

Nov. 3, 1953

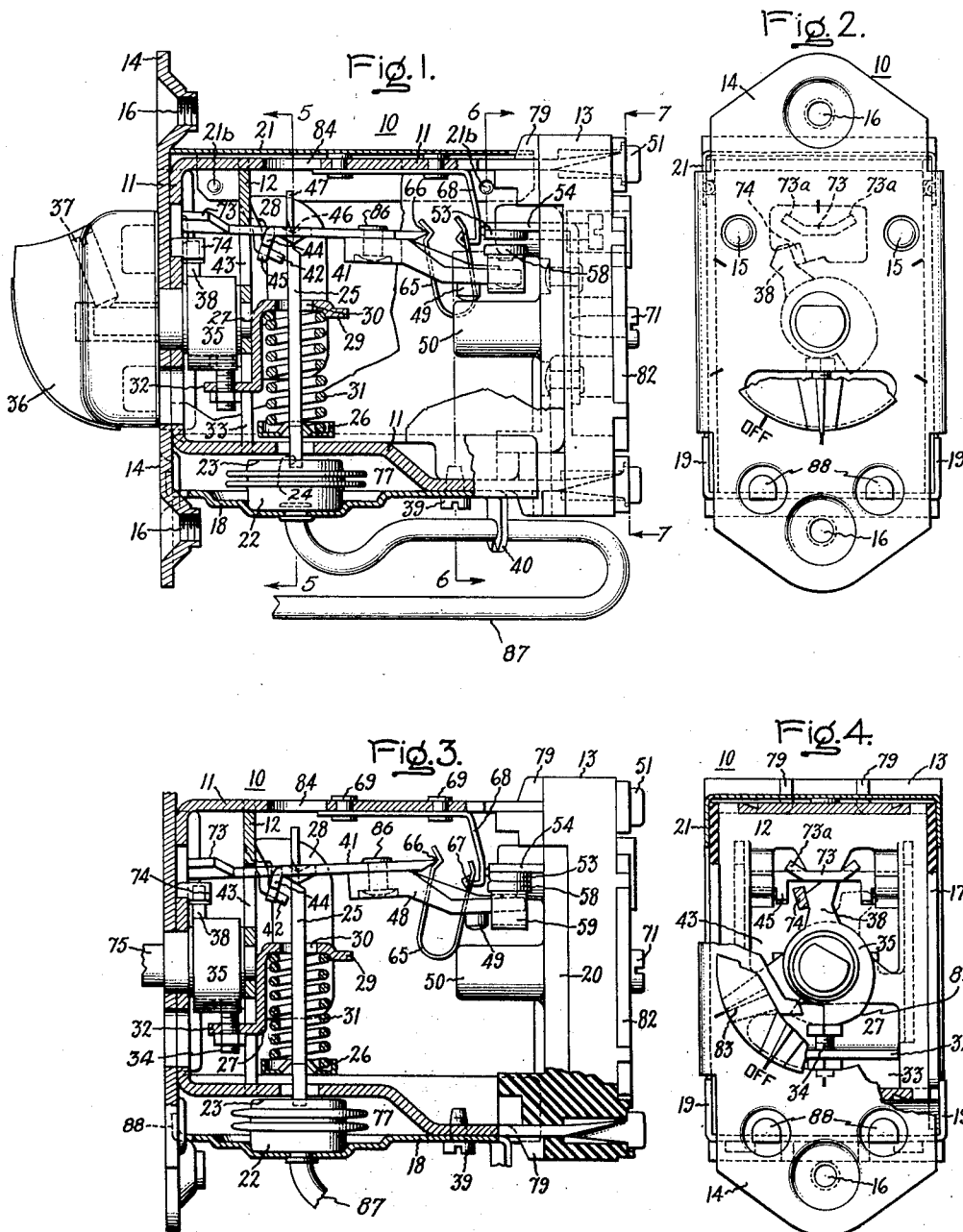
R. L. GRAY ET AL

2,658,121

CONDITION RESPONSIVE ELECTRIC SWITCH MECHANISM

Filed July 30, 1951

2 Sheets-Sheet 1



Inventors:
Robert L. Gray,
Charles S. Grimshaw,

Claude T. Mod.
bL Their Attorney

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2 Sheets-Sheet 2

Fig. 5.

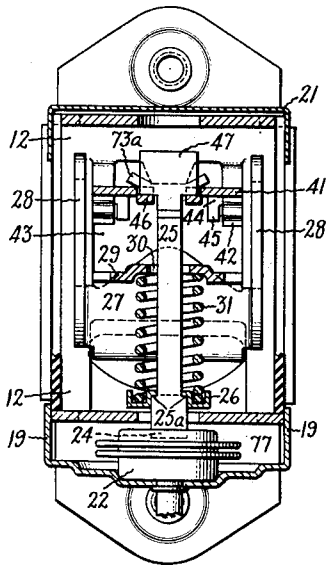


Fig. 6.

