

Sept. 28, 1937.

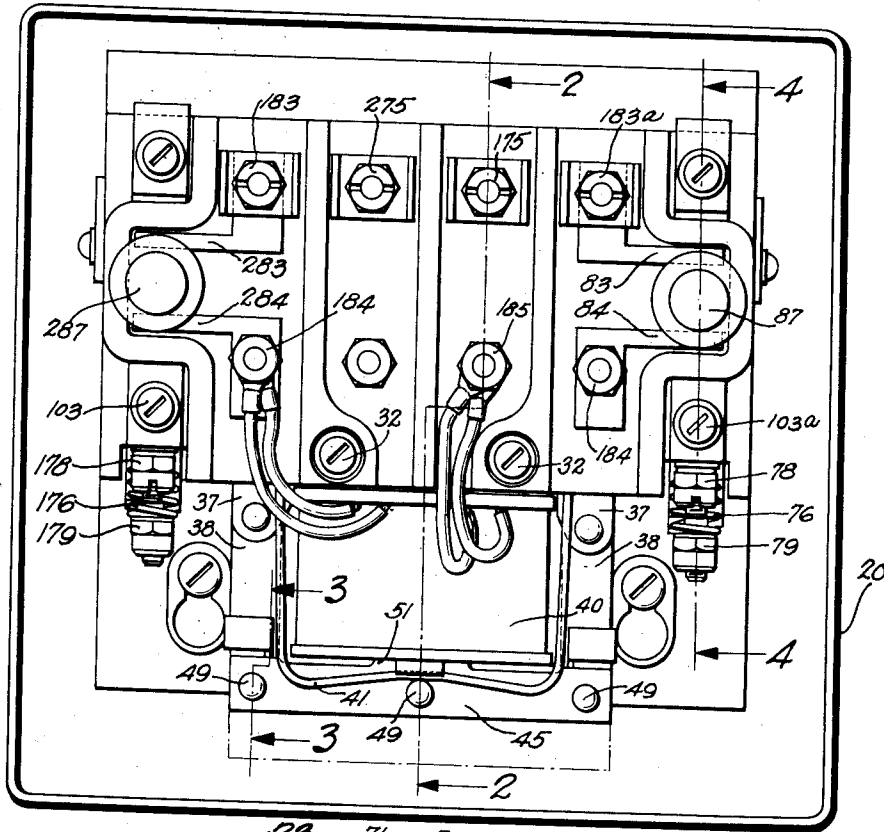
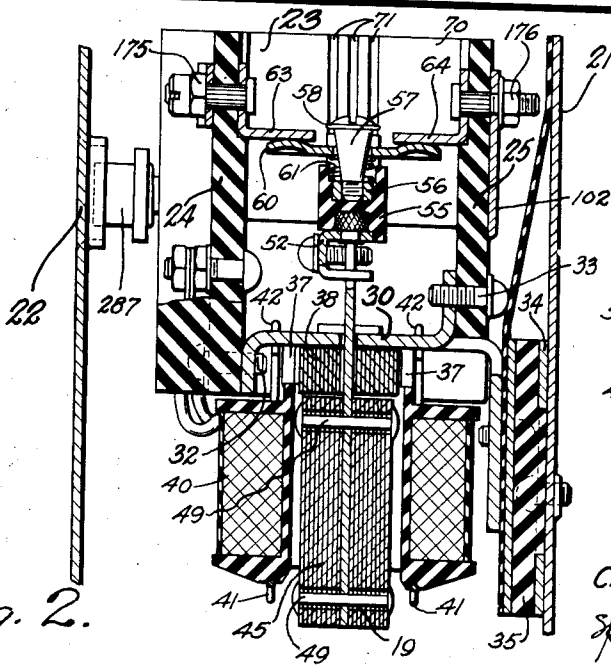
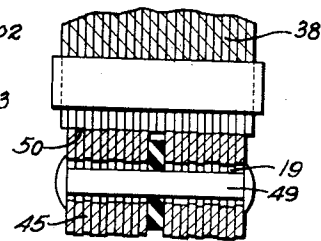
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2,094,199

