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W. M. HUMMEL

3,210,503

ADJUSTABLE CONTACT SPACING FOR DIFFERENTIAL SWITCH

Filed Dec. 31, 1962

Fig. 1.

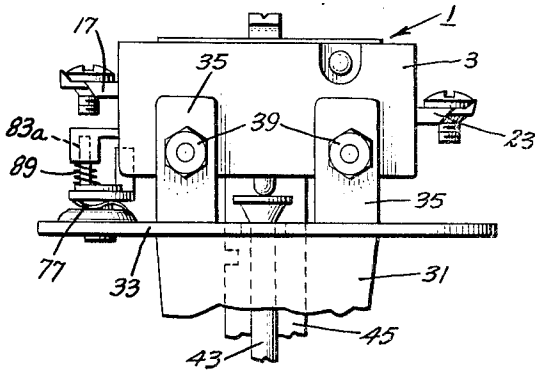


Fig. 2.

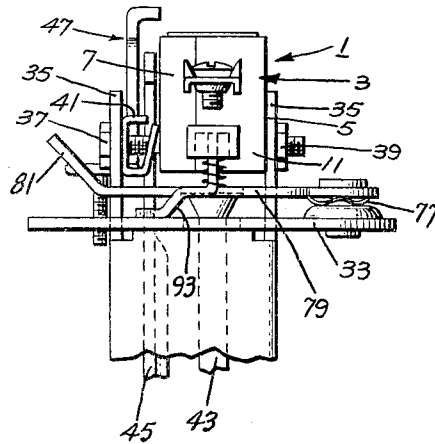


Fig. 3.

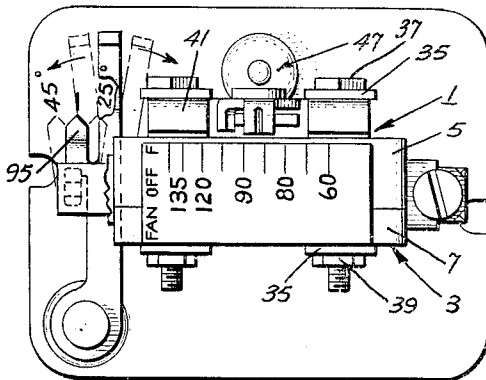


Fig. 4.

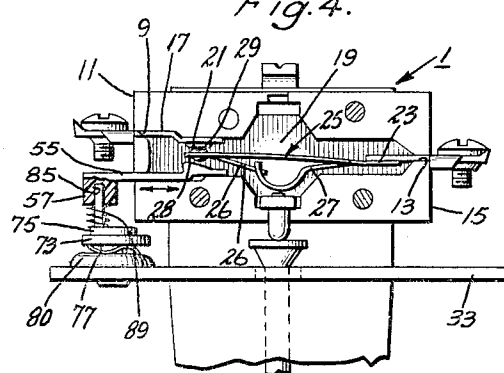


Fig. 5.

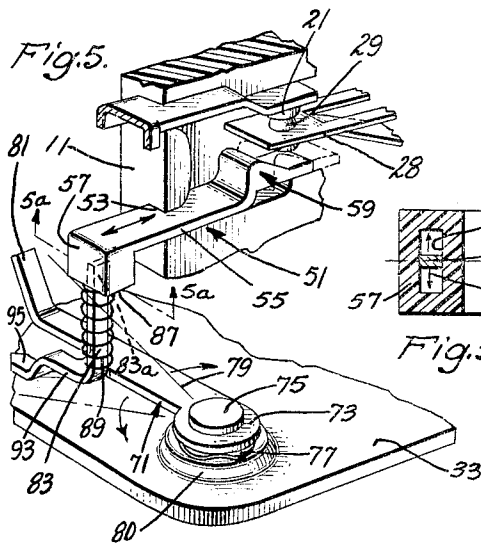


Fig. 5a.