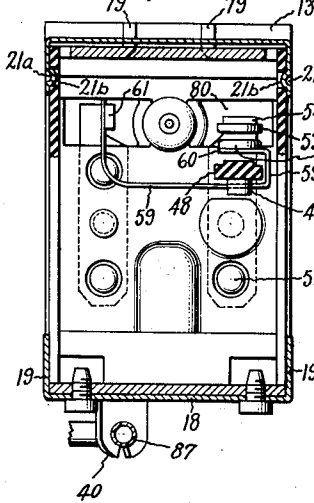


Fig. 7.

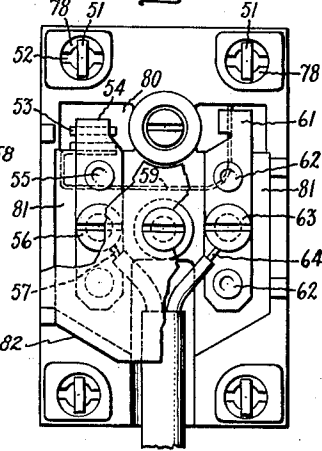


Fig. 8.

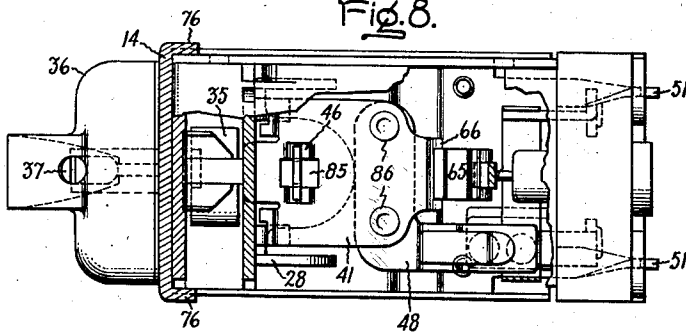
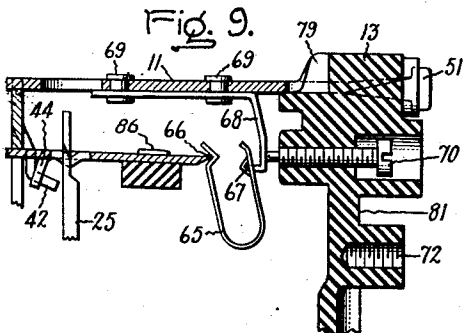


Fig. 9.



Inventors:
Robert L. Gray,
Charles S. Grimshaw,

by *Glenn H. Mott*
Their Attorney.

UNITED STATES PATENT OFFICE

2,658,121

CONDITION RESPONSIVE ELECTRIC SWITCH
MECHANISMRobert L. Gray, Schenectady, N. Y., and Charles
S. Grimshaw, Erie, Pa., assignors to General
Electric Company, a corporation of New York

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13 Claims. (Cl. 200—83)

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This invention relates to electric switch mechanisms, and more particularly to such mechanisms which are utilized in the automatic regulation of a condition such as temperature or pressure.

The principal object of our invention is to provide a condition responsive switch mechanism which is inexpensive and easy to manufacture, and at the same time is reliable in operation and will provide a long life.

A feature of the invention is the provision of a snap action switch mechanism employing a non-overcenter spring.

Other objects and advantages of our invention will be in part obvious and are in part pointed out in the subsequent detailed description of a preferred embodiment of the invention.

In carrying out our invention in one form, we provide a switch mechanism which includes a fixed contact, a movable contact mounted on a cantilever spring, and a main operating lever arranged to move the cantilever spring member to open and close the contacts. The main operating lever is continually biased in the contacts closed direction by a non-overcenter spring. The operating lever is further biased in the opposite or contacts open direction by an additional spring which normally overpowers the non-overcenter spring and maintains and contacts open. Condition responsive means are provided for partially counteracting the second spring under certain circumstances to such an extent that the non-overcenter spring is able to close the contacts. When the counteracting action lessens sufficiently, the contacts are again opened.

For a clearer and more complete understanding of our invention, reference should be had to the accompanying drawing in which:

Fig. 1 is a side elevation view, partially in section, of a condition control device embodying our invention in a preferred form,

Fig. 2 is a left end view of the device of Fig. 1 showing only a fragmentary part of the control knob,

Fig. 3 is a side view, partially in section, similar to Fig. 1 except omitting some parts and showing the contacts in the closed position,

Fig. 4 is an end view similar to Fig. 2 except partially in section,

Fig. 5 is a sectional view along the lines 5—5 of Fig. 1,

Fig. 6 is a sectional view along the lines 6—6 of Fig. 1,

Fig. 7 is an end view along the lines 7—7 of Fig. 1,

Fig. 8 is a top view partially in section of the device of Fig. 1, and

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Fig. 9 is a partial side view in section of the device of Fig. 1 showing the details of the differential adjustment mechanism thereof.