SWITCH

Filed July 25, 1934

3 Sheets-Sheet 1



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SWITCH

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3 Sheets-Sheet 2

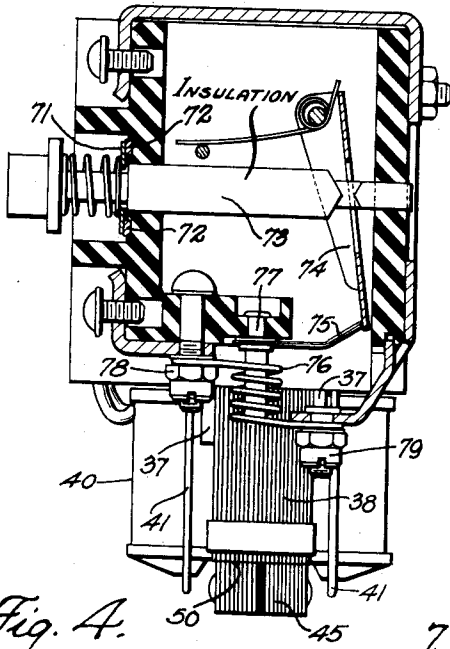


Fig. 4.

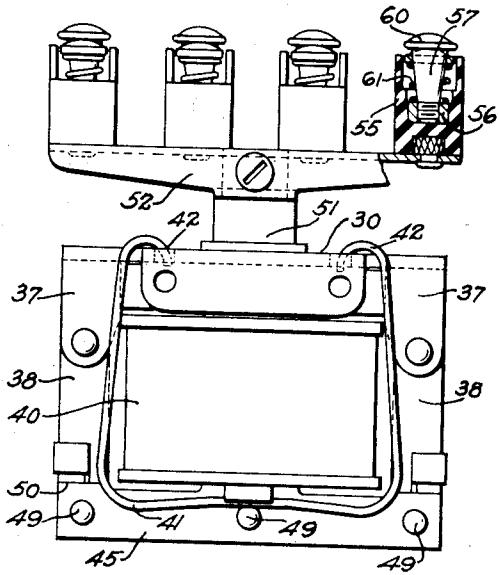


Fig. 5.

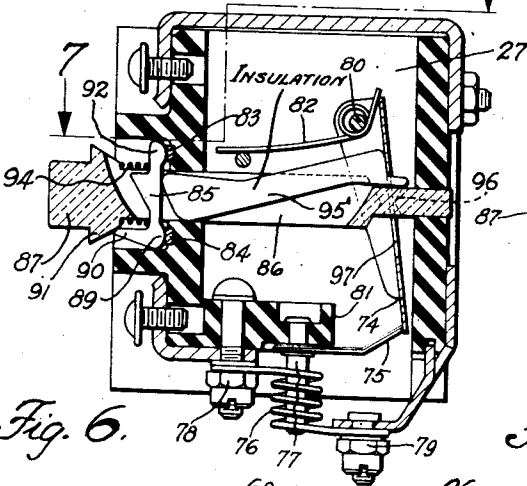


Fig. 6.

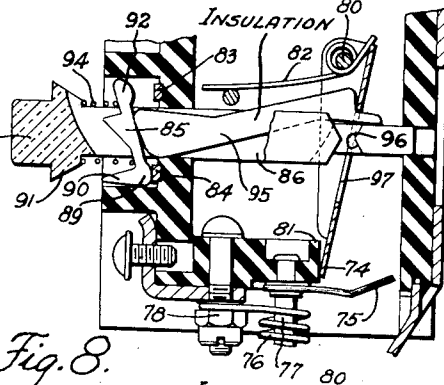


Fig. 8.

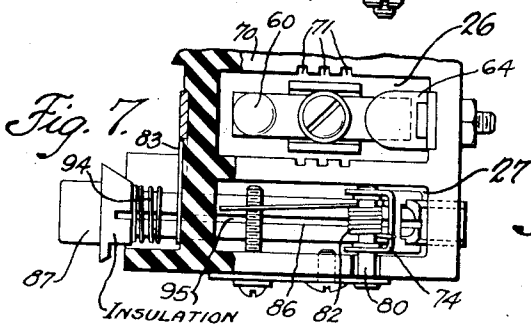


Fig. 7.

