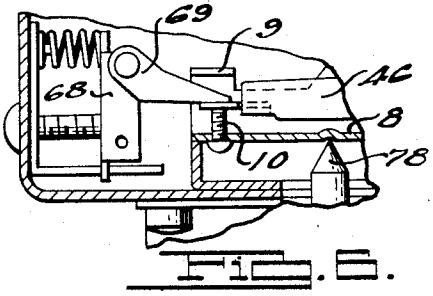


Fig. 6.

Fig. 4.

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ELECTRIC SWITCH

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Application March 27, 1941, Serial No. 385,411

16 Claims. (Cl. 200—83)

This invention relates to devices for making and breaking electrical circuits and more particularly to electric switches automatically operable in response to an exterior condition.

An object of the present invention is to provide an improved form of differential adjustment for an electric switch.

Another object of the invention is the provision of differential adjusting means for a snap acting switch which will utilize practically the full sensitivity inherent in the switch.

Another object of the invention is an improved form of differential adjustment for an automatic electric switch which is applicable to either constant "on" or constant "off" point with ready interchangeability.

Other objects and features of the invention will be readily apparent to those skilled in the art from the specification and appended drawings illustrating certain preferred embodiments in which:

Figure 1 is a side elevational view of the automatic electric switch according to the present invention with the parts broken away to show internal parts.

Figure 2 is a vertical sectional view taken on the line II—II of Figure 1.

Figure 3 is a vertical sectional view taken on the line III—III of Figure 2.

Figure 4 is a vertical sectional view taken on the line IV—IV of Figure 2.

Figure 5 is a horizontal sectional view taken on the line V—V of Figure 1.

Figure 6 is a partial figure of the differential adjustment with constant cut-in point.

The switch as illustrated in Figures 1–6 inclusive comprises a housing 1 having a removable cover and openings for the reception of a conduit connector 2 and a normal pressure responsive actuating means 3. Rigidly secured within the interior of the housing at the lower end thereof is a supporting plate 4 having an inwardly bent portion 5 at one extremity and inwardly directed leg members 6 at the other. The leg members 6 are provided with openings through which is passed a rod 7 which pivotally supports a main operating lever 8. A flange 9 bent from a side of the operating lever 8 to a position parallel with and spaced from the main surface of the lever has a stud 10 threaded thereinto and directed toward the main surface of the lever. An arm 11 provided by an extended side of lever 8 carries one end of a range spring 12, the upper end of which is secured to a range adjusting nut 13 threaded on an adjusting screw 14 having an end accessible at the outside of the housing 1 provided with a screw driver slot for rotation to increase or decrease the spring force acting on lever 8. Carried upon the back wall of housing 1 is a supporting bracket 15 having flanges 16 and 17 through which studs 18 are passed to rigidly secure the bracket to the wall. Mounted upon the bracket 15, as by studs 19, is a self-contained switching unit 21 of the same general type disclosed in the McGall Patent No. 1,960,020. The switching unit 21 comprises a cup shaped enclosure 22 having a cover 23 secured thereto. Within the enclosure 22 is disposed a leaf spring 25 with arm portions 26 thereof engaging V-shaped bearing ends of arms 27 of a conducting plate 28 secured within the enclosure 22. Upon the leaf spring 25 and at an end thereof is securely mounted a contact 29. Cooperating with the contact 29 for making and breaking an electric circuit is a stationary contact 31. As shown herein, the arms 26 of leaf spring 25 are so disposed within the bearing ends of arms 27 as to cause the spring to exert its force to bias the contacts 29 and 31 toward engaged position. The conducting plate 28 and the stationary contact 31 are secured to enclosure 22 by studs 32 threaded into the lower ends of conducting inserts 33 disposed at either end of the switching unit 21. Conductor terminals 34 also are mounted upon the switching unit at either end thereof, being secured thereto by studs 35 threaded into the upper extremities of the conducting inserts 33. To actuate the leaf spring 25 and thereby move the contacts 29 and 31 to engaged or disengaged positions, there is provided within the enclosure 22 a pin 37 having a portion thereof extending through an opening in the cover to the exterior and having a button member 36 secured to its inner end in abutting engagement with leaf spring 25. Inward movement of the pin 37 will, through the button 36, cause the main body portion of leaf spring 25 to move past the point of engagement of the arms 26 with the bearing ends of arms 27 thereby changing the line of force of the spring to move the contact 29 away from contact 31 with a snap action.

