Feb. 3, 1942. J. R. KIRKPATRICK 2,272,064

SWITCH MECHANISM

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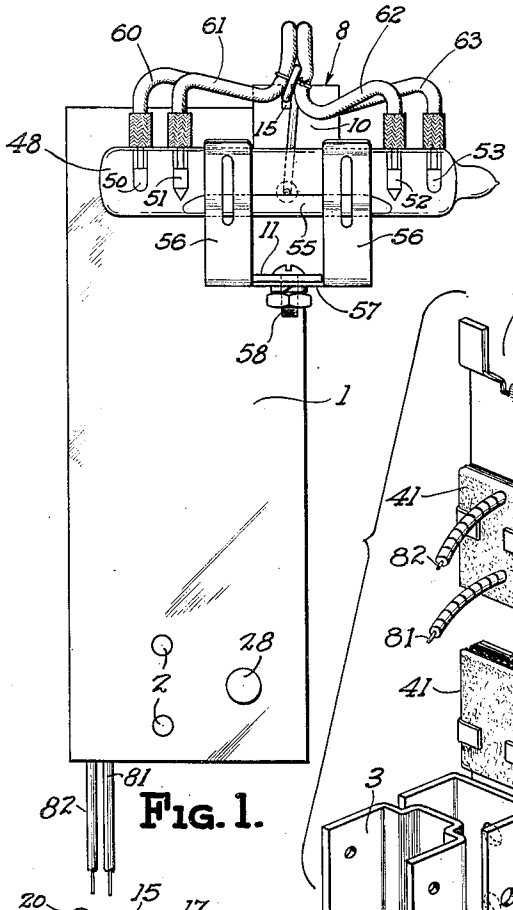

FIG. 1.

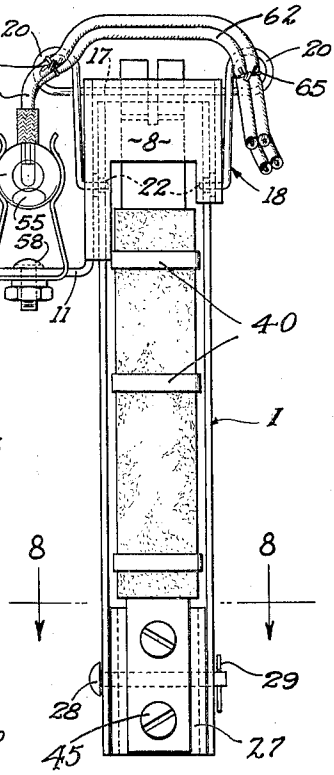

FIG. 2.

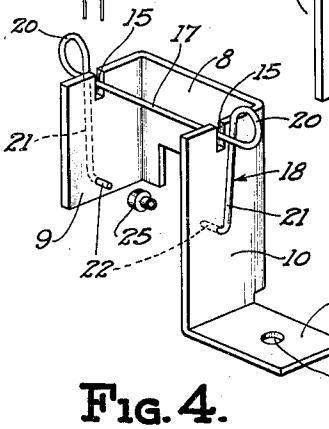

FIG. 4.

FIG. 5.

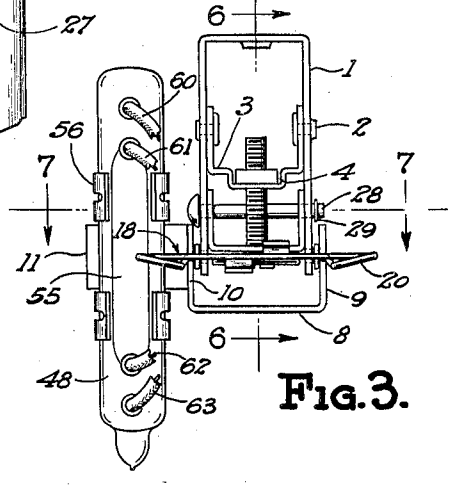

FIG. 3.