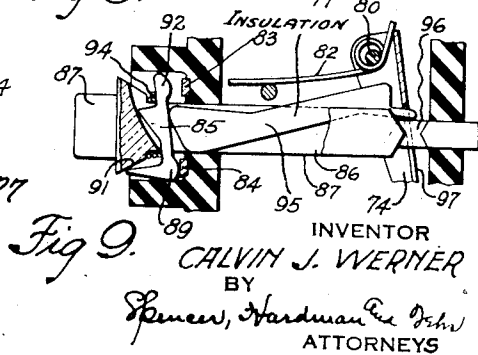


Fig. 9.

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SWITCH

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3 Sheets-Sheet 3

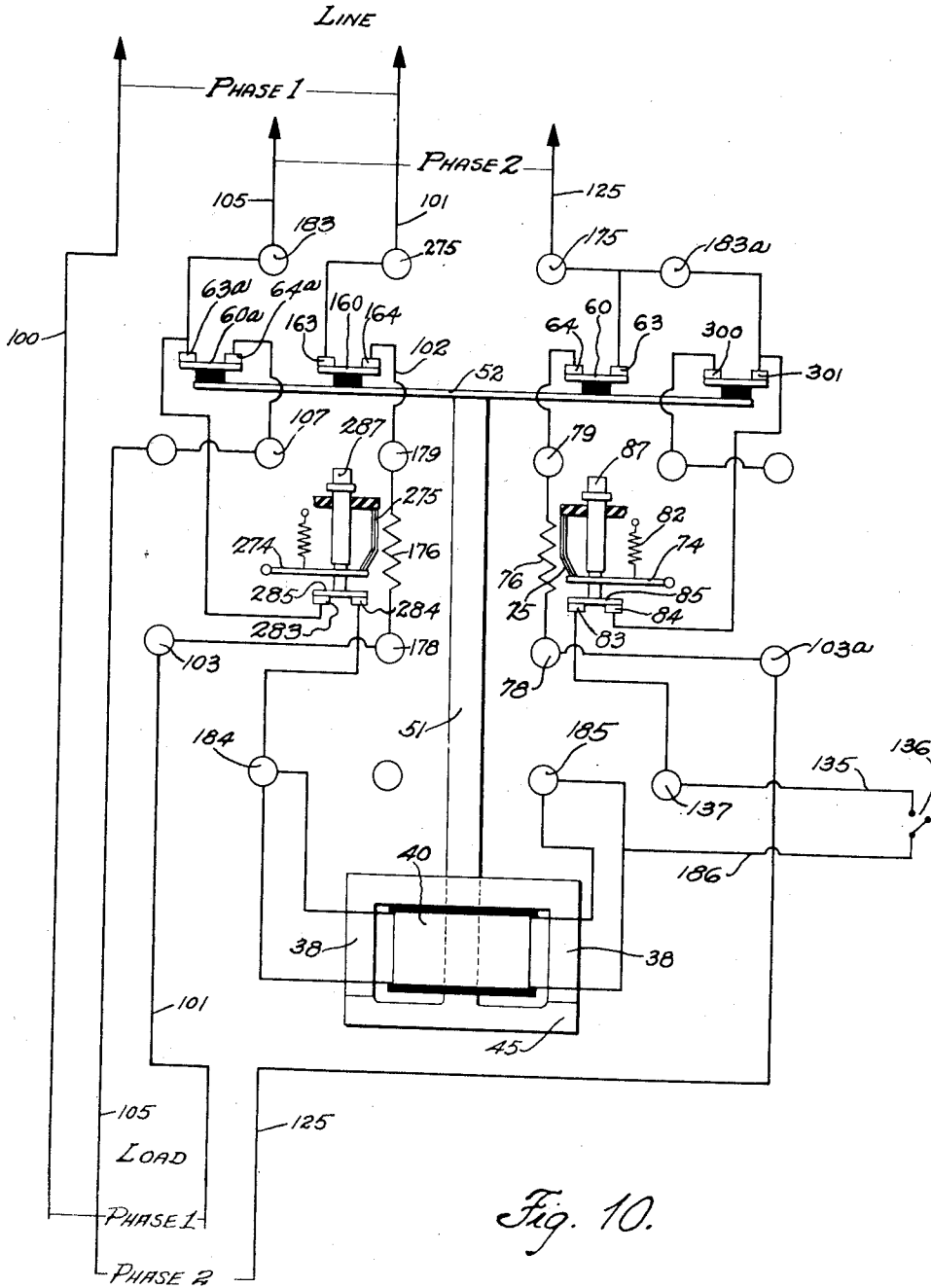


Fig. 10.

