Oct. 26, 1954 E. J. DILLMAN 2,692,930

THERMOSTATICALLY OPERATED SWITCH

Filed Oct. 27, 1950

4 Sheets-Sheet 1

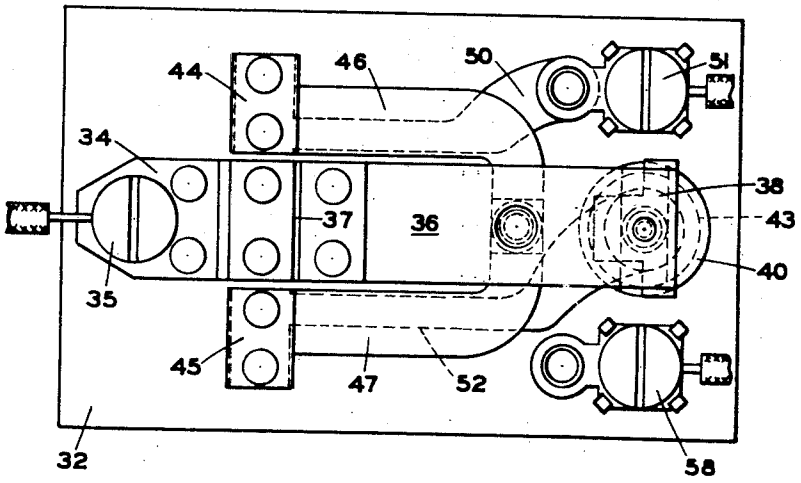


FIG. 1

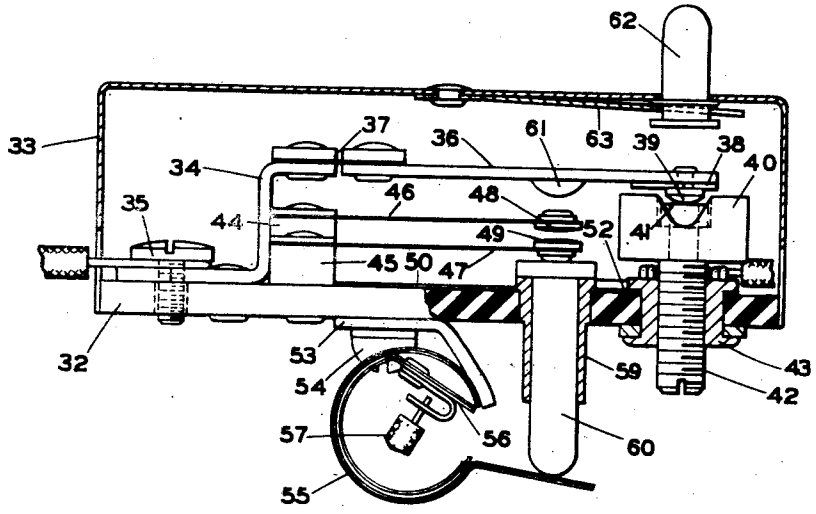


FIG. 2

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Filed Oct. 27, 1950 4 Sheets-Sheet 2