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SWITCH MECHANISM

Filed Aug. 5, 1939 2 Sheets-Sheet 2

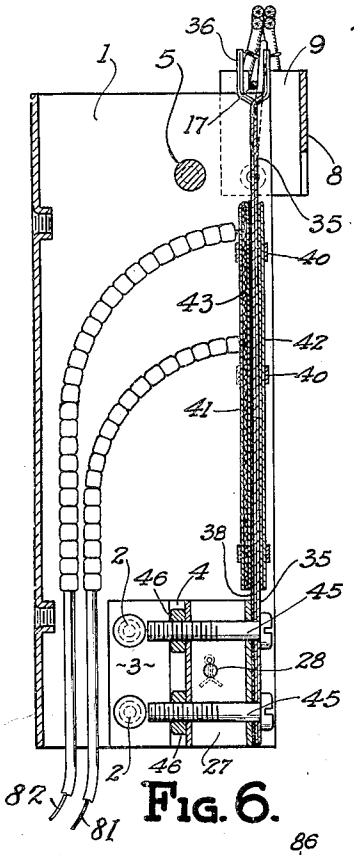

FIG. 6.

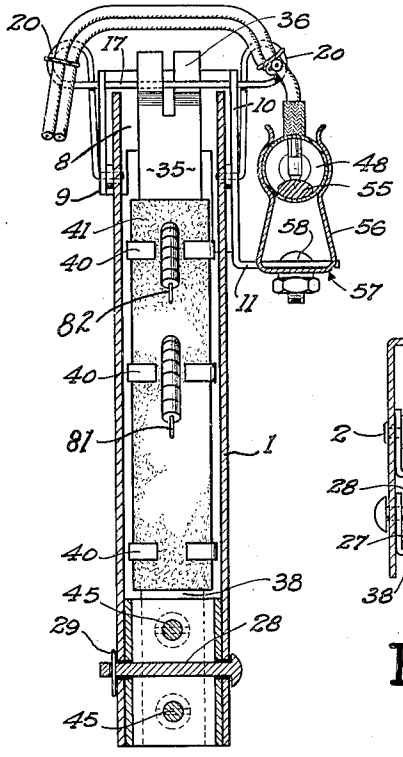

FIG. 7.

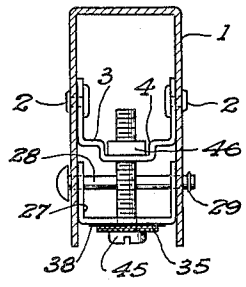

FIG. 8.

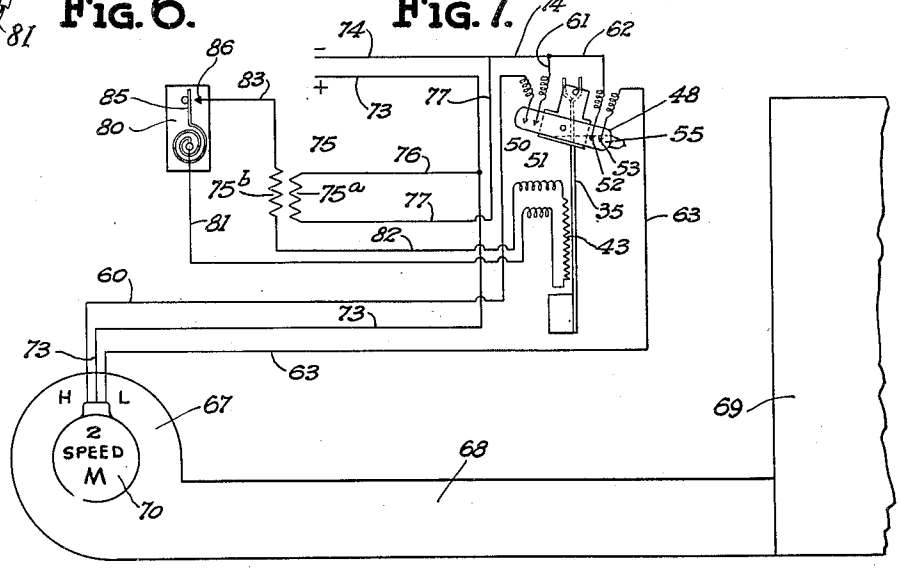

FIG. 9.