In the drawing our invention is shown embodied in a refrigerator temperature control device which is designated generally by the numeral 10. As shown particularly in Figs. 1 and 3, this device includes a substantially U-shaped metal frame or support member 11 having two substantially horizontal legs, the lower of which has an offset portion, and a vertical connecting or bight portion, which is to the left in these figures. The frame 11 has a vertical metal cross member 12 rigidly connected between the two horizontal legs of member 11, preferably by means of projections along the upper and lower edges of member 12 which engage corresponding openings in member 11, while an additional insulating support member 13 closes the free ends of member 11.

Referring to Figs. 2 and 4 in addition to Figs. 1 and 3, the device 10 includes a face plate 14 rigidly secured to the vertical bight portion of support member 11 in a suitable manner such as by a pair of rivets 15. As illustrated, the face plate 14 has a pair of countersunk tapped openings 16 to provide for the attachment of device 10 to another apparatus or support. As seen best in Fig. 4, the device 10 also includes a pair of side plates 17 of insulating material enclosing the rectangular opening formed by support member 11 and insulating support member 13. For ease of assembly, these insulating side members are preferably arranged to be held in place along their lower edges by upturned side portions 19 of a bottom plate 18, and along their side edges by right angle portions 16 of front plate 14 along one edge (see Fig. 8) and indentations 20 in insulating member 13 (one of which is shown in Fig. 3) along the other edge. As shown in Figs. 4 and 5, a U-shaped resilient member 21 fits down over the top horizontal leg of frame member 11; member 21 preferably has a plurality of indentations 21a (as shown in Fig. 6) forming projections 21b which snap into corresponding openings in side member 17, thus holding the side members firmly in position and completely enclosing the switch mechanism of device 10.

The bottom plate 18 may conveniently be secured to the remainder of the device by a pair of right angle projections 22 which are positioned in suitable recessed openings in face plate 14 and a pair of screws 23 which are positioned in suitable tapped openings in the lower leg of frame 11. The bottom plate 18 and its upturned side

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portions 19 form an auxiliary enclosure 77 beneath the lower horizontal member of frame 11 which houses a bellows 22. The bellows 22 may be connected by an external tube 87 to a source of fluid under pressure which actuates the bellows under conditions hereinafter discussed. The bellows 22 is rigidly secured to bottom plate 18 and when fluid pressure is applied to the inside of the bellows the upper surface 23 thereof expands upwardly. The vertical spacing in the bellows enclosure 77 is preferably such that only a limited expansion of the bellows can take place before the upper surface of the bellows contacts the frame member 11, in order to prevent damage to the bellows in the event of an abnormally high pressure. As an aid in firmly securing tube 87, it may be held by a split bracket 40 forming a downward right angle extension of plate 18.

The upper surface 23 of the bellows has a rectangular indentation 24 located approximately centrally thereof in which is positioned a rectangular vertical operating rod 25. The operating rod has shoulder portions 25a (see Fig. 5) a short distance above the lower horizontal leg of frame 11, and a circular spring retaining member 26 rests on these shoulders. A suitable rectangular indentation is provided in the lower surface of member 26 which engages the shoulders 25a and holds member 26 in place. Circular member 26 also has an elongated slot at right angles to the longitudinal axis of operating rod 25 and to the plane of Fig. 5, this slot being of such dimensions that the lower enlarged portion of operating rod 25 can be readily slipped through the slot in member 26 during assembly. Then when operating rod 25 is subsequently turned 90° to the position shown in Figs. 1, 3 and 5 and the indentation in the bottom surface of retainer 26 is engaged with the shoulder portions 25a of the operating rod, the retaining ring is prevented from being dislodged.

The device 10 further includes a bracket 27 which is vertically slidable along cross member 12 of the frame. Bracket 27 includes a pair of vertically disposed right angle side members 28 which provide contact with cross member 12 near the top and near the bottom thereof along each side in order to provide a stable sliding bracket. Bracket 27 also includes a centrally positioned horizontal right-angle portion 29 having an opening 30 therein through which rod 25 operates. A compression spring 31 which opposes the expansion of bellows 22 is positioned between horizontal portion 29 of the slidable bracket 27 and retaining ring 26.

Near the lower portion thereof, the bracket 27 is provided with a second horizontal projection 32 which extends (to the left in Figs. 1 and 3) through a suitable opening 33 in cross member 12. Extension 32 provides means for the vertical movement of bracket 27, and may have a set screw 34 positioned in a suitable tapped opening therein. The set screw 34 rides on a cam 35 (best seen in Figs. 2 and 4) which provides for a movement of bracket 27 upwardly and downwardly, with consequent changes in the force exerted by spring 31. In Fig. 2, the cam is shown in the position which allows the greatest rise of bracket 27 thereby producing the minimum compression in spring 31. In Fig. 4, the cam is shown rotated through almost a complete revolution counterclockwise from Fig. 2 to the position which produces the maximum downward movement of bracket 27 and consequently the greatest compressive force on spring 31.