A generally U-shaped supporting member 38 is secured to the switching unit 21 by the studs 19 passing through leg portions 39 and 41 of the member 38 and into support 15. Disposed on either side of the switching unit 21 are insulating sheets 42, held in position by the studs 19 passing through openings therein.

Legs 39 and 41 are provided with openings therethrough for the reception of a pivot pin

43 upon which is pivotally supported the member 44 of general L-shape with a horizontal leg 46 and vertical leg 47. The leg 47 has secured thereon by rivets 51 a resilient spring piece 52 having a horizontal arm 53 which engages the switch operating pin 37. This resilient connection provides for overtravel of leg 47 without damage to the switch parts.

Secured to flange 17 of supporting member 15 as by riveting is an L-shaped member 55. A stud 56 passing through the flange 17 and the L-shaped member 55 carries a notched movable member 57 for movement thereon upon rotation of the stud. The movable member 57 has a portion 58 bent therefrom and disposed adjacent leg 59 of member 55 and has the notch 61 thereof engaging the leg 59. The bent portion 58 and the notch 61 cooperate with leg 59 to support and guide member 57 in its movements.

Rigidly secured within housing 1 to a side wall 60 thereof is an L-shaped bracket 62. A stud 63 is passed through both the side wall 60 and a leg of the bracket 62 and carries a movable member 64 upon its inner end and is provided at its outer end with a screw driver slot for rotation thereof to move the movable member 64 in or out on the stud. The movable member 64 is notched as at 66 and also has a portion 65 bent therefrom, the portion 65 being disposed adjacent a leg 67 of the L-shaped member 62 and notch 66 engaging the leg to guide and stabilize movable member 64 in its movement along stud 63. The movable member 64 carries a side flange 68 upon which is pivotally secured a wedge member 69 adapted to extend into the space separating the main surface of operating lever 8 from leg 46 of member 44. A spring 72 disposed between the L-shaped member 62 and the movable member 64 and positioned by a projection 70 bent from a leg 71 of member 62 exerts its force to bias the member 64 away from leg 71. A tension spring 73 interconnects the movable member 57 and the extended arm 47 of pivoted member 44 and exerts its bias thereon to move it counterclockwise as viewed in Figure 1.

The operating condition responsive element 3 includes an exterior casing 74 having a connection means 75 secured thereto providing access to the interior of housing 74. Within housing 74 is disposed a corrugated bellows 76 having an actuating pin 77 secured thereto and extending upwardly into the switch housing. The end of the pin 77 is provided with a bearing point 78 receivable within a corresponding impression in the lever 8.

The spring 73 is a loading spring for the member 44 and is more sensitive to an applied force than is the resilient contact carrying member 25, so that a given force effects a greater movement of spring 73 than it would of the member 25. In the operation of the switch, this characteristic of the loading spring 73 permits it to be readily initially adjusted to a pressure intermediate the "on" and "off" operating pressures of the mechanism. For example, assuming a sensitive switch mechanism in which a downward force of fourteen ounces on the pin 37 effects operation of the switch in one direction and that the switch operated in the reverse direction when the force on the pin 37 decreases to 10 ounces, then the spring 73 is tensioned to an extent so as to give a resultant force at the arm 53 of about twelve ounces. With this initial adjustment of spring 73, it is clear that the switch contacts will remain in whatever position they are placed, since the resultant force on the operating pin is greater than the release force to one position and less than the actuated force to the other position. With this initial loading by spring 73 on member 44, the switch contacts will be operated only when an additional force is placed on the member 44 by actuation of the main lever 8 either through stud 10 in the one direction under the influence of range spring 12, or through the wedge shaped member 69 in the opposite direction under the action of the bellows pin 77 against the bias of the range spring 12. In the position shown in Figure 3, the contacts are in separated position with the pin 37 pressed inwardly through the arm 53 under the force exerted thereon through the loading spring 73 and through the force exerted on the pivoted member 44 through the engagement of the stud 10 of operating lever 8 with the leg 46 of the member 44. In this position the resultant force exerted by the range spring 12 is greater than the resultant force of the bellows pin 77 so that the tendency is for the operating lever 8 to rotate in a counterclockwise direction to apply its force to the pivoted member 44 in the same direction. As the pressure within the bellows chamber 74 builds up, the pressure exerted by bellows pin 77 will increase until it exceeds the resultant force of the range spring 12 and the main operating lever 8 will be rotated in a clockwise direction. As the stud 10 leaves the leg 46 on member 44, no reverse operation of the switch will be accomplished since the loading of spring 73 will maintain the contacts in their separated position; however, as the lever 8 continues to rotate, the wedge member 69 will engage the bottom surface of the leg 46 of the member 44 to rotate it in a clockwise direction against the bias of the loading spring 73. With the bias of the loading spring thus released, the pressure on pin 37 becomes less than the critical released pressure of the switch, and the contacts will snap to their engaged position. The action of the parts to again move the contact to disengaged position occurs in a reversed manner with the contacts remaining closed after wedge 69 leaves the leg 46 of member 44 and until stud 10 presses against the upper surface of the leg 46 of member 44 to increase the force on lever 37 to a value sufficient to cause opening movement of the contacts.