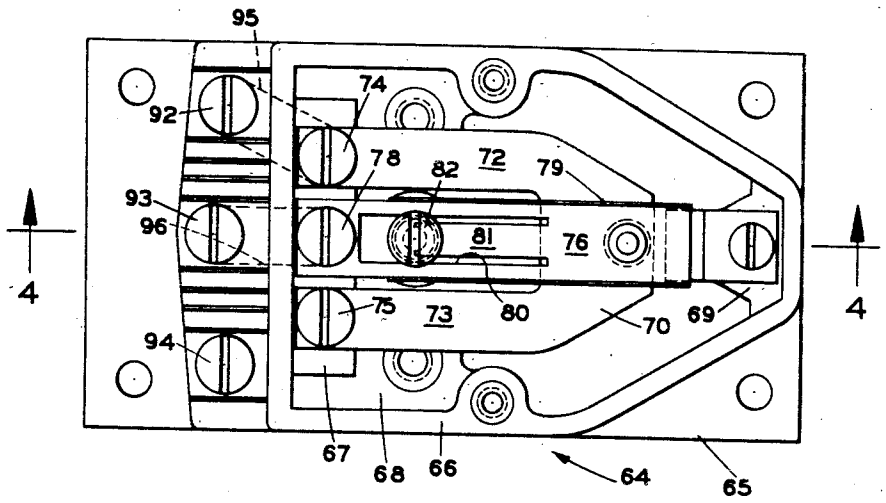


FIG. 3

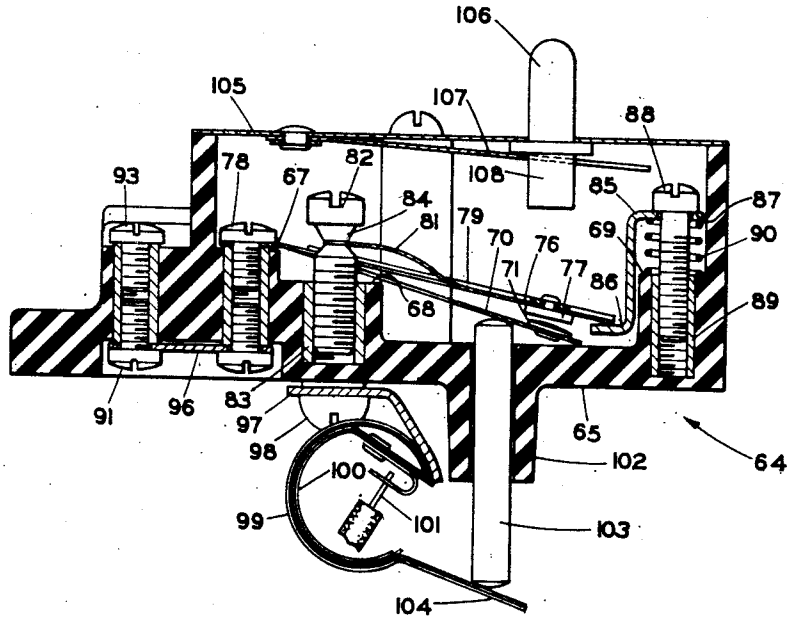


FIG. 4

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THERMOSTATICALLY OPERATED SWITCH

Filed Oct. 27, 1950 4 Sheets-Sheet 3

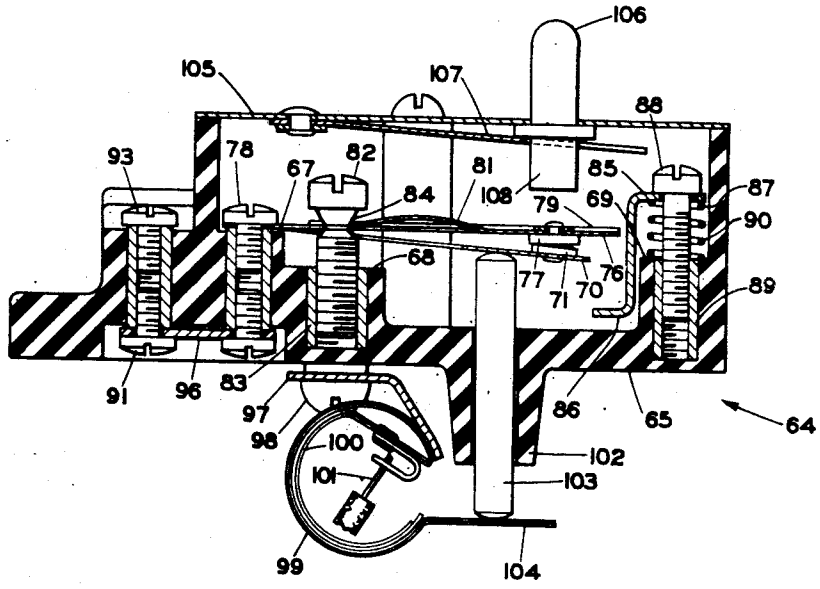


FIG. 5

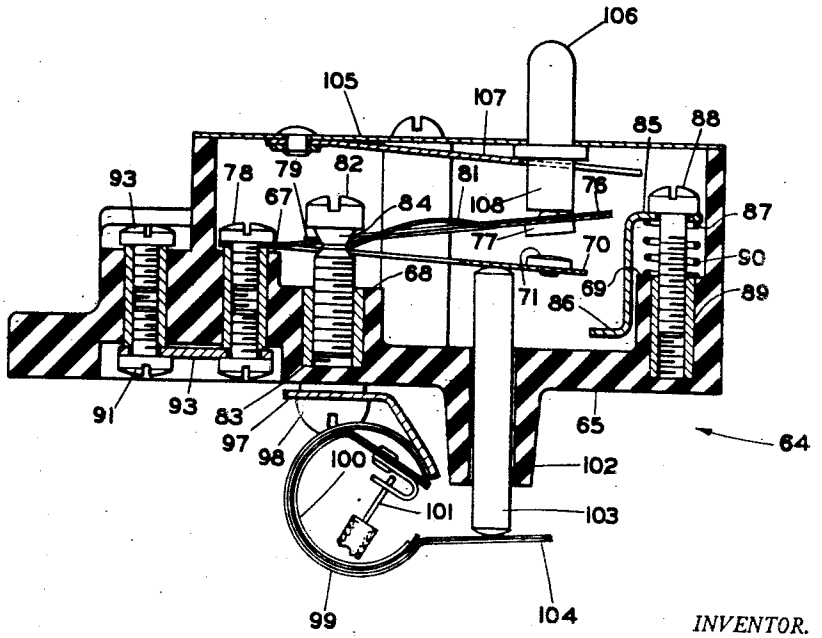


FIG. 6

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Oct. 26, 1954 E. J. DILLMAN 2,692,930