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Patented Feb. 3, 1942

2,272,064

UNITED STATES PATENT OFFICE

2,272,064

SWITCH MECHANISM

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Application August 5, 1939, Serial No. 288,631

8 Claims. (Cl. 200—122)

This invention relates to switch mechanism that is especially suitable for use in automatic control systems. For example, the switch mechanism, included in an electric circuit with a room thermostat that governs its actions, may be employed to control the circuit of an electric motor that drives a blower or fan for supplying air to a heating apparatus.

The general objects of the invention are to provide a simple and relatively inexpensive switch mechanism that is sensitive of action, thoroughly dependable, very durable, and not likely to get out of order.

Another object is to provide very simple means of adjustment for the switch mechanism by which its speed of action and timing may be varied.

Other objects will appear as I proceed to describe in detail the embodiment of the invention illustrated in the accompanying drawings wherein Figs. 1 and 2 are elevational views at right angles to each other, and Fig. 3 a plan view, of the switch mechanism; Fig. 4 is a perspective view embracing the rocker frame, the spring wire pivotal element and one of the bearing thimbles; Fig. 5 is a similar view of the thermosensitive element by which the rocker frame is oscillated, the view including the heater for such element and other associated parts; Figs. 6 and 7 are sections on the respective lines 6—6 and 7—7 of Fig. 3; Fig. 8 is a section on the line 8—8 of Fig. 2, and Fig. 9 is a diagram of a control system including the switch mechanism.

Describing the present embodiment of the invention by the use of reference characters, 1 is a main frame or support that is in the nature of a relatively deep channel member, as best shown in Figs. 3 and 8; and secured within the lower portion of the main frame or support, as by rivets 2, is a base member 3, also in the nature of a channel and the web portion of which is formed to provide a groove 4. The presence of the member 3 imparts rigidity to the lower portion of the main frame or support 1, and adjacent its top, said frame or support may be stiffened by a tie and spacing member 5 (Fig. 6) secured at its ends to the opposed walls of the frame or support. Said member 5 is omitted from all views but Fig. 6 for clearness.

Disposed at the top and adjacent the open side of the main frame or support 1 is a rocker frame 8, shown in perspective in Fig. 4. This rocker frame is desirably constructed of sheet metal, as are practically all other major parts of the structure, and it includes side plates 9 and 10, the latter extending further down than the former and terminating at its lower end in a laterally extending ledge 11, having an aperture 12. The top edges of the side plates 9 and 10 are formed with notches 15 through which extend a cross bar 17 that is formed by the central portion of a spring wire pivotal element designated generally by the reference numeral 18. Beyond the ends of the bar 17 the portions of the pivotal element are extended upwardly, inwardly, and over to form loops 20, and thence downwardly to provide legs 21. The terminals of said legs are turned inwardly in axial alignment with each other to form pintles 22 that are projected through apertures in the plates 9 and 10, said apertures being in longitudinal alignment with the notches 15. The formation and resilient quality of the element 18 causes the pintles 22 to be urged inwardly. The pintles are journaled in bearing thimbles 25 whose reduced inner ends occupy holes in the sides of the main frame or support 1. Pivotally connected in this manner to the frame or support 1, the rocking frame 8 is free to oscillate through the plane of its pivotal axis between extreme positions on opposite sides of said plane, such positions being determined by engagement of parts of the rocker frame with adjacent edge portions of the main frame or support 1.

Situated within the lower open side of the main frame or support 1 in the horizontal plane of the base member 3 is a channel shaped bracket 27. This bracket is pivoted on a pin 28 that is supported by and between the side walls of the main frame or support, such pin being shown as having a head at one end and a transverse hole near its other end for the reception of a cotter pin 29. Overlying the front wall or web of the bracket 27 is the lower end of a tongue-like thermosensitive element 35, desirably consisting of a bi-metal strip, and the same is notched at its upper end and the portions on opposite sides of the notch are offset in opposite directions to provide a fork 36 that receives the previously mentioned cross bar 17 of the pivotal element 18. The fork 36, as best shown in Figs. 6 and 9, has a width or span materially greater than the diameter of the cross bar 17 so that considerable lost motion is provided in the connection between these parts. Engaged with the inner side of the element 35 is a strip 38 of mica or other suitable insulating material and the same desirably extends downwardly between said element and the adjacent