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The cam 35 may be integrally formed with a shaft 75 which projects through bight portion of support 11 and face plate 14. An operating knob 36 may be mounted on the shaft and secured thereto in a suitable manner such as by a set screw 37, the knob thus providing means for rotating cam 35 to adjust the force of spring 31. Cam 35 also includes an additional projection 38 in addition to the main cam surface, and the purpose of this projection and the operation of the cam are explained in detail hereinafter.

The device 10 has a main operating lever 41 which is pivoted on a pair of lanced and formed arms, or bosses, 42 which project out from vertical cross member 12 of the frame. Member 12 includes an opening 43 to provide for the extension of lever 41 therethrough, and arms 42 may conveniently be formed from metal which previously lay along the sides of this opening. Lever 41 has on opposite sides thereof a pair of downwardly turned portions 44 which rest on bosses 42, and each portion 44 is provided with an additional small projection 45 extending downwardly along the inner edge of boss 42 to aid in maintaining the alignment of lever 41.

The lever 41 has a transversely disposed indentation 46 in the upper surface thereof in which is positioned an enlarged upper portion 47 of operating rod 25. Lever 41 also includes a slot 48 at right angles with the indentation 46, which is similar to the slot previously described for retainer 26, to permit the passage of the lower enlarged portion of operating rod 25 through lever 41 during assembly. In the absence of pressure in bellows 22, the spring 31 exerts a downward biasing force which, acting through the enlarged upper portion 47 of the operating rod in indentation 46, tends to pull the right extremity (as seen in Figs. 1 and 3) of lever 41 downward.

Near its right end, lever 41 has secured thereto in a suitable manner such as by a pair of rivets 86 an extension 48. This extension is of insulating material and extends beyond the end of lever 41 to one side and below lever 41, as shown best in Figs. 1, 3 and 8. A small projection 49 may be formed integrally with extension 48 on the lower surface thereof, and in the open contacts position shown in Fig. 1 this projection is in engagement with a larger horizontal projection 50 on insulating support member 13. The engagement of projection 49 with projection 50 limits the downward motion of the right end of lever 41.

The insulating member 13 may be assembled conveniently with metal frame member 11 by means of four rectangular projections 51 on member 11 which pass through four rectangular openings 52 in member 13 near the four corners thereof and are twisted 90°, as seen best in Figs. 1, 7 and 8, in order to engage suitable cam surfaces 78 on member 13 and hold the member 13 securely to member 11. The upper and lower legs of member 11 each have a pair of projections 79 against which member 13 abuts, to provide exact positioning of member 13.

The member 13 supports both the fixed and movable contact members of the device 10. As shown in Figs. 1, 6 and 7 particularly, the fixed contact member 53 is positioned on a right angle terminal member 54. One portion of member 54 is secured to a sunken outer surface portion 81 of member 13 in a suitable manner such as by a pair of rivets 55, while the right angle portion of member 54 extends into the device enclosure through a suitable opening 80 in mem-

ber 13 and supports fixed contact member 53 in horizontally disposed relation. Terminal member 54 may be provided with a screw 56 by which an electrical conductor such as conductor 57 may be secured thereto in order to provide an electrical connection to the fixed contact of the switching mechanism.

A movable contact member 58 arranged for movement into and out of engagement with fixed contact member 53 is secured to and is supported by a resilient member 59 which is positioned in transversely disposed operative relation with respect to extension 48 of lever 41 and is biased toward contact 53. As illustrated in Figs. 6 and 7 particularly, resilient member 59 has a reversely bent portion 60 overlying extension 48 to which the movable contact member 58 is secured. Resilient member 59 is secured to and supported by a second terminal member 61 which likewise extends through opening 60 in member 13 and has a right-angle portion secured to the sunken outer surface 81 thereof in a suitable manner such as by a pair of rivets 62. A screw 63 is provided in terminal 62 for an electrical connection to a conductor such as 64.

For biasing lever 41 upwardly, i. e., toward the contacts closed position, there is provided a hairpin spring 65 which is best seen in Figs. 1, 3 and 9. Spring 65 has two indentations, one of which is engaged by a knife edge portion 66 on the right end of lever 41 while the other is engaged by a knife edge portion 67 on a member 68. The latter member may conveniently be secured to the top leg of frame 11 by a pair of rivets 69. The member 68 is preferably of resilient material and, as shown in Fig. 9, there may be provided a set screw 70 threaded through a suitable opening in insulating member 13 which provides for the adjustment of knife edge 67 to the left or right to decrease or increase the spacing between knife edges 66 and 67.