THERMOSTATICALLY OPERATED SWITCH

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4 Sheets-Sheet 4

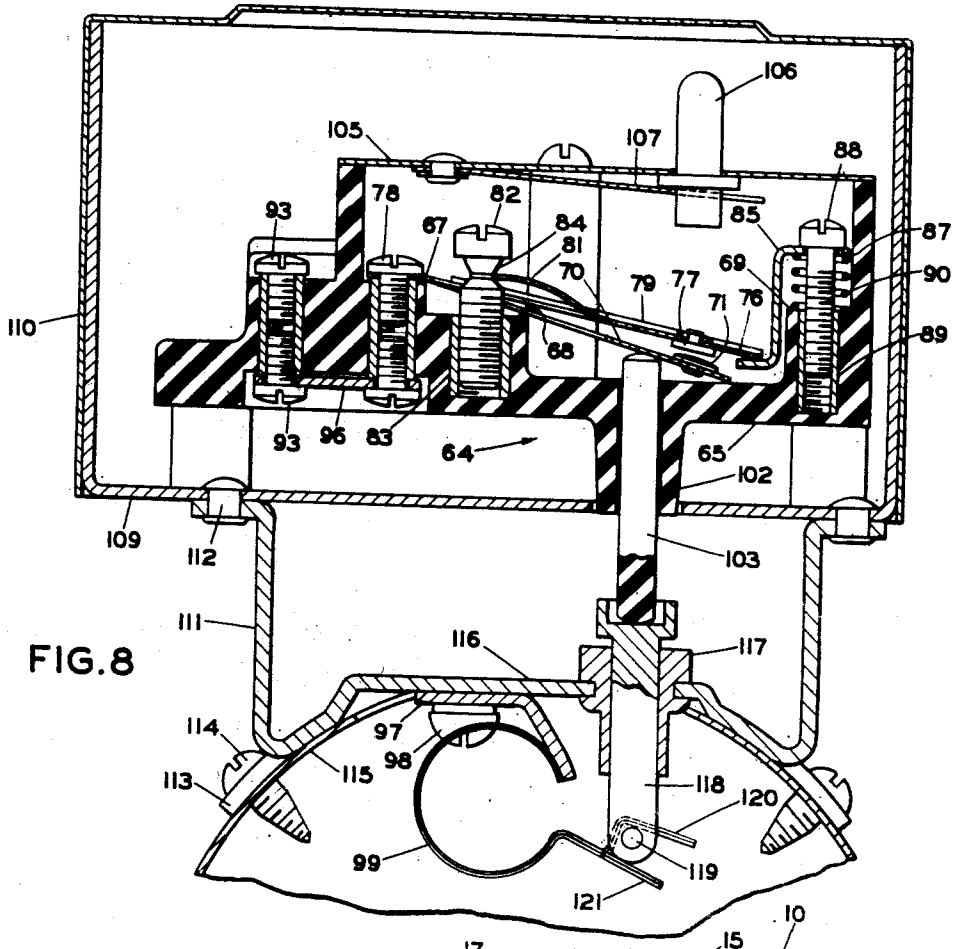


FIG. 8

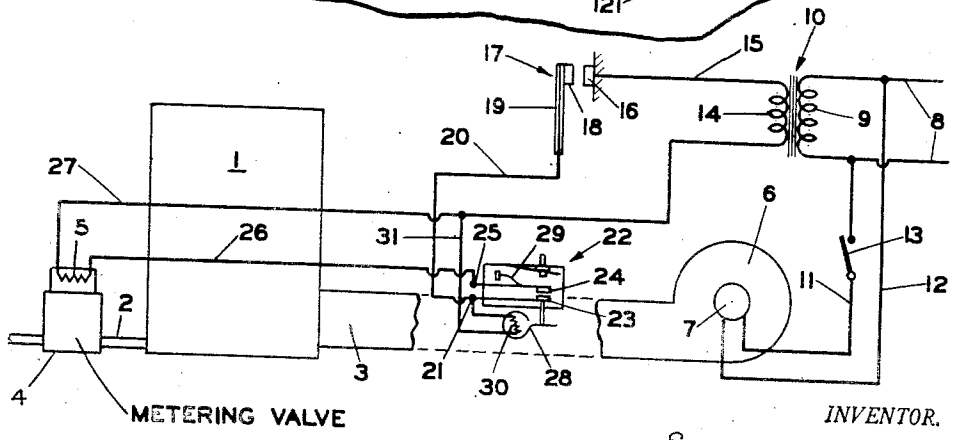


FIG. 7

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UNITED STATES PATENT OFFICE

2,692,930

THERMOSTATICALLY OPERATED SWITCH

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Application October 27, 1950, Serial No. 192,484

16 Claims. (Cl. 200—122)

1

This invention relates to new and useful improvements in thermostatically operated switches, and more particularly to a thermostatic switch which is particularly adapted for use as an air flow responsive safety switch.

One of the objects of this invention is to provide a thermostatically actuated switch of new and improved construction.

Another object is to provide a thermostatic switch structure including means for opening the switch upon predetermined movement in one direction.

Another object is to provide a switch structure having initially open contacts operable upon actuation to be closed and upon continued movement in the same direction to be reopened.

Another object is to provide a thermostatic switch operable upon actuation in one direction to be closed and upon continued movement in the same direction to be reopened and including adjustable means for varying the amount of movement required for initial switch closure and for reopening.

Another object is to provide a novel electrically energized safety switch which is operable to be closed in the presence of air flow and to be reopened upon failure of air flow or upon failure of the energizing circuit for the switch.

Another object is to provide a switch of the character described including a simple mechanically operable means for resetting the switch from a reopened position.

Other objects will become apparent from time to time throughout the specification and claims as hereinafter related.