wall or web of the bracket 27. Clamped, as by metallic clips 40, to the element 35 are layers 41 and 42 of non-inflammable heat insulating material, such as asbestos or the like, and beneath or within folds of the layer 41 is an electric heating element 43. Following approved practice, the heating element may consist of a coil of resistance wire or ribbon wrapped about a plate of mica or the like. The clips 40 permit the assembly comprising the heating element and layers 41 and 42 of insulating material to be shifted longitudinally of the element 35, and such adjustment changes the speed of action of the thermo-sensitive element. A further adjustment is provided in the mounting of the thermosensitive element. Screws 45 are engaged through aligned holes in the lower end of the element or strip 35, in the underlying portion of the strip of insulating material 33, in the wall or web of the bracket 27, and in the web of the base member 3; and beyond the latter, nuts 46 are applied to the screws and are held against turning by being confined within the groove 4 of said base member. By loosening one screw and tightening the other, the bracket 27, and consequently the thermosensitive element, may be adjusted to vary the relation of its fork 36 to the cross bar 17.

In the embodiment of the invention herein disclosed I employ what is known as a "mercoid" switch which, as is well known to those familiar with the art, consists of a sealed glass tube containing a quantity of mercury and through the wall of which extend spaced contact members that are arranged to dip into the mercury when the tube is tilted to effect this result. The switch is designated 48, and the one selected for the purpose of the present illustration involves two sets of contact members, one set being situated adjacent each end of the tube. The contact members are designated 50, 51, 52 and 53, and the mercury, 55. The tube 48 is firmly held by spring clips 56 that are parts of a unit 57 secured by a bolt 58, to the ledge 11 of the rocker frame 8, the aperture 12 of said ledge accommodating the bolt. Conductors 60, 61, 62 and 63, desirably consisting of very flexible insulated wires, lead from the respective contact members 50, 51, 52 and 53, and, as illustrated in Figs. 1, 2 and 7, these wires are brought together in pairs on opposite sides of the loops 20 of the pivotal element 18 and secured thereto by ties 65 that extend through said loops and connect the pairs of conductors together. By this arrangement the conductors are fastened indirectly to the rocker frame 8 and are prevented from interfering in any way with its sensitive action.

For clearness and convenience of illustration the switch and thermosensitive element are shown in the structural views in central position, although, as will be readily understood, the rocker frame and parts carried thereby including the switch 48 are always in one extreme position or the other on opposite sides of the vertical plane of the pivotal axis of the rocker frame except during the shift from one of said positions to the other, the mercury within the tube acting as a movable weight to aid in the overbalancing of the rocker frame in both directions. It will be seen, therefore, that the switch functions with a quick throw or so-called "snap action"; and in this connection it should be pointed out that the invention is regarded as broad enough to embrace any switch of suitable and approved type that operates on this principle, such switch being actuated by or through the instrumentality of the rocker frame 8.

To illustrate a practical application of my improved switch mechanism I have shown it schematically in the diagram of Fig. 9 as a part of an automatic control system for a fan or blower 67 that supplies air through a conduit 68 to a heating apparatus or furnace, a part of which is shown at 69. The fan or blower 67 is driven by a two-speed electric motor 70.

Electric current is supplied to the motor 70 from a suitable source through a conductor 73; and when the motor is running at low speed, the current returns through the previously mentioned conductor 63 that leads to the contact member 53 of the switch 48, through said member and the mercury 55, contact member 52, conductor 62, and a conductor 74 that represents the opposite side of the motor circuit. When the switch is thrown to its other extreme position in a manner presently to be described, the mercury bridges the contact members 50 and 51 whereupon the current will return from the motor through conductor 60, contact member 50, mercury 55, contact member 51 and conductors 61 and 74, causing the motor 70 to operate at high speed. A transformer is represented at 75 and its primary winding 75^a is included in a shunt of the main circuit represented by the conductors 76 and 77. A room thermostat, designated 80, with the secondary winding 75^b of the transformer, is placed in circuit, through conductors 81, 82 and 83, with the previously mentioned heating element 43 that is disposed in heat exchanging relation to the thermosensitive element 35.