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SWITCH

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Application July 25, 1934, Serial No. 736,832

12 Claims. (Cl. 200—116)

This invention relates to improvements in electric switches and particularly to electric switches adapted to be actuated automatically in response to temperature changes.

It is among the objects of the present invention to provide a switch which is adapted to be operated automatically to open an electric circuit in response to an increased temperature caused by abnormal flow of current through the switch.

A further object of the present invention is to provide an automatically controlled electric switch, the contacts of which cannot be engaged while the high temperature, which causes the switch to be moved automatically to circuit breaking position, exists.

A still further object of the present invention is to provide an electric switch which is adapted to be actuated automatically to circuit-breaking position in response to a predetermined rise in temperature and which cannot be tied or fastened in the circuit-making position by any means separate from the switch.

Another object of the present invention is to provide a switch with means for preventing short circuiting film from building up on the insulated walls of the switch housing adjacent its contacts.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred embodiment of the present invention is clearly shown.

In the drawings:

Fig. 1 is a front view of the switch mechanism in position within a terminal box.

Fig. 2 is a fragmentary sectional view taken substantially along the line 2—2 of Fig. 1.

Fig. 3 is an enlarged fragmentary sectional view taken substantially along the line 3—3 of Fig. 1.

Fig. 4 is a detail sectional view taken substantially along the line 4—4 of Fig. 1 and showing an ordinary thermostatically controlled switch.

Fig. 5 is a detail view of the electro-magnet and the movable contact of the main switch.

Fig. 6 is a view somewhat similar to Fig. 4 illustrating the improved thermostatically controlled switch. In this view the switch is in full contact-making position.

Fig. 7 is a view taken substantially along the line 7—7 of Fig. 6.

Fig. 8 is a fragmentary part sectional view somewhat like Fig. 6, showing the switch mechanism in normal inoperative position.

Fig. 9 is a fragmentary view showing portions of the switch in full operated position and the

actuator in the position into which manual force will move it if applied after the switch has been engaged by the thermostatic detent.

Fig. 10 is a diagrammatic view showing the switch and its electrical circuit.

Referring to the drawings, the numeral 20 designates a terminal box in which the switch is mounted. This terminal box has a back plate 21 and a hinged door 22, opening of which renders the switch accessible.

The switch comprises a housing 23, made of any suitable insulating material, said housing having front and back walls 24 and 25 respectively, partitions between said front and back walls providing compartments within the switch housing, certain of these compartments being designated in the Fig. 7 by the numerals 26 and 27. It will of course be understood that the number of compartments is dependent upon the number of switch contacts to be provided by the switch. In the present instance, for a two-phase machine which is to be controlled by this switch, six compartments are provided, four, similar to the compartment 26, in which the switch contacts are housed, and two, similar to compartment 27, in which the thermostatically controlled switches are housed. A bracket 30 is secured to the front and back walls of the housing 23 by screws 32 and 33 respectively, said bracket having the mounting plate 34 attached thereto in any suitable manner, a rubber shock-absorbing element 35 being interposed between the bracket 30 of the switch housing and the mounting plate 34. This mounting plate has slotted openings which are adapted to receive stud heads carried by the terminal box 20 so that the switch may easily be attached to said box.

Bracket 30 has spaced, depending ears 37 between which the laminated polepiece 38 is rigidly supported. Associated with the polepiece 38 is an electro-magnet coil 40, held in position on the polepiece by wire clamps 41 which are hingedly attached to the bracket 30 as at 42.