This invention comprises the new and improved construction and combination of parts to be more fully described hereinafter and the novelty of which will be particularly pointed out and distinctly claimed.

In the accompanying drawings to be taken as part of this specification there are clearly and fully illustrated two preferred embodiments of this invention in which drawings:

Figure 1 is a plan view with cover removed of one form of safety switch comprising an embodiment of this invention,

Fig. 2 is a side elevation of the switch structure shown in Fig. 1 and showing the cover in section and a broken detail section of the switch actuating and adjusting mechanism,

Fig. 3 is a horizontal plan view with cover removed of another form of safety switch comprising another embodiment of this invention,

Fig. 4 is a central vertical section of the switch

2

structure shown in Fig. 3 and cover therefor and taken on the section line 4—4 thereof,

Fig. 5 is a sectional view of the switch structure as shown in Fig. 4 and showing the same in an intermediate actuated position,

Fig. 6 is a sectional view of the switch as shown in Figs. 4 and 5 and showing the same actuated to a safety position,

Fig. 7 is a diagrammatic view of a fuel burner control system utilizing either of the switches previously disclosed as safety switches controlling a fuel valve in response to air flow to the burner, and

Fig. 8 is a longitudinal central section of a switch structure similar to that shown in Figs. 4 to 6 but showing the same constructed for use as a thermostatic stack switch.

Referring to the drawings by characters of reference and more particularly to Fig. 7 there is shown a control system for a vaporizing type liquid fuel burner. In this system there is shown a burner pot 1 which is supplied with liquid fuel through an inlet conduit 2 and with air through an air duct 3. Liquid fuel for the burner 1 is supplied through a constant level metering valve 4 which is electrically controlled by an electrically energized means designated diagrammatically as 5. The air supply for the burner is produced by a blower 6 driven by an electric motor 7. A high voltage electric power source 8 supplies electric current to the primary 9 of a transformer 10. The blower motor 7 is connected by lead wires 11 and 12 in parallel circuit with the transformer primary 9. A switch 13 is provided in the blower circuit and may be controlled by the fuel valve energizing means 5, for example, as is shown in Patent 2,337,476 to Landon and Russel. The transformer 10 has a secondary 14 connected to provide current for energizing the fuel valve controlling means 5. From one side of the transformer secondary 14 a lead wire 15 extends to a fixed contact 16 of a room thermostat 17. A movable contact 18 of the room thermostat 17 is carried by a heat responsive bimetal strip 19 which is connected by a lead wire 20 to a terminal 21 on a safety switch generally designated as 22. The terminal 21 is connected to one contact 23 of the switch 22 which is cooperable with another contact 24 in turn connected with a terminal 25. The terminal 25 is connected by a lead wire 26 to one side of the energizing means 5 for the fuel valve 4, the other side of which is connected by lead wire 27 to the other side of the transformer secondary 14. In the switch 22 there is provided a heat responsive

actuating means 28 for closing the switch contacts 23 and 24 and a snap acting means 29 for causing the contact 24 to be moved away from the contact 23 upon excessive movement by the actuating means 28. The member 28 is heated by an electric resistor 30 which is connected to the terminal 21 on one side and to a lead wire 31 connected with the lead wire 27 to the transformer secondary 14. When the room thermostat 17 is closed demanding heat and the blower switch 13 is closed, the fuel valve energizing means 5 is energized through a circuit including and subject to the control of the open switch contacts 23 and 24, the electric resistor 30 being connected in parallel therewith. As the resistor 30 energizes the actuating member 28 the contacts 23 and 24 are closed permitting the actuating means 5 to be energized and the fuel valve 4 to be opened for supply of fuel to the burner 1. If the blower 6 is operating and supplying air to the burner 1 the flow of air will abstract sufficient heat from the actuating member 28 to prevent the same from moving the switch contacts sufficiently to cause them to be reopened by the snap acting means 29 thus permitting the fuel valve 4 to remain energized. If the blower 6 does not operate or there is some other reason for failure of air flow, the actuating member 28 will move the contacts of the switch 22 until the snap acting means 29 causes the same to be opened thus deenergizing the actuating means 5 for the metering valve 4.

It should be noted that air responsive safety switches for liquid fuel burning systems are recognized as being old in the art and that the present switch is an improvement of an earlier one shown in Patent 2,344,946 to Walter S. Landon. However, earlier types of safety switches such as the aforementioned Landon switch were connected in series with the load (or valve) in the main control circuit with the heater element for the switch connected in series therewith. This arrangement was satisfactory and safe (since if the resistor were broken the valve circuit would be opened) where the load circuit was designed to permit the introduction of the switch heater element in the circuit but could not be used in circuits which were not so designed. The present system provides a simple arrangement whereby the heater element or resistor for the safety switch can be connected in parallel with the load of the circuit and thus not affect its operation and at the same time provide the required safety of operation in the event that the resistor should burn out or break. In order to provide this safety of operation, it is necessary to have a switch in which the contacts are open when deenergized, which are closed upon energization of the resistor and which are moved to a safety or reopened position by overheating of the actuating element as in case of failure of air flow.