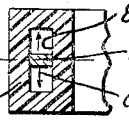
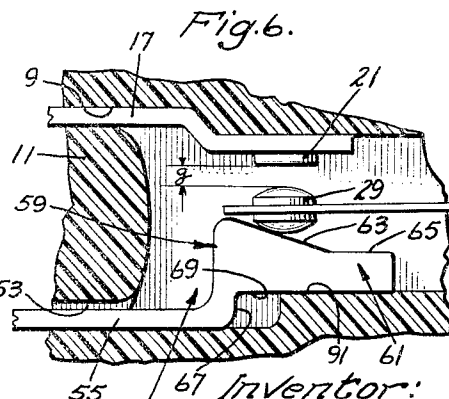


Fig. 6.



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ADJUSTABLE CONTACT SPACING FOR DIFFERENTIAL SWITCH

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3 Claims. (Cl. 200—139)

The present relates to switches, and in particular to thermally responsive switches which incorporate a snap acting means for operating the switch contacts.

Thermally responsive switches of the snap acting variety are used in numerous applications. One such common application is in opening and closing a circuit to the blower of a warm air furnace. For such an application, it becomes desirable to provide a readily adjustment means for varying the temperature differential at which the switch will respond to a thermally responsive element. In the past, thermally responsive switches incorporating a means for varying the temperature differential thereof, have been relatively complex, thereby adding to the overall cost. It has therefore been found desirable to provide a new and improved switch of the nature referred to.

The principal object of the present invention is to provide an improved switch with a novel, low-cost, and efficient means for adjusting the response thereof to an actuating element.

Another object of this invention is to provide a new and improved snap acting switch which includes a simplified and accurate adjustment means for varying the operative spacing between the switch contacts.

A further object of my invention is to provide a new and improved snap acting thermally responsive switch which includes a sliding wedge means for varying the temperature differential to which the operation of the contacts of the switch is responsive.

A still further object of my invention is to provide an improved and relatively inexpensive sliding adjustment means for varying the spacing between a pair of contacts of a snap acting self-contained switching mechanism.

In carrying out my invention, in one form thereof, I apply it to a thermally responsive switching device which includes a switch housing, fixed and movable contacts disposed within the housing for making and breaking a circuit to an external device, and a thermally responsive means located externally of the switch housing for actuating the switch contacts. A snap acting means is also included to help provide a differential for operating the movable contacts of the switch. In my improved arrangement, a sliding member is extended through a slot formed in the switch housing near the contacts thereof. The sliding member has an inclined surface disposed at its inner end and on the side of the movable contact opposite to the fixed contact. Movement of the sliding member varies the gap between the fixed and movable contacts when the movable contact is disengaged from the fixed contact to adjust the temperature differential to which the switch is responsive. To effectively maintain the desired setting of the temperature differential for the switch, a spring is arranged outside of the switch housing to act upon the outer end of the sliding member to bias an internal surface of the member into frictional engagement with a contiguous inner surface of the switch housing. With such an adjusting arrangement for the switch, an accurate predetermination of the temperature differential is facilitated by a simplified and efficient mechanism.

Further aspects of my invention will become apparent hereinafter, and the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which I regard as my invention. The inven-

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tion, as to organization and method of operation, together with further objects and advantages thereof, may best be understood by reference to the following description, when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a side elevational view of a thermally responsive switching device embodying my invention;

FIG. 2 is an end view of the device of FIG. 1, from the left side thereof;

FIG. 3 is a plan view of the device of FIG. 1;

FIG. 4 is a view similar to FIG. 1, but which is partially in section and partially broken away to show the switch operating mechanism within the switch housing;

FIG. 5 is a fragmentary perspective view to illustrate the differential adjusting mechanism for the switching device;

FIG. 5a is a sectional view taken as indicated in FIG. 5; and

FIG. 6 is an enlarged detail view showing the mode of adjustment of the tip gap between the switch contacts by means of the sliding wedge.