The electro-magnetic coil is adapted to be energized to actuate an armature which has a support carrying the movable contacts or bridging elements of the main switch. This armature is T-shaped, being designated by the numeral 45. It is made up of a plurality of stacked laminations, secured together by rivets 49 which pass through aligned openings 19 in the laminations of the armature, said openings being of greater diameter than the rivets. The laminations are not tightly riveted together, but may move relatively to each other so that the faces

of the laminations of the armature, when engaging the adjacent laminated ends of the associated polepieces, may align themselves with the respective laminations of said polepieces so as to avoid air gaps at these points, which practically eliminates humming while the armature is in attracted position. The main or central stem of the T-shaped armature, designated by the numeral 51, extends into and through the central opening in the electro-magnet coil and has the carrier 52 attached thereto in any suitable manner. This carrier supports the movable contacts or bridging elements of the main switch, as has been mentioned before. In the present drawings four such movable contacts or bridging elements are shown, and inasmuch as all are alike, only one will be described detailedly.

The movable contact comprises an insulating barrel 55 secured to the carrier 52. The outer end of this barrel is recessed to receive a nut 56 into which one end of the cone-shaped standard 57 is screw-threaded. The bridging element or movable contact 60 fits about the cone-shaped standard 57, the opening in said bridging element being of such a size that it cannot pass the flanged head 58 of the cone-shaped standard. A spring 61, interposed between the nut 56 and the movable contact or bridging element 60, normally urges said contact toward and against the flanged head 58 of the cone-shaped standard 57. When the armature is unattracted, the bridging element 60 is out of engagement with the stationary contact terminals 63 and 64 secured to the front and back walls 24 and 25 respectively, of the housing. However, when the armature is attracted by the electro-magnet coil and is moved upwardly, the bridging element 60 is moved into contact engagement with the stationary contact terminals 63 and 64 as shown in Fig. 2, the spring 61 being compressed under these circumstances. Deenergization of the electro-magnetic coil releases the armature and, as said armature drops, the flanged head 58 of the standard 57 engages the movable contact or bridging element 60 with a hammer-blow effect, resulting in a quick separation of the contacts.

Referring to Figs. 2 and 7, it will be seen that the surface of the partition walls 70 have spaced grooves 71 provided therein adjacent the contacts, or more particularly between the two stationary contact elements 63 and 64. By experience it has been found that, after comparatively long operation of a switch of this type, a film will form on the wall of the housing adjacent the contacts due to arcing, this film being of a metallic character and eventually providing a conductor between the two stationary contacts, which will cause short circuiting of the switch. The slots 71 between the two terminals provide inaccessible corners in which this film cannot build up and consequently, although a film does accumulate, there will be breaks in the film which breaks prevent a continuous conductive film between the stationary terminals, thus eliminating the danger of short circuits. The stationary terminals 63 and 64 in this instance are secured to their respective walls by terminal screws 175 and 176 respectively.

One feature of the present invention resides in the thermostatically controlled switch which controls the main switch just described. As has been mentioned heretofore, the thermostatic switch is provided in the end compartment of the insulated switch housing, the one compartment being shown in Fig. 7 and designated by the numeral

27. This thermostatically controlled switch is an improvement over the thermostatic switch shown in Fig. 4, which is of the ordinary standard type having a movable contact 71 adapted to be actuated into engagement with the stationary contacts 72 by an actuator 73, which actuator is retained in contact-making position by a spring loaded trigger 74 when it is engaging the thermostatic detent 75. The thermostatic detent 75 is heated to flex and release the trigger 74 by a heating element 76 which surrounds a stud 77 carried by the switch housing and in thermal contact with the thermostatic element 75. Terminal posts 78 and 79 are provided for the heating element 76.