Referring to the form of switch structure shown in Figs. 1 and 2 there is shown a switch arrangement wherein the safety snap opening movement is produced by cooperating magnet and armature members. In this form of switch there is provided a supporting wall member or terminal board 32 having a cover 33. At one end of the terminal board 32 there is supported a bracket 34 having a connecting terminal screw 35 therein and carrying a switch contact arm 36 flexibly connected thereto by a leaf spring 37 having an inherent bias urging the arm 36 toward the top wall of the cover 33. The end of

the contact arm 36 carries thereon an armature member 38 and a contact 39 which are cooperable with the magnet 40 and fixed contact 41 respectively. The magnet 40 and contact 41 are carried by an adjustable bolt or screw member 42 supported by a sleeve or bushing 43 in an aperture in the terminal board 32. Adjacent the bracket 34 and on opposite sides thereof there are positioned supporting brackets 44 and 45 carrying contact arms 46 and 47 respectively. The contact arms 46 and 47 have their end portions carrying contacts 48 and 49 respectively, contact 48 overlying contact 49. Bracket 44 is connected by a jumper 50 to a terminal screw connection 51. Similarly, bracket 45 is connected by a jumper 52 with the supporting sleeve 43 and the magnet 40 and fixed contact 41. On the underside of the terminal board 32 bracket 53 is secured as by one or more bolts or screws 54 and has secured thereto one end of a bimetallic member 55 which is provided for actuating this switch arrangement. The bimetallic member 55 is curved and has supported therein a resistor element 56 woven between sheets of corrugated mica. The bimetal element 55 and resistor 56 form an electrically energized heat motor of a type which is shown and described more completely in Patent 2,352,439 to Walter S. Landon. One end of the resistor 56 is connected by a lead wire 57 to the underside of the terminal screw connection 51. The other end of the resistor 56 (not shown) is connected by a lead wire to the underside of a screw terminal connection 58. The terminal 35 is arranged to be connected in operation to a load circuit which is not shown for this modification of the invention. The load circuit is preferably an oil controlling valve as is shown in Fig. 7. The terminal 58 is similarly arranged to be connected with a return wire from the load circuit similar to the arrangement in Fig. 7. The resistor 56 is thus arranged in parallel with the switch contacts 48, 49, 39 and 41 and the load circuit which is not shown for this modification. By this arrangement there is in effect provided a pair of switches formed by the contacts 48, 49 and 39, 41 respectively connected in series. A sleeve member 59 is secured in an aperture in the terminal board 32 which guides a thrust transmitting rod 60 engaging the end of the bimetal member 55 and the underside of the switch contact 49 respectively. As the bimetal 55 is heated by the resistor 56 it moves upward causing the thrust rod 60 to move the contact 49 into engagement with contact 48. The closure of contacts 48 and 49 completes a circuit through the switch structure as follows: From terminal screw 51 through jumper 50, bracket 44 and contact arm 46 to contacts 48, 49; from contact 49 through contact arm 47, bracket 45 and jumper 52 to sleeve 43 supporting the adjusting screw 42 and contact 41; from contacts 41, 39 through contact arm 36 and bracket 34 to terminal screw 35. If this switch is positioned in an air stream so that sufficient heat is abstracted from the bimetal 55 the switch will not be actuated further. If, however, there is a failure of the air stream or the bimetal 55 overheats from any other cause the contacts 49 and 48 and their contact arms 46, 47 will be moved upward until they engage an abutment 61 on the contact arm 36. At this point further movement will cause the contact arm 36 to be moved and to move the armature 38 out of attractive relation with the magnet 40 thus releasing the inherent bias of the connecting leaf spring 37 to move the

contact arm 36 toward the upper wall of the switch cover 33 and opening the switch structure at contacts 39 and 41. A resetting mechanism for the arm 36 is provided on the cover 33. There in a movable reset member 62 overlying the armature carrying portion of the contact arm 36 and held in position by a leaf spring 63. The reset member 62 may be depressed to move the contact arm 36 to position the armature 38 in an attractive relation with the magnet 40.

From the foregoing we see that there is provided a simple switch structure having initially open contacts which are closed upon energization of the electrically energized heat motor and having another set of contacts which are snapped open upon predetermined further movement by the heat motor. The arrangement thus provided when used in the circuit shown in Fig. 7 will cause the circuit to the metering valve to be closed when energized and the blower is operating and to be opened either upon failure of the resistor 56 or upon failure of air flow from the blower 6.