The parts of the switching mechanism, and particularly projections 49 and 50, are so portioned and arranged that knife edge 66 on lever 41 is always above a straight line connecting knife edge 67 and the pivot point of lever 41 where projections 44 rest on projections 42, i. e., spring 65 biases the right end of lever 41 continuously upward. Thus spring 65 always exerts a contact closing force on lever 41 tending to force the right end of lever 41 upward to cause projection 48 on the lever to engage the under side of projection 60 of resilient member 59 and force movable contact member 58 up against fixed contact member 53.

The force exerted by spring 65 on lever 41 may be looked upon as having two components, a horizontal component attempting to push knife edges 66 and 67 apart and a vertical component tending to force the right end of lever 41 upward. The latter component increases very rapidly as the right end of lever 41 moves upwardly, and this action aids very materially in causing our mechanism to move from the contacts open position to the contacts closed position with a snap action, as described in greater detail hereinbelow. Similarly, the very rapid decrease of this component of force aids in producing a snap action in the opposite direction of movement, i. e., from contacts closed to contacts open.

A cover plate 82, preferably of insulating material, may be provided for the sunken outer portion of insulating member 13 and secured to member 13 by means of a screw 71 which en-

gages a suitable tapped opening 72 in the outer surface of member 13. This cover plate protects the terminals but preferably does not cover set screw 70 as it is generally desirable to leave this available for adjustment.

At the opposite, or left end, lever 41 is provided with an enlarged portion 73 having a pair of slightly upturned edges 73a. In the extreme counterclockwise position of control knob 36, shown in Fig. 4, projection 38 on the cam engages portion 73 of lever 41 and holds it fixed so that the lever cannot be pivoted regardless of the actions of the bellows and the spring members. As will be readily understood, this is the off position of the switching mechanism and when the knob is in this position the contacts 53, 58 cannot be closed. There is provided a projection 74 extending outwardly from the bight portion of support member 11 into the path of projection 38 which limits the rotation of knob 36 and cam 35 slightly less than a complete revolution. In Fig. 4 the knob and cam are shown in the extreme counterclockwise position, while in Fig. 2, they are shown in the extreme clockwise position. In both extreme positions cam projection 38 is in engagement with projection 74.

The device illustrated and described herein embodying the switching mechanism of our invention may be advantageously used for automatically regulating the temperature of a household refrigerator, for example. In such a case, the tube 27 may contain a temperature responsive fluid. Upon an increase in the temperature within the refrigerator to or beyond a predetermined value, the pressure in tube 27 and hence in bellows 22 is increased enough to overcome the downward biasing force of spring 31 sufficiently to allow the right end of lever 41 to be moved upwardly by spring 65. This results in the closing of contacts 53, 58 with a snap action, the snap action being due in large measure to the rapid increase in the upward component of the force exerted by spring 65, as discussed previously. Two other features also contribute to the snap action closing of the contacts, namely, the action of resilient member 59 which, as mentioned previously, is biased toward the fixed contact 53 and immediately moves the movable contact member 58 in this direction as soon as it is released, and the hammer blow provided by projection 48 on the under surface of projection 60 beneath movable contact member 58. When the temperature in the refrigerator is reduced sufficiently that the reduced pressure in bulb 22 is overcome by the spring 31, the right-hand end of lever 41 again moves downwardly. This opens contacts 53, 58, with a snap action due to the rapid decrease in the vertical force component of spring 65 and the hammer blow effect of projection 48 on the portion of resilient member 59 extending beneath projection 48.

The temperature at which the switching mechanism operates to close the contacts is determined by the position of cam 35 and knob 36. As mentioned previously, the contacts are held open in the extreme counterclockwise position of cam 35 and knob 36, shown in Fig. 4, by the action of cam projection 38 on lever 41. At all other positions of the cam and knob, the contacts will close when the pressure in bellows 22 reaches a predetermined amount corresponding to a temperature selected by the knob position. These selected pressures and temperatures decrease as the knob and cam are rotated clockwise from the extreme counterclockwise position of Fig. 4.

Closely adjacent the off position of Fig. 4, the mechanism illustrated is provided with a defrost position. This position is indicated by dotted lines 83 in Fig. 4 for the pointer on the knob. When the knob is in the position indicated by the dotted lines, the portion 89 of the cam surface will be in engagement with set screw 34 and a relatively high temperature will be required in order to operate the switching mechanism to close the contacts. From this point on around the remaining portion of the cam, the temperature required for operation gradually decreases, and in Fig. 2 the cam and knob pointer are shown in the minimum temperature position.

The differential, i. e., the difference between the temperature at which the contacts close and that at which they open again, is determined by the adjustment of knife edge 67 by set screw 70. As knife edge 67 is moved closer to knife edge 66 by set screw 70 the temperature differential increases; and, conversely, the temperature differential decreases as set screw 70 is moved to allow knife edge 67 to move in the opposite direction.