Adjustment of range spring 12 operates to determine the operating range of the switch. Adjustment of spring 73 is a fixed adjustment for any particular sensitive switch and this adjustment need only be inwardly made to be of value in between the critical actuating and release pressure of the switch. The adjustment of the slide member 64 varies the differential of operation of the switch between its cut-in and cut-out point. In the device as shown in the drawings, the switch will operate with a constant cut-out point and the cut-in point of the switch will be varied as the differential of the switch is changed through the adjustment of the position of the slide 64. The cut-out point of the switch will always be determined by the relation of the end of the stud 10 with the upper surface of the leg 46 of member 44 and this remains constant; however, the relation of the operating lever 8 to the under surface of the leg 46 of member 44 is varied

by movement of the wedge shaped member 69 inwardly and outwardly. If the stud 63 is rotated from the position of Figure 3, to move the slide 64 to the left, the wedge 69 will also move to the left and the differential of the switch will be increased, since the operating lever 8 must move a greater distance before the top surface of the wedge engages the under surface of the leg 46 of member 44. Since this adjustment affects the operation of the switch only as the member 8 is moved in a clockwise direction, it is seen that variations in the differential of the switch occur by varying the cut-in point while the cut-out point remains constant.

Provision is made for reversing the above characteristic to provide for variation in the differential between the cut-in and cut-out portions of the switch while maintaining a constant cut-in portion and variable cut-out portion. This is done by providing an additional opening 80 in the flange 68 on the member 64 which provides for an alternative pivotal mounting for the wedge 69. This arrangement is shown in the partial Figure 6 in which the wedge 69 has been inverted with its pivot pin disposed in the top opening in the flange 68 and with its wedge shaped end disposed in the space between the top surface of the leg 46 and flange 9. The stud 10 is also reversed and is now threaded through an opening 81 in the main surface of the operating lever 8 and is adapted to bear against the under surface of the leg 46. With this reversal, it is readily seen that variation of the differential adjustment now varies the amount of movement of the operating lever 8 in a counterclockwise direction necessary to effect movement of the member 44 in a counterclockwise direction. Accordingly, the variation in the differential will produce a variation in the cut-out point of the switch while the cut-in point remains constant as determined by the point of engagement of stud 10 with the under surface of the leg 46.

With the switch according to the present invention, it is seen that a differential adjustment is provided which is applicable alternatively either to constant cut-in or constant cut-out points and which allows utilization of most of the sensitivity of the switch mechanism, which mechanism, although normally biased to one position, remains in whatever position it is operated to through the free loading spring applied to the switch operator. This arrangement further permits attainment of a very fine differential from the sensitive switch mechanism which, however, may be varied in the reverse direction to give as wide a differential between the cutting in and out of the switch as is desired.

While certain preferred embodiments of the invention have been specifically disclosed, it is understood that the invention is not limited thereto, as many variations will be readily apparent to those skilled in the art and the invention is to be given its broadest possible interpretation within the terms of the following claims.