Referring to the switch structure shown in Figs. 3 to 6 there is shown an arrangement which is similar in purpose to the switch arrangement shown in Figs. 1 and 2 but which has certain structural advantages which will be set forth more completely hereinafter. For the switch structure shown in Figs. 3 to 6 there is provided a box-like supporting structure or casing of insulating material, such as a molded phenolic resin, generally designated as 64 and having a bottom wall 65 and side walls 66. Within the casing 64 there are provided a plurality of internal shoulders 67, 68 and 69 respectively for supporting various portions of the switch as hereinafter set forth. Within the casing 64 there is positioned a bifurcated switch contact arm 70 carrying thereon a switch contact 71 and having two legs 72 and 73 secured to the shoulder 67 by securing screws 74 and 75 respectively. The contact legs 72 and 73 are each bent downward adjacent the edge of the shoulder 67 to provide an inherent downward bias of the contact arm 70 toward the bottom wall 65 of the casing 64. Contact arm 76 overlies the contact arm 70 and carries a switch contact 77 engageable with contact 71. The contact arm 76 is secured at one end to the shoulder 67 at a point intermediate and spaced from the contact legs 72 and 73 as by a securing screw 78. The contact carrying end of the contact arm 76 has its edges bent upward as at 79 to provide a channel-like construction for stiffness. The contact arm 76 has a U-shaped elongated aperture 80 formed therein providing a tongue member or leaf spring portion 81 integral therewith. The leaf spring 81 is cooperable with a screw member 82 secured in an insert 83 on the shoulder 68 and extending through the aperture 80. The screw member 82 is notched as at 84 and receives one end of the leaf spring 81 forming therewith a buckled leaf type toggle spring urging the contact arm 76 downward toward engagement of the contacts 71 and 77. Positioned adjacent the contact carrying ends of the contact arms is an adjustable conductive abutment member 85 having a lower flange portion 86 cooperable with the end of the contact arm 76 and having a reversely bent apertured flange portion 87 carried by an adjustment screw 88. The adjustment screw 88 extends through the aperture in the flange 87 and is secured in an insert 89 in the shoulder 69 of the casing 64. A spring 90 surrounds the screw 88 and engages the flange 82 to hold the same in engagement with the head of the screw for adjustment therewith. On an exterior shoulder 91 of the casing 64 there are a plurality of terminal screws 92, 93 and 94 secured in metal inserts in the shoulder 91. The terminal screw 92 is connected by a jumper 95 on the underside of the casing wall 65 to the connecting screw 74 of the contact arm 70. Similarly, a jumper 96 (shown in Fig. 4) is provided to connect the terminal screw 93 with the connecting screw 78 of the contact arm 76. On the underside of the casing wall 65 a bracket 97 is secured by one or more screws 98 and carries the bimetal heat motor 99 which is similar in construction to the one shown in Fig. 2. The heat motor 99 has a resistor 100 of the type described in connection with Fig. 2 and has its ends connected to the underside of the inserts holding the terminal screws 92 and 94 respectively by connecting wires 101. The bottom casing wall 65 has an apertured projecting portion or sleeve 102 in which a thrust member or rod 103 is slidably positioned. The thrust rod 103 is engageable at one end with the end portion 104 of the heat motor 99 and at its other end with the contact arm 70. The movement of this switch structure through its various stages of operation is shown successively in Figs. 4, 5 and 6. In this arrangement the adjustment screw 88 is positioned to hold the flange 86 in a position holding the contact 77 out of engagement with the contact 71. This switch is intended primarily for use in a control system similar to that shown in Fig. 7 and would be connected with terminal screws 92 and 93 corresponding to terminals 21 and 25 respectively in Fig. 7 and the resistor 100 corresponding to the resistor 30. Similarly, the contacts 77 and 71 would correspond to contacts 24 and 23 respectively in Fig. 7. When the resistor 100 is energized to heat the heat motor 99 the end portion 104 thereof engages and moves the thrust rod 103 to move the contact arm 70 upward to engage the contact 71 with the contact 77. If while this heat motor is energized, there is an air stream flowing over it to abstract heat therefrom, the heat motor and the contacts moved thereby will "float" in an intermediate position as is shown in Fig. 5 maintaining the contacts closed. If there is a failure of air supply as by a failure of the blower to function or an obstruction in the supply duct, the required amount of heat will not be abstracted from the heat motor 99 and it will move the contact arms further upward. Upon predetermined upward movement the contact arm 76 will be moved overcenter relative to the toggle spring 81 which spring will then urge the arm 76 upward and away from the arm 70 to open the contacts 77 and 71. This last-named position is shown in Fig. 6.

It should be noted in connection with the snap opening of the switch contacts by overcenter movement that the amount of upward movement of the contact arm 76 is greater than the maximum movement of the contact arm 70 by the heat motor 99 so that the contacts cannot again be closed by continued heat motor operation.

A cover member 105 closes the top of the casing 64 and carries in an aperture overlying the contact arm 76 a reset member 106 which is held in position against the cover 105 by a leaf spring 107. The lower end portion 108 of the reset member 106 projects into the casing 64 and is engageable with the contact arm 76 as a stop to determine the maximum opening movement of

the arm 76. After the switch has been operated to a safety open position it may be reset by de-energizing the heat motor 99 and depressing the reset member 106 to move the contact arm 76 back from its overcenter position whereby it will assume its initial position as shown in Fig. 4.

The adjustment screw 88 is adjustable to determine the position of the flange 86 and thereby to determine the extent of opening of the contacts 71 and 77 in the initial position shown in Fig. 4 (which may be completely closed), or to determine the amount of movement of the heat motor 99 required to close said contacts. The adjustment screw 82 is adjustable to vary the position of the toggle spring 81 to determine the "snap point" thereof and thereby to determine the minimum air velocity required for abstraction of heat to prevent safety operation of the switch.

It should be noted that a safety switch structure of this type which is independently adjustable both for closing movement and for snap point is capable of many and varied uses in addition to the safety structure shown herein. Among the possible variations of the use of this safety switch is a stack switch arrangement as is shown in Fig. 8. In this arrangement the switch structure is substantially identical to that shown in Figs. 3 to 6 inclusive and all similar parts are given the same reference numerals.