Referring in detail to the drawing, and in particular to FIGS. 1 and 4, there is shown a pushbutton operated switch unit 1, with which my invention has been advantageously employed. The switch housing 3 comprises a pair of recessed base members 5 and 7 which are formed of suitable insulating material and cooperate to provide an elongated box-shaped supporting structure and enclosure for the operating mechanism of the switch.

As shown in FIG. 4, a slot 9 is formed in the left end 11 of the elongated housing 3, and a slot 13 is formed in the right end 15 of the housing. Through the slot 9, a fixed contact terminal 17 is extended into the inner cavity 19 of the switch. On a downwardly facing surface (FIG. 4) of the terminal 17 (near its inner end) there is secured a fixed contact button 21. Through the slot 13 formed on the other side of the switch housing 3, a movable contact terminal 23 is extended into the inner cavity 19 of the switch. The inner end of the terminal 23 has a snap acting movable contact carrying member 25 secured thereto. The member 25 is of the leaf-type-spring variety and is preferably composed of a springy type conductive metal, such as beryllium copper. The member 25 includes a tongue 26 which is placed in compression between a toggle spring element 27 and the free end 28 of the member 25. Toggle spring element 27 is also supported at the inner end of the movable contact terminal 23 and has the general configuration of a "question mark," with the free end of its bow shaped toggle section in pivotal cooperation with the inner end of tongue 26. A movable contact button 29 is secured to the free end of member 25. With this arrangement, the movable contact button 29 snaps into and out of engagement with fixed contact button 21, and the toggle spring element 27 provides a differential for the operation of the switch contacts.

As shown in FIGS. 1 and 4, the switch unit 1 is suitably supported upon a thermally responsive device which includes as a supporting frame a channel member 31 and a supporting plate 33 secured thereto. The channel member 31 has two pairs of opposed tongues 35 formed thereon, which extend upwardly (viewing FIG. 1) through slots formed in plate 33. The switch unit 1 is secured to the thermally responsive device between the opposed pairs of tongues 35 (FIG. 2) by means of screws 37, nuts 39, and spacers 41.

For operating the switch unit 1 in response to a thermally responsive element (not shown) the elongated pushrod 43 is extended through an aperture of the plate 33. The upper end of pushrod 43 (FIG. 1) is enlarged to limit its downward movement, and the lower end

thereof (not shown) is suitably connected to the thermally responsive element. The thermally responsive device shown in FIGS. 1 and 2 also includes a sliding carriage member 45 which supports the bimetal. This carriage member 45 is adjustably positioned by a lever mechanism 47 to vary the temperature responsive level for the switch 1.

Turning now to an important aspect of the present invention which concerns itself with an improved mechanism for varying the temperature differential of the switch unit 1, attention is directed to FIGS. 5 and 6. As shown therein, an elongated element 51 is extended into the cavity 19 of the switch unit 1, through slot 53 of the end wall 11. The element 51 comprises a relatively thin and flat elongated section 55 of uniform rectangular cross section. At the left end of section 55 (viewing FIG. 5) there is formed a turned down leg 57 of box-shaped configuration. On the right end of thin section 55 (viewing FIG. 5) there is formed a wedge shaped portion 59, and an extension 61 of the bottom end of the portion 59. The wedge shaped portion 59 includes an inclined surface 63 which extends downwardly and to the right (viewing FIG. 6) and merges into a surface 65 that is parallel to the plane of the elongated section 55. Surface 65 is provided to allow overtravel of the sliding element 51 when the element 51 is in its outermost position. The bottom surface of the right end of the elongated section 55 (as shown in FIG. 6) is curved upwardly at 67 and then extends to the right (viewing FIG. 6) in a plane parallel to the plane of the section 55 to form surface 69 which is in upwardly stepped relationship from the bottom surface of section 55.