As will be readily apparent from the drawing and the foregoing description, the device disclosed herein is easily assembled. In manufacturing such a device, the various component parts are first assembled. The terminal members with the contact members thereon are assembled on insulating member 13. The bellows 22 is secured to plate 18 and tube 87. Face plate 14 is secured to main frame member 11, and member 68 is riveted to the upper surface of member 11, these operations being performed after member 11 has been partially formed into its final U-shape, that is, with the leg portions of support member 11 bent until they form an angle greater than 90° with the bight portion 11 instead of approximately 90° as in the final form. Extension 48 is riveted on to lever 41.

In the final assembly, cam member 35 is assembled by putting the shaft 75 through the opening provided therefor and assembling knob 36. Then cross member 12 of the frame is put in position and the legs of the frame member 11 are bent to their final position in which they hold cross member 12 rigidly in position. The insulating member 13 is then assembled by putting the projections 51 through the openings 52 and twisting them in the manner previously described. The bellows is assembled by putting the projections 88 through the openings provided therefor in front plate 14 and putting screws 39 in place. Then the retainer 26, the spring 31, the vertical slider 27, the lever 41 and hairpin spring 65 are loosely positioned in approximately their final location. Operating rod 25 is then dropped through an opening 84 provided therefor in the upper surface of frame member 11. With the component parts in approximately their final position and with lever 41 properly restrained, the operating rod can be turned 90° so that the various portions of the mechanism assume their final positions as illustrated in Fig. 1. Thereafter the side plates 17 and the top cover plate 21 can be added to complete the assembly.

It will be seen, therefore, that we have provided a relatively simple condition responsive device which can be assembled from a small number of relatively simple and inexpensive parts. The device includes a switching mechanism employing a non-overcenter spring, which arrange-

ment we have found provides very reliable snap action for both opening and closing operation.

While we have illustrated and described our invention in a preferred form, modifications thereof may be made by those skilled in the art, and, therefore, it should be understood that we intend to cover by the appended claims all such modifications which fall within the true spirit and scope of our invention.

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

1. An electric switch mechanism comprising, support means, an operating lever pivotally mounted for movement between two positions, a fixed contact member secured to said support means, an elongated flexible member secured to said support in operative relation with said operating lever and arranged for movement by said lever, movable contact means forming a portion of said flexible member and arranged to engage said fixed contact member, said contacts being open in one of said positions of said operating lever and closed in the other said position, spring means biasing said lever continuously toward the contacts closed position, said spring means providing an increasing component of force tending to close the contacts as the lever moves from the contacts open position toward the contacts closed position, additional spring means biasing said lever continuously toward the contacts open position, said additional spring means normally overpowering said first spring means and holding said contacts open, and condition responsive means for counteracting said additional spring means sufficiently that said first spring means cause said contacts to close with a snap action.

2. An electric switch mechanism comprising, support means, an operating lever pivotally mounted on said support means for movement between two positions, a fixed contact member secured to said support means, a flexible member secured to said support means in operative relation with said operating lever and arranged for movement by said lever, movable contact means forming a portion of said flexible member and arranged to engage said fixed contact member, said contacts being engaged in one position of said operating lever and disengaged in the other position, non-overcenter hairpin spring biasing said lever continuously toward a first one of its two positions, additional spring means biasing said lever continuously toward the second of its two positions, said additional spring means normally overpowering said hairpin spring means and holding said lever in said second position, and condition responsive means for partially counteracting said additional spring means whereby said hairpin spring means is enabled to move said lever to said first position.

3. An electric switch mechanism comprising, support means, an operating lever pivotally mounted on said support means for movement between two positions, a fixed contact member secured to said support, a flexible member secured to said support in operative relation with said operating lever and arranged for movement by said lever, movable contact means forming a portion of said flexible member and arranged to engage said fixed contact member, said contacts being open in one position of said operating lever and closed in the other said position, a non-overcenter hairpin spring biasing said lever continuously toward the contacts closed position, said hairpin spring means providing an increasing component of force tending to close the contacts as the lever moves from the contacts open

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position toward the contacts closed position, additional spring means biasing said lever continuously toward the contacts open position, said additional spring means normally overpowering said hairpin spring means, and condition responsive means for counteracting said additional spring means to such an extent that said hairpin spring means causes said contacts to close with a snap action.

4. An electric switch mechanism comprising, support means, an operating lever pivotally mounted on said support means for movement between two positions, a fixed contact member secured to said support means, a resilient member having as a portion thereof movable contact means arranged to engage said fixed contact member secured to said support means in operative relation with said operating lever, said resilient member being biased to move the movable contact portion thereof in a predetermined direction and having means providing for the movement of the resilient member responsively to the movement of said lever, said contacts being engaged in one position of said operating lever and disengaged in the other position, spring means biasing said lever continuously toward a first of its two positions, additional spring means biasing said lever continuously toward the second of its two positions, said additional spring means normally overpowering said first spring means and maintaining said lever in said second position, and condition responsive means for partially counteracting said additional spring means whereby said first spring means is enabled to move said lever from said second position to said first position.