In Fig. 8 the switch casing 64 is supported in an exterior casing 109 having a cover 110. The casing 109 has another casing portion 111 connected to it as by rivets 112 which is dished to the contour of a furnace stack. The dished casing portion 111 has a plurality of ears 113 which are secured as by sheet metal screws 114 to a stack pipe 115, only a fragment of which is shown herein. In this arrangement the heat motor 99 comprises only the bimetal, the resistor being eliminated since this structure is responsive to the effect of stack temperature. The dished wall 116 of the casing 111 has a sleeve 117 therein which guides the thrust rod 118 engageable with the switch thrust rod 103 and having a pin portion 119 positioned between two prongs 120 and 121 of the end of the bimetal 99. The bimetal 99 is supported by the bracket 97 which is secured by screws 98 to the dished wall 116 of the casing 111 instead of the switch casing wall 65. In this form of construction there is provided a stack switch which will close in response to a predetermined rise in temperature in the furnace stack which is indicative of flame in the furnace and which will be moved to a safety open position by excessive rise in temperature in the furnace stack as in the case of a run-away stack fire.

While there are shown in this application only two forms of the invention, it will be obvious to those skilled in the art that numerous modifications thereof might be made without departing from the reasonable scope of the invention which is intended to be limited only by the appended claims.

Having thus described the invention, what is claimed and desired to be secured by Letters Patent of the United States is:

1. In a switch structure, first and second contact arms, means cooperable with said second contact arm when in one position to bias the same toward a switch closed position, means engageable with said first contact arm and operable to move the same in one direction against said second contact arm and the force of said first-named biasing means, means operable to bias said second contact arm away from said first contact arm upon predetermined movement in said one direction to cause said contacts to open, and adjustable means cooperable with said last-named biasing means to vary its relation to said second contact arm to determine the extent of said predetermined movement required to render the same operable.

2. In a switch structure, first and second contact arms, a toggle spring cooperable with said second contact arm when in one position to bias the same toward a switch closed position, means engageable with said first contact arm and operable to move the same in one direction against said second contact arm and the force of said toggle spring, means including said toggle spring operable to bias said second contact arm away from said first contact arm upon overcenter movement in said one direction to cause said contacts to open, and adjustable means cooperable with and operable to move said toggle spring to determine the snap point of the same relative to said second contact arm.

3. In a switch structure, first and second contact arms, said second contact arm being biased in one direction and said first contact arm in the opposite direction, magnetic members comprising cooperable magnet and armature members, one of said magnetic members being carried by said second contact arm and cooperable with the other member to bias said second contact arm in said opposite direction toward a switch closed position, means operable to move said first contact arm in said one direction against said second arm and against the force of said magnetic members, and said last-named means being operable upon predetermined movement to move said one magnetic member out of attractive relation with the other thereby releasing the bias of said second contact arm to move the same in said one direction to an open position.

4. In a switch structure, first and second contact arms, said second contact arm being biased in one direction and said first contact arm in the opposite direction, magnetic members comprising cooperable magnet and armature members, one of said magnetic members being carried by said second contact arm and cooperable with the other member to bias said second contact arm in said opposite direction toward a switch closed position, means operable to move said first contact arm in said one direction against said second arm and against the force of said magnetic members, said last-named means being operable upon predetermined movement to move said one magnetic member out of attractive relation with the other thereby releasing the bias of said second contact arm to move the same in said one direction to an open position, and adjustable means for moving said other magnetic member to determine the extent of said predetermined movement required to release the bias of said second contact arm.

5. In an air responsive safety switch structure for controlling an electrical load, first and second contact arms carrying contacts having switch open and switch closed positions, said second contact arm having a first position in which it is biased toward said first contact arm and a second position in which it is biased away from said first contact arm and toward a switch open position, and an electrically heated "heat motor" operable to move said contact arms and upon predetermined movement in one direction to cause said second contact arm to assume said second position and to move to said switch open

position, said "heat motor" being adapted to be positioned in an air stream for abstraction of heat therefrom, the cessation of said air stream being operable to permit said "heat motor" to move through said predetermined distance, said heat motor having an electric resistance heater arranged to be connected in parallel with said switch contacts and said electrical load, and means for resetting said second contact arm to said first position.

6. In an air responsive safety switch structure for controlling an electrical load, first and second contact arms carrying contacts having a switch closed position, means cooperable with said second contact arm when in one position to bias the same toward said first contact arm, means operable to bias said second contact arm away from said first contact arm to open said switch upon predetermined movement thereof in one direction, an electrically heated "heat motor" operable upon energization to move said contact arms through said predetermined movement, said heat motor having an electric resistance heater arranged to be connected in parallel with said switch contacts and said electrical load, said "heat motor" being adapted to be positioned in an air stream for abstraction of heat therefrom to prevent opening said switch contacts, and the cessation of air flow being operable to permit said "heat motor" to move said contact arms through said predetermined movement.

7. A switch structure as set forth in claim 6 wherein the first-named biasing means comprises cooperable magnet and armature members initially positioned in attractive relation, and the second-named biasing means comprises an inherent flexural bias in said second contact arm rendered operable upon predetermined separation of said magnet from said armature.