When the temperature to which the room thermostat 80 is subjected and which is governed by the heat output of the apparatus or furnace 69 is above a predetermined value, the movable element 85 of the room thermostat will be out of engagement with a contact member 86; but when said temperature falls below said predetermined value, it will cause the movable element 85 to engage said contact member 86 and close the circuit of the heater 43, thus energizing the heater. The heat transfer between the energized heater 43 and the thermosensitive element 35 will so affect the latter as to cause it to swing to the left (as the parts are viewed in Fig. 9), and the movement of said element will be transmitted, through the cross bar 17, to the rocker frame 8 and parts carried thereby, thereby to swing the connection between the upper end of the rocker frame and the thermosensitive element through the vertical plane of the pivotal axis of the frame. This movement is, of course, imparted to the switch 48 and at the moment said connection moves through said plane the mercury 55 will flow to the left hand end of the switch 48, due to the reverse inclination of the switch. The weight of the parts, including that of the mercury, will now cause the switch to instantly assume the extreme position wherein its left hand end is depressed, resulting in the establishment of the circuit above described which causes the motor to operate at high speed. This will continue until the temperature affecting the room thermostat rises above the aforesaid predetermined value when the movable contact element 85 will withdraw from the contact member 86 and open the circuit including the heater 45, permitting the heater to cool, under which circumstances the thermosensitive element 35 will swing to the right to throw the switch to

the position shown in the diagram, thus causing the motor **10** to resume low speed operation.

As stated before, the speed of action and timing of the thermosensitive element **35** may be altered by adjusting the heater assembly longitudinally of the element, and by adjusting the screws **45** to change the angle of the pivoted bracket **27** by which said element is supported.

Having thus described my invention, what I claim is:

1. Switch mechanism comprising a support, a rocker frame including side plates disposed on opposite sides of a part of said support, said part being provided with bearings, the side plates of the rocker frame having apertures aligned with said bearings, a spring wire pivotal element formed to provide a cross bar extending across the rocker frame and depending legs adjacent the side plates whose lower ends are turned inwardly to produce pintles engaged through the apertures of the side plates and journaled in the aforesaid bearings, the rocker frame being thus pivoted to the support, an electric switch actuated by the rocker frame, a thermosensitive element operatively connected to the aforesaid cross bar so as to move the frame through the intervention thereof, and means for imparting heat to said thermosensitive element.

2. Switch mechanism comprising a support, a rocker frame including side plates disposed on opposite sides of a part of said support, said part being provided with bearings, the side plates of the rocker frame having apertures aligned with said bearings, a spring wire pivotal element formed to provide a cross bar extending across the rocker frame and depending legs adjacent the side plates whose lower ends are turned inwardly to produce pintles engaged through the apertures of the side plates and journaled in the aforesaid bearings, the rocker frame being thus pivoted to the support to swing through the plane of its pivotal axis, said frame being biased toward an extreme position on each side of said plane, an electric switch actuated by the rocker frame, a tongue-like thermosensitive element fixed at one end with respect to the support and having its opposite end provided with a fork that loosely engages the aforesaid cross bar, and an electric heater attached to the thermosensitive element.

3. Switch mechanism comprising a support, a rocker frame including side plates disposed on opposite sides of a part of said support, said part being provided with bearings, the side plates of the rocker frame having apertures aligned with said bearings, a spring wire pivotal element formed to provide a cross bar extending across the rocker frame and depending legs adjacent the side plates whose lower ends are turned inwardly to produce pintles engaged through the apertures of the side plates and journaled in the aforesaid bearings, the rocker frame being thus pivoted to the support to swing through the plane of its pivotal axis, said frame being biased toward an extreme position on each side of said plane, an electric switch actuated by the rocker frame, a tongue-like thermosensitive element fixed at one end with respect to the support and having its opposite end provided with a fork that loosely engages the aforesaid cross bar, an electric heater including a resistance element and insulating parts, and means attaching said heater to the thermosensitive element in such manner as to permit adjustment of the heater longitudinally of said element.