5. An electric switch mechanism comprising, support means, an operating lever pivotally mounted on said support means for movement between two positions, a fixed contact member secured to said support means, a resilient member having movable contact means arranged to engage said fixed contact member as a portion thereof and secured to said support in operative relation with said operating lever, said resilient member being biased toward the contacts closed position and having means providing for the movement thereof responsively to the movement of said lever, said contacts being open in one position of said operating lever and closed in the other said position, spring means biasing said lever continuously toward said other position, said spring means providing an increasing component of force tending to close the contacts as the lever moves from said one position toward said other position, additional spring means biasing said lever continuously toward said one position, said additional spring means normally overpowering said first spring means and maintaining said contacts open, and condition responsive means for counteracting said additional spring means sufficiently that said first spring means causes said lever to move from said one position to said other position and close said contacts with a snap action.

6. An electric switch mechanism comprising, support means, an operating lever pivotally mounted on said support means for movement between two positions, a fixed contact member secured to said support means, a resilient member having movable contact means arranged to engage said fixed contact member as a portion thereof and secured to said support means in operative relation with said operating lever, said resilient member being biased to move the mov-

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able contact portion thereof in a predetermined direction and having means providing for the movement of the resilient member responsively to the movement of said lever, said contacts being engaged in one said position of the operating lever and disengaged in the other position, non-overcenter spring means biasing said lever continuously toward a first of its two positions, said non-overcenter spring means providing an increasing component of force on the lever aiding its movement as the lever moves from its second position toward the said first position, additional spring means biasing said lever continuously toward the said second of its two positions, said additional spring means normally overpowering said non-overcenter spring means and maintaining said lever in said second position, and condition responsive means for counteracting said additional spring means to such an extent that said non-overcenter spring means causes said lever to move from said second position to said first position.

7. An electric switch mechanism comprising, support means, an operating lever pivotally mounted on said support means, a fixed contact member secured to said support means, a flexible member secured to said support means in operative relation with said operating lever and having means for loosely receiving a portion of said lever, movable contact means forming a portion of said flexible member and arranged for engagement with said fixed contact member, said operating lever being movable between two positions in one of which it engages said flexible member and holds said contacts engaged and in the other of which it engages the flexible member and holds the contacts out of engagement, said lever being disposed to provide a hammer blow on said flexible member upon movement of the contacts to either the engaged or disengaged position, spring means biasing said lever continuously toward a first of its two positions, additional spring means biasing said lever continuously toward the second of its two positions, said additional spring means normally overpowering said first spring means, and condition responsive means for counteracting said additional spring means to such an extent that said first spring means causes said lever to move from said second to said first position.

8. An electric switch mechanism comprising, support means, an operating lever pivotally mounted on said support means, a fixed contact member secured to said support means, a flexible member secured to said support in operative relation with said operating lever and having means for loosely receiving a portion of said lever, movable contact means forming a portion of said flexible member arranged for engagement with said fixed contact member, said operating lever being movable between two positions in one of which it engages said flexible member and holds said contacts apart and in the other of which it engages the flexible member and holds the contacts in engagement and said lever being disposed to provide a hammer blow on said flexible member upon movement to either of the two positions, spring means biasing said lever continuously toward the contacts closed position, said spring means providing a rapidly increasing component of force tending to close the contacts as the lever moves from the contacts open position towards the contacts closed position, additional spring means biasing said lever continuously toward the contacts open position, said

additional spring means normally overpowering said first spring means, and condition responsive means for counteracting said additional spring means to such an extent that said first spring means cause said contacts to close.

9. An electric switch mechanism comprising, support means, an operating lever pivotally mounted on said support means, a fixed contact member secured to said support means, an elongated resilient member secured to said support in operative relation with said operating lever and having means for loosely receiving a portion of said lever, movable contact means mounted on said resilient member and arranged for engagement with said fixed contact member, said resilient member being biased to move said movable contact means in a predetermined direction with respect to said fixed contact member, said operating lever being movable between two positions in one of which it engages said resilient member and holds said contacts engaged and in the other of which it engages the resilient member and holds the contacts disengaged and said lever being disposed to provide a hammer blow on said resilient member upon movement to either the contacts engaged or contacts disengaged position, spring means biasing said lever continuously toward a first of its two positions, additional spring means biasing said lever continuously toward the second of its two positions, said additional spring means normally overpowering said first spring means and holding said lever in said second position, and condition responsive means for partially counteracting said additional spring means whereby said first spring means is enabled to move said lever from said second position to said first position.