What is claimed is:

1. In an electric switch, switching means normally biased toward engaged position, said switching means being responsive to a predetermined maximum pressure for movement to disengaged position and responsive to a predetermined minimum pressure for return movement to engaged position, means to apply an intermediate pressure upon the switching means to maintain said switching means when in disengaged position, and comprising a movable member operatively connected to said switching means, a stud, movable means carried thereupon and movable thereby, and spring means interconnecting said movable member and said means carried by the stud, and means to release said switching member from said intermediate pressure and to secure the condition of predetermined minimum pressure to effect return movement of the switching means to engaged position.

2. In an electric switch, switching means normally biased toward a first position and responsive to a predetermined pressure for movement to a second position and to a second predetermined pressure for return movement to said first position, an operating element for said switching means, means to apply a pressure upon said switching means intermediate said predetermined pressure and comprising a movable member actuable upon said operating element, a stud, means carried thereupon and movable thereby, and spring means interconnecting said movable member and said means carried by the stud, said intermediate pressure applying means serving to maintain said switching means in one of said positions, and means to oppose said intermediate pressure on said switching means to secure a predetermined pressure condition to effect movement of the switching means to the other of said positions.

3. In an electric switch, switching means normally biased towards a first position and responsive to a predetermined pressure for movement to a second position and to a second predetermined pressure for return movement to said first position, an operating element operatively connected to said switching means, means to apply a pressure upon said switching means intermediate said predetermined pressures and comprising a movable member actuable upon said operating element for movement thereof, a stud, means carried thereby and movable thereupon and spring means interconnecting said movable member and said means carried by the stud, means to apply an additional pressure upon said switching means cooperating with said intermediate pressure to provide said first predetermined pressure condition to effect operation of the switching means to said second position and comprising a movable member operatively connected to said operating element, and means responsive to an exterior condition for normally automatically moving said movable members.

4. In an electric switch, switching means, a pivotal member operatively connected thereto and movable to actuate said switching means, a second pivotal member spaced from said first pivotal member, means responsive to an exterior condition for moving said second pivotal member in a first direction, spring means operable thereupon for movement thereof in a second direction, a third pivotal member disposed between said first and second pivotal members and actuable by said second pivotal member to engage and move said first pivotal member in one of said directions, and means whereby said second pivotal member may engage and move said first pivotal member in the other of said directions.

5. In an electric switch, switching means, an operating element therefor, a pivotal member operable to move said operating element, a second pivotal member spaced from said first pivotal member, means responsive to an exterior

condition for moving said second pivotal member in a first direction, spring means operable upon said second pivotal member for movement thereof in a second direction, means carried by said second pivotal member and engageable with said first pivotal member for movement thereof in the first direction, and means for varying the differential of the switch and comprising an adjustable member disposed between said first and second pivotal members and actuable by said second pivotal member to engage and move said first pivotal member in the second direction.

6. In an electric switch, switching means, a pivotal member operatively connected thereto and movable to actuate said switching means, a second pivotal member spaced from said first pivotal member, means responsive to an exterior condition for moving said second pivotal member in a first direction, spring means operable thereupon for movement thereof in a second direction, a third pivotal member disposed between said first and second pivotal members and actuable by said second pivotal member to engage and move said first pivotal member in one of said directions, and means whereby said second pivotal member may engage and move said first pivotal member in the other of said directions, and a reciprocable member operatively connected to said third pivotal member for movement thereof to vary the differential of the switch.

7. In an electric switch, switching means, a pivotal member operatively connected thereto and movable to actuate said switching means, a second pivotal member spaced from said first pivotal member, means responsive to an exterior condition for moving said second pivotal member, a wedge member disposed between said first and second pivotal members and actuable upon movement of said second pivotal member to engage and move said first pivotal member, and means to move said wedge member to vary the travel of the second pivotal member necessary to move the first pivotal member.

8. In an electric switch, switching means, an operating element therefor, a pivotal member movable to move said operating element, a second pivotal member spaced from said first pivotal member, means responsive to an exterior condition for moving said second pivotal member, a wedge member disposed between said first and second pivotal members and actuable upon movement of said second pivotal member to engage and move said first pivotal member, and a reciprocable member for moving said wedge member to vary the effective width thereof disposed between said first and second pivotal members.