To enable the elongated element 51 to slide in the direction of the arrows in FIGS. 4 and 5 for varying the temperature differential of the switch operation, as shown in FIG. 5, a specially configured rotatable lever 71 has been provided. The lever 71 comprises an apertured hub 73 which is rotatably supported on plate 33 by means of a shoulder rivet 75 secured thereto. More particularly, the shoulder rivet 75 is extended through an aperture of the hub 73 and a raised aperture of the plate 33, with the free end of the shank of the rivet turned over on the underside of the plate 33 (FIG. 4). The lever 71 is thus mounted on the shoulder rivet 75 for movement through a limited arc, as indicated by the curved arrows of FIG. 5. To maintain the desired torque required for rotating the lever 71 upon its supporting rivet 75, a spring washer 77 is also arranged on the rivet, and is in compression between the hub 73 and the raised area of the plate surrounding the rivet.

To transmit the limited rotary movement of lever 71 to the slidable element 51 for adjusting the switch unit 1, as further shown in FIG. 5, the lever 71 includes an elongated arm 79 which extends radially outwardly from hub 73. The arm 79 is generally flat and is in coplanar relationship with hub 73, being thereby disposed in spaced parallel relationship (FIG. 2) to plate 33 due to the raised embossment 80 of the plate 33 surrounding the rivet 75 and the inclusion of spring washer 77. The outer or free end 81 of the arm 79 is turned angularly upwardly and away from plate 33 to facilitate the manual operation thereof. Between the hub 73 and the outer end of arm 79 there is formed an upright finger 83 which extends upwardly toward the leg 57 of the elongated element 51. The finger 83 has a thin rectangular cross section with the long axis thereof parallel to the long axis and direction of sliding movement of element 51 (FIG. 5). The upper end 83a of the finger 83 fits into laterally slidable cooperation with an elongated recess 85 formed in the bottom side 87 of leg 57, as indicated by FIG. 5a. The recess 85 is of generally oblong cross section, with the long axis thereof arranged in perpendicular and crosswise relationship to the long axis of the upper end 83a of finger 83 (FIG. 5a). In addition, the long axis of finger 83 is slightly shorter than the short axis of recess 85, as shown

in FIG. 5a. With such an arrangement, when the lever 79 is rotated through a limited arc, the upper end 83a of the finger 83 of the lever has freedom to move in a direction transverse to the long axis of element 51 as illustrated by the arrows c in FIG. 5a, and also rotates very slightly in recess 85 of the element 51. Such an arrangement of the finger 83 in recess 85 of the element 51 precludes any undesirable lateral movement of the slidable element 51 and the finger 83 acts upon the element 51 to effectively slide it as indicated by the arrows of FIG. 4, in a direction parallel to the long axis of the member 25 (i.e., toward and away from end 15 of the switch housing).

To help maintain the sliding element 51 in the desired position upon rotation of lever 71, as shown in FIG. 5, a coil spring 89 is positioned around the upright finger 83 of the lever 71. Spring 89 runs in continuous compression between the surface of lever 71 adjacent the bottom of finger 83 (viewing FIG. 5) and the bottom side 87 of leg 57 of the sliding element 51 to continuously bias the upper surface of elongated section 55 of the element 51 into frictional engagement with an adjacent surface of slot 53, and to also continuously bias the surface 69 of the element 51 underlying the inclined surface 63 into frictional engagement with surface 91 within the switch housing. Such an arrangement enables the lever 71 to slide the element 51 to the desired extent, and the spring 89 provides frictional engagement between the switch housing 3 and opposite spaced apart faces of the sliding element 51 to maintain it in its manually adjusted position.

For suitably indicating the angular position of lever 71 and thereby also indicating the location of the inclined surface 63 of element 51 within the switch cavity 19, the indicating finger 93 is integrally formed on lever 71. The finger 93 extends outwardly, from the bottom of spring finger 83 (FIG. 5), angularly toward plate 33, and then parallel to the plate at its free end 95. The free end 95 of the indicating finger 93 is arranged to point to the desired differential setting (FIG. 3) and also frictionally engages the surface of plate 33 to help support the free end of the lever 71.