10. An electric switch mechanism comprising, support means, an operating lever pivotally mounted on said support means, a fixed contact member secured to said support means, a flexible member secured to said support means in operative relation with said operating lever and having means for loosely receiving a portion of said lever, movable contact means forming a portion of said flexible member and arranged for engagement with said fixed contact member, said operating lever being movable between two positions, in one of which it engages said flexible member and holds said contacts engaged and in the other of which it engages the flexible member and holds the contacts out of engagement, said lever being disposed to provide a hammer blow on said flexible member upon movement of the contacts to either the engaged or disengaged position, non-overcenter spring means biasing said lever continuously toward a first of its two positions, said non-overcenter spring means providing a rapidly increasing component of force on the lever aiding its movement as it moves from its second position toward the said first position, additional spring means biasing said lever continuously toward the said second of its two positions, said additional spring means normally overpowering the said non-overcenter spring means and holding said lever in said second position, and condition responsive means for counteracting said additional spring means to such an extent that non-overcenter spring means moves said lever from said second to said first position with a snap action.

11. An electric switch mechanism comprising, support means, an operating lever pivotally mounted on said support means, a fixed contact member secured to said support means, an elongated resilient member secured to said support

in operative relation with said operating lever and having means for loosely receiving a portion of said lever, movable contact means mounted on said resilient member and arranged for engagement with said fixed contact member, said resilient member being biased to move said movable contact means in a predetermined direction with respect to said fixed contact member, said operating lever being movable between two positions in one of which it engages said resilient member and holds said contacts engaged and in the other of which it engages the resilient member and holds the contacts disengaged and said lever being disposed to provide a hammer blow on said resilient member upon movement thereof to either the contacts engaged or contacts disengaged position, non-overcenter hairpin spring means biasing said lever continuously toward a first of its two positions, additional adjustable spring means biasing said lever continuously toward the second of its two positions, said additional spring means normally overpowering said non-overcenter hairpin spring means and holding said lever in said second position, and condition responsive means for partially counteracting said additional spring means whereby said non-overcenter spring means is enabled to move said lever from said second to said first position.

12. An electric switch mechanism comprising, support means, an operating lever pivotally mounted on said support means, a fixed contact member secured to said support means, an elongated resilient member secured to said support in transversely disposed relation with said operating lever and having means for loosely receiving a portion of said lever, movable contact means mounted on said resilient member and arranged for engagement with said fixed contact member, said resilient member being biased to move said movable contact means in a predetermined direction with respect to said fixed contact member, said operating lever being movable between two positions in one of which it engages said resilient member and holds said contacts engaged and in the other of which it engages the resilient member and holds the contacts disengaged and said lever being disposed to provide a hammer blow on said resilient member upon movement thereof to either the contacts engaged or contacts disengaged position, non-overcenter hairpin spring means biasing said lever toward a first of its two positions, additional adjustable spring means biasing said lever toward the second of its two positions, said additional spring means including an operating rod operatively engaging said lever and positioned substantially normally thereto and a coil spring surrounding said operating rod, said additional spring means normally overpowering said non-overcenter hairpin spring means and holding said lever in said second position, and condition responsive means operatively connected with said operating rod for partially counteracting said additional spring means to such an extent that said non-overcenter spring means causes said lever to move from said second to said first position.

13. A condition responsive electric switch mechanism comprising, support means, an operating lever pivotally mounted on said support means, a fixed contact member secured to said support means, a cantilever spring member secured to said support means in transversely disposed relation with said operating lever and having a reversely turned portion on the free end

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thereof for loosely receiving a portion of said operating lever, a movable contact member mounted on said reversely turned portion and arranged for engagement with said fixed contact member, said operating lever being movable between two positions, in one of which it engages said cantilever spring member and holds said contacts in engagement and in the other of which it engages said resilient member and holds the contacts apart, said lever being disposed to provide a hammer blow on said cantilever spring member upon movement to either the contacts closed or the contacts open position, non-over-center hairpin spring means biasing said lever toward the contacts closed position, additional adjustable spring means biasing said lever toward the contacts open position, said additional spring means including an operating rod extending through an opening in said lever on the same side of the pivot point thereof as said contacts, said rod operatively engaging said lever and being positioned substantially normally thereto, a retaining ring secured to said rod, a slidable spring adjusting bracket, and a coil spring surrounding said operating rod and positioned between said retaining ring and said bracket, said additional spring means normally overpowering said non-overcenter hairpin spring means and maintaining said contacts open, a

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bellows engaging an end of said operating rod for partially counteracting said additional spring means to such an extent that said non-over-center hairpin spring means is enabled to move said lever from the contacts open to the contacts closed position, an adjusting cam engaging said bracket for adjusting the pressure at which said bellows counteracts said additional spring means sufficiently to enclose said contacts, a projection on said cam for engaging said lever on the opposite side of said pivot to hold said contacts open regardless of the action of said bellows, and adjustment means for said hairpin spring to adjust the differential between the pressure at which said bellows causes said contacts to close and the pressure at which said additional spring means can overpower said hairpin spring means and said bellows to open said contacts again.

ROBERT L. GRAY.
CHARLES S. GRIMSHAW.

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