4. Switch mechanism comprising a support, a rocker frame including side plates disposed on opposite sides of a part of said support, said part being provided with bearings, the side plates of the rocker frame having apertures aligned with said bearings, a spring wire pivotal element formed to provide a cross bar extending across the rocker frame and depending legs adjacent the side plates whose lower ends are turned inwardly to produce pintles engaged through the apertures of the side plates and journaled in the aforesaid bearings, the rocker frame being thus pivoted to the support to swing through the plane of its pivotal axis, said frame being biased toward an extreme position on each side of said plane, an electric switch actuated by the rocker frame, a tongue-like thermosensitive element adjustably supported at one end with respect to the support and having its opposite end provided with a fork that loosely engages the aforesaid cross bar, and means for imparting heat to said thermosensitive element.

5. Switch mechanism comprising a support, a rocker frame including side plates disposed on opposite sides of a part of said support, said part being provided with opposed bearings, the side plates of the rocker frame having apertures aligned with said bearings and notches in their top edges in longitudinal alignment with said apertures, a spring wire pivotal element formed to provide a cross bar engaged within said notches and outwardly beyond said side plates to provide legs that extend downwardly and are turned inwardly to form pintles, said pintles being engaged through said apertures and being journaled in the aforesaid bearings, the rocker frame being thus pivotally connected to the support so as to swing freely through substantially the vertical plane of its pivotal axis, a "mercoid" switch carried by the rocker frame, conductors connected to the contact members of the switch and being attached to the aforesaid pivotal element, a tongue-like thermosensitive element fixed at one end with respect to the support and having its opposite end provided with a fork that is loosely engaged with the cross bar of said pivotal element, and means for imparting heat to the thermosensitive element.

6. Switch mechanism comprising a support, a rocker frame including side plates disposed on opposite sides of a part of said support, said part being provided with opposed bearings, the side plates of the rocker frame having apertures aligned with said bearings and notches in their top edges in longitudinal alignment with said apertures, a spring wire pivotal element formed to provide a cross bar engaged within said notches and outwardly beyond said side plates to provide a cross bear engaged within said wardly from said loops adjacent the side plates and being turned inwardly to form pintles that are engaged through said apertures and are journaled in the aforesaid bearings, the rocker frame being thus pivotally connected to the support so as to swing freely through substantially the vertical plane of its pivotal axis, a "mercoid" switch carried by the rocker frame, conductors connected to the contact members of the switch and being attached to one or both of the loops of the aforesaid pivotal element, a tongue-like thermosensitive element fixed at one end with respect to the support and having its opposite end provided with a fork that is loosely engaged with the cross bar of said pivotal element, and means

for imparting heat to the thermosensitive element.

7. Switch mechanism comprising a support, a rocker frame including side plates disposed on opposite sides of a part of said support, said part and said side plates having aligned apertures, bearing thimbles engaged in the apertures of said part of the support, a spring wire pivotal element formed to provide a cross bar that is disposed across the rocker frame and outwardly beyond said bar is formed to produce depending legs that have their lower ends turned inwardly and engaged through the apertures of said side plates and journaled in the said bearing thimbles, the frame being thus pivoted to the support for swinging movement through the plane of its pivotal axis, the frame being biased toward an extreme position on each side of said plane, an electric switch actuated by the rocker frame, a thermosensitive element having lost motion connection with said cross bar, and means for imparting heat to said thermosensitive element.

8. Switch mechanism comprising a support, a rocker frame pivoted thereto on a substantially horizontal axis to swing freely through the vertical plane of its pivot, the frame involving a laterally extending part a material distance below said axis which is substantially horizontal when the frame is midway of its extreme positions, a "mercoid" switch having a pair of electrical contact members at each end thereof so arranged that each pair substantially belances the other pair, flexible electrical conductors connected to said contact members and compactly grouped together and supported in substantially fixed relation to the rocker frame in about the vertical plane of its pivot, an attaching member sustaining said switch and connected to the aforesaid part of said rocker frame in such a position as to dispose the switch with its longitudinal axis substantially bisecting the pivotal axis of the rocker frame, a thermosensitive element having a lost motion connection with the rocker frame for initiating its oscillation, and means for imparting heat to said thermosensitive element.

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