In operation, the wedge shaped portion 59 of the element 51 slides back and forth in the direction indicated by the arrows of FIGS. 4 and 5 to vary its position underneath the movable contact button 29. This adjustment varies the size of the tip gap g or spacing between the contact buttons 21 and 29 when they are in the open position. For the illustrated control device, the tip gap g is directly proportional to the temperature differential, i.e., the difference in temperature between the temperatures at which the contacts open and close. By way of example, a tip gap of 0.020 inch has been found to provide a 25° F. temperature differential and a 0.065 inch tip gap has been found to provide a 45° temperature differential. The angle of the inclined surface 63 and its location relative to the contact buttons is such as to provide these desired extremes of tip gap adjustment. Thus, if the indicating finger 95 of lever 71 is pointed to "45°" (as shown by the dotted lines in FIG. 3), the inclined surface 63 of wedge shaped portion 59 is located to the left of its intermediate position in FIG. 6, and the movable contact button 29 is allowed to open to a relatively large tip gap g, since it engages the surface 63 near surface 65 (or near the bottom of surface 63). If the indicating finger 95 of lever 71 is pointed to "25°" (as shown by the dotted lines of FIG. 3) the inclined surface 63 of wedge shaped portion 59 is located to the right of its position in FIG. 6, and the movable contact button 29 is then allowed to open to a relatively small tip gap g, since it engages the surface 63 near to the top thereof. By simply rotating the lever 71 to the desired setting of pointer 95 on the scale of plate 33, the temperature differential for the actuation of switch unit 1 may thus be expeditiously adjusted.

It will now therefore be seen that I have provided a new and improved thermally responsive snap action switch which includes a low-cost and efficient means for

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adjusting the temperature differential to which the operation of the contacts of the switch is responsive. It should also be understood that I have provided a simplified and accurate adjustment means for varying the spacing between cooperating contacts of a switch.

While in accordance with the patent statutes, I have described what at present is considered to be the preferred embodiment of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from my invention, and I, therefore, aim in the following claims to cover all such equivalent variations as fall within the true spirit and scope of this invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A snap acting switch comprising a housing, a fixed contact disposed in said housing, a movable contact disposed in said housing and arranged to snap into and out of engagement with said fixed contact, a rotatable lever supported externally of said housing, a slidably adjustable wedge member extending into said housing and movable back and forth within said housing by said lever, said wedge member having an inclined surface disposed within said housing on the side of said movable contact opposite to said fixed contact, said inclined surface being arranged to engage said movable contact when said movable contact is disengaged from said fixed contact thereby to adjust the mode of operation of said switch, and resilient means acting upon the outer end of said wedge member externally of said housing for effecting frictional engagement between said wedge member and said housing within said housing thereby to maintain said mode of operation of said switch.

2. A thermally responsive switch comprising a housing, a fixed contact disposed in said housing, a movable contact disposed in said housing and arranged to snap into and out of engagement with said fixed contact, thermally responsive means for operating said movable contact, a

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rotatable lever supported externally of said housing, a slidably adjustable wedge member extending into said housing and coupled to said lever for movement thereby, said wedge member having an inclined surface disposed within said housing on the side of said movable contact opposite to said fixed contact, said inclined surface being moved by said lever to slidably adjust the gap between said movable contact and said fixed contact when said movable contact is disengaged from said fixed contact thereby to adjust the temperature differential of said switch, and resilient means positioned upon said rotatable lever and acting upon the outer end of said wedge member externally of said housing for effecting frictional engagement between said wedge member and said housing within said housing thereby to maintain said mode of operation of said switch.

3. The switch of claim 2 wherein the resilient means is a coil spring positioned on a finger of said lever, said spring being arranged in compression between said lever and the outer end of said slidable wedge member to effect the frictional engagement of said member with the inside of said switch housing.

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