8. A switch structure as set forth in claim 6 wherein the biasing means comprises a toggle spring cooperable with said second contact arm and movable back and forth from an overcenter position.

9. In a switch structure, first and second contact arms having engageable contacts, said first contact arm being biased in one direction, means cooperable with said second contact arm when in one position to bias the same in said one direction toward engagement with said first contact arm, abutment means engageable with said second contact arm upon movement in said one direction to permit said first contact arm to move away therefrom to open said contacts, means for moving said first contact arm in the other direction against its bias and against the bias of said second arm, and means operable upon predetermined movement in said other direction to bias said second contact arm in said other direction to cause said contacts to open.

10. A switch structure as defined in claim 9 wherein said abutment means and said last-named biasing means are independently adjustable.

11. In a switch structure, first and second contact arms having engageable contacts, said first contact arm being biased in one direction, a toggle spring cooperable with said second contact arm when in one position to bias the same in said one direction toward engagement with said first contact arm, a threadedly adjustable abutment engageable with said second contact arm upon movement in said one direction to permit said first contact arm to move away therefrom to open said contacts, means for moving said first

contact arm in the other direction against its bias and against the bias of said second arm, said toggle spring being operable upon movement in said other direction to an overcenter position to bias said second contact arm in said other direction to cause said contacts to open, and an abutment member positioned to support one end of said toggle spring and threadedly adjustable to determine the snap point thereof.

12. In a switch structure, first and second contact arms having engageable contacts, said first contact arm being biased in one direction, means cooperable with said second contact arm when in one position to bias the same in said one direction toward engagement with said first contact arm, abutment means engageable with said second contact arm upon movement in said one direction to permit said first contact arm to move away therefrom to open said contacts, an electrically energized "heat motor" operable upon energization to move said first contact arm in the other direction against its bias and against the bias of said second arm, and means operable upon predetermined movement in said other direction to bias said second contact arm in said other direction to cause said contacts to open, said "heat motor" being adapted to be supported in an air stream for abstraction of heat in an amount preventing "heat motor" movement through said predetermined distance, the cessation of air flow being operable to permit said "heat motor" to move said predetermined distance to open said switch contacts.

13. In a switch structure, a hollow casing of insulating material having a top opening and a plurality of spaced shoulders within, a first flexible contact arm secured at one end to one of said shoulders and inherently flexed to be biased against the bottom wall of said casing, a second flexible contact arm overlying said first arm and secured at one end to said one shoulder in spaced relation to said first arm, said second contact arm having a U shaped aperture therein forming a leaf spring portion, a first adjustable screw member secured in the second of said shoulders, said leaf spring portion being engageable with said screw member to form therewith a toggle spring having an initial position urging said second contact arm toward said bottom wall and engagement with said first contact arm, a second adjustable screw member secured in the third of said shoulders at the other end of said casing from said one shoulder, a stop member adjustably carried by said second screw member and engageable with said second contact arm to hold the same spaced from said first arm, the bottom wall of said casing having a guide passage therein, a thrust transmitting rod guided in said passage and engageable with said first contact arm for moving the same, a bracket secured to the under side of said casing bottom wall, a bimetal member secured at one end to said bracket and having its other end engageable with said thrust rod, an electric resistor insulated from, carried by, and flexible with said bimetal member, said bimetal member being operable upon being heated to move said thrust rod to move said first contact arm upward against said second contact arm, said second contact arm being operable upon upward movement overcenter relative to said toggle spring to be moved by said toggle spring away from said first contact arm, a cover for said casing top opening, said cover having an aperture overlying the end portion of said second contact arm and having a reset

member positioned therein, a leaf spring carried on the underside of said cover and engageable with said reset member, said reset member being engageable with said second contact arm to move the same from an overcenter position back to said initial position, said second screw member being adjustable to determine the extent of separation of said contact arms when moved fully toward said bottom wall, and said first screw member being adjustable to determine the snap point of said toggle spring.

14. In a switch structure, a plurality of contact arms providing a pair of switches arranged in series, one of said switches having its contacts closed, the other of said switches having its contacts open, one of said contact arms in said one switch being biased toward an open position, snap acting means cooperable with and biasing said one contact arm to a closed position and operable upon predetermined movement to permit said one switch to open with a snap movement, means engageable with a contact arm of said other switch to move the same to closed position, and said last-named means being operable upon further movement to flex the contacts of said other switch to engage and move said one contact arm to cause the same to snap open.

15. In a switch structure, a plurality of contact arms providing a pair of switches arranged in series, one of said switches having its contacts closed, the other of said switches having its contacts open, one of said contact arms in said one switch being biased toward an open position, snap acting means cooperable with and biasing said one contact arm to a closed position and operable upon predetermined movement to permit said one switch to open with a snap movement, means engageable with a contact arm of said other switch to move the same to closed position, said last-named means being operable upon further movement to flex the contacts of said other switch to engage and move said one contact arm to cause the same to snap open, and means to adjust the snap point of said snap acting means.

16. A switch structure as defined in claim 15 wherein said snap acting means comprises cooperable magnet and armature members one of which is carried by said one contact arm.

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