9. In an electric switch, switching means, an operating element therefor, a pivotal member movable to move said operating element, a second pivotal member spaced from said first pivotal member, means responsive to an exterior condition for moving said second pivotal member a wedge member disposed between said first and second pivotal members and actuable upon movement of said second pivotal member to engage and move said first pivotal member, a stud, means providing a support for said wedge member carried by the stud, said support being actuable by said stud to move the wedge member to vary the effective width thereof disposed between said first and second pivotal members.

10. In an electric switch, a switching means, a pivotal member operatively connected thereto and movable to actuate said switching means, a second pivotal member spaced from said first pivotal member, means responsive to an exterior condition for moving said second pivotal member, a third pivotal member disposed within the space provided between the first and second pivotal members and actuable by the latter to move the former, a movable support carrying said third pivotal member, reciprocating means for moving said support to move the third pivotal member to vary the relative movement of said second pivotal member necessary to move the first pivotal member.

11. In an electric switch, switching means normally biased toward a first position and responsive to a predetermined pressure for movement to a second position and to a second predetermined pressure for return movement to said first position, means including a pivoted member to apply a pressure upon said switching means intermediate said predetermined pressures to maintain said switching means in said second position, means cooperating with said intermediate pressure applying means to obtain said first predetermined pressure condition to effect movement of the switching means to the first of said positions, means to apply an additional pressure upon said switching means when in said first position cooperating with said intermediate pressure to effect operation of the switching means to said second position and including said pivoted member, means including a second pivoted member responsive to an exterior condition for normally automatically moving said first pivoted member, and means to vary the differential of the switch comprising a reciprocable member disposed between said first and second pivoted members and movable by said second pivotal member to engage and move said first pivoted member.

12. In an electric switch, switching means normally biased toward engaged position, said switching means being responsive to a predetermined maximum pressure for movement to disengaged position and responsive to a predetermined minimum pressure for return movement to engaged position, means including a movable member operatively connected to said switching means to apply an intermediate pressure upon the switching means to maintain said switching means when in disengaged position, and means to release said switching means from said intermediate pressure and to secure the condition of predetermined minimum pressure for effecting return movement of the switching means to engaged position, a second movable member, spaced from said first movable member, means responsive to an exterior condition for normally automatically moving said second movable member, a movable wedge member disposed between said first and second movable members and actuable upon movement of said second movable member to engage and move said first movable member, and means to move said wedge member to vary the effective width thereof disposed between said first and second movable members.

13. In an electric switch, switching means normally biased toward engaged position, said switching means being responsive to a predetermined maximum pressure for movement to disengaged position and responsive to a predetermined minimum pressure for return movement to engaged position, means to apply an intermediate pressure upon the switching means and including a pivoted member, means for applying

an additional pressure upon said switching means when in engaged position cooperating with the intermediate pressure to obtain the condition of predetermined maximum pressure to effect operation of the switching means to disengaged position, a second pivoted member spaced from said first pivoted member, a movable wedge member disposed between said first and second pivoted members and actuable upon movement of said second pivoted member to engage and move said first pivoted member and a reciprocable member for moving said wedge member to vary the effective width thereof disposed between said first and second pivoted members.

14. In an electric switch, a stationary contact, a movable contact, a switching member to carry said movable contact into and out of engagement with said stationary contact, a movable member operatively connected thereto to positively move said switching member, a second movable member having a lost motion connection with said first movable member whereby movement of said second movable member effects movement of said first movable member, a relatively fixed support and means carried thereby actuable to adjust said lost motion connection between said movable members to vary the movement of said second member necessary to move the first member.

15. In an electric switch, stationary and movable contacts, a switching member to move said movable contact for cooperation with said stationary contact, a pivotal member operatively connected thereto to positively move said switching member, a second pivotal member, means responsive to an exterior condition for moving said second pivotal member in a first direction, spring means operable thereupon for movement thereof in a second direction, means providing a lost motion connection between said first and second pivotal members whereby movement of said second pivotal member effects movement of said first pivotal member, a relatively fixed support, and means carried thereby actuable to move said lost motion means to vary the travel of the second pivotal member necessary to move the first pivotal member.

16. In an electric switch, a contact carrying member, an operating member movable to positively move said contact carrying member, a pivotal member actuable to move said operating member, a second pivotal member responsive to an exterior condition for moving said first pivotal member, and means independently mounted of said switching member and said pivotal members and actuable by said second pivotal member to engage and move said first pivotal member, said means being adjustable to vary the differential of the switch.

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