In the improved thermostatic switch shown particularly in Figs. 6, 7, 8, and 9, the bi-metallic thermostatic element 75, the heating element 76 and its stud 77 as well as the heating element terminals 78 and 79 are exactly like the structure shown in Fig. 4. This improved structure also includes the trigger 74 of the structure shown in Fig. 4. This trigger is pivotally supported by the pin 80 and is constantly urged clockwise toward the stop 81, provided by the switch housing, by a spring 82. In this improved construction the stationary terminals 83 and 84, adapted to be bridged by the movable contact element 85, are attached to the switch housing by terminal posts 183a and 184 respectively, which terminal posts are best shown in Figs. 1 and 10. The movable contact 85 is floatingly supported in a slot 86 provided in the actuator 87. As shown in Figs. 6, 8, and 9 this slot terminates short of both ends of this actuator. The movable contact has one end 89 substantially in constant pivotal engagement with the stationary contact 84 as shown in Fig. 8. At this end of the movable contact a projection 90 is provided which is adapted to cooperate with a wedge-shaped flange 91 on the actuator 87, for purposes to be described. The end 92 of the movable contact is adapted to engage the stationary contact 83 to bridge contacts 83 and 84. A spring 94 is interposed between the wedge-shaped flange 91 of the actuator and the movable contact 85. A floating cam element 95 is located within the slot 86 of the actuator, one end of said floating cam element being adapted to engage the movable contact 85 under certain circumstances, the other end being adapted to engage the trigger 74. Trigger 74 is connected with the actuator by a lost-motion connection which consists of elongated notches 96 on opposite sides of the actuator 87 cooperating with the slotted portion 97 of the trigger 74. In the normal off position of the switch, as shown in Fig. 8, it will be seen that the rear end walls of the elongated notches 96 of the actuator 87 engage the trigger 74 due to the action of the spring 94 urging the actuator 87 forward. In the normal off position as shown in Fig. 8, spring 82 yieldably holds the trigger against the stop 81. When manual pressure is exerted upon the actuator 87 to move it inwardly, the actuator moves relatively to the trigger a distance equal to the distance between the rear end and the front end walls of notches 96 or until the front end walls of said notches engage the trigger, after which the trigger will be moved counter-clockwise about its pivotal pin 80 by the movement of the actuator 87 toward contact closing position. During this time the floating cam 95 has its respective ends engaging the movable contact 85 and the trigger 74 and thus the movable contact 85 will be held from engagement with the stationary

contact 83, and will only partially pivot about its resting end 89. The continued movement of the actuator 87 toward the contact-making position will eventually bring the trigger 74 over and behind the end of the bi-metallic detent 75 as shown in Fig. 6. However, at this time the projection 90 on the movable contact 85 will have engaged the sloping surface of the wedge-shaped flange 91 so that continued movement of the actuator 87 toward the contact closing position, after the trigger has engaged the detent 75, will act to pivot the movable contact 85 about its resting end 89 to move its end 92 a greater distance away from the stationary contact 83. Thus it may be seen that while the actuator is moving the trigger 74 toward its detent-engaged position, the floating cam 95 will prevent the movable contact 85 from having its end 92 engage the stationary terminal 83, and continued movement of the actuator thereafter will bring the wedge-shaped flange 91 into effect, as shown in Fig. 9, to move the end 92 of the movable contact 85 farther away from the stationary terminal 83. Thus it may be said that while the actuator is being moved toward contact-making position and while manual pressure is being exerted upon said actuator, movable contact 85 cannot engage stationary contact 83 to bridge contacts 83 and 84. However, when manual pressure on the actuator is released after the trigger 74 has been moved into engagement with the thermostatic detent 75, then the spring 94 may become effective to move the actuator forwardly through a distance equal to the length of the notches 96 in actuator 87, so that the rear ends of notches 96 of the actuator again engage the trigger. Because the effective length of the floating cam is less than the distance between the trigger and the closed contact, the floating cam 95 is ineffective to hold the movable contact 85 out of contact-engaging position and the release of pressure upon the actuator permits the spring 94, which is considerably weaker than spring 82, to move the movable contact 85 about its resting end 89, so that its end 92 engages the stationary terminal 83 as shown in Fig. 6. Thus contacts 83 and 84 may be bridged only upon release of the actuator after it has moved the trigger 74 into locking engagement with the detent 75.

From the foregoing it may be seen that if the actuator 87 were retained in the position as shown in Fig. 6, in which the movable contact bridges contacts 83 and 84, and if the thermostatic detent 75 were flexed to release trigger 74, then the spring 82, moving the trigger 74 clockwise, and being considerably stronger than spring 94, would cause said trigger to move the floating cam 95 forwardly so that its front end would engage the movable contact 85 and thus move said contact about its resting point 89 to disengage its end 92 from contact 83. It may also be seen that this construction absolutely renders the switch incapable of being tied in such a position in which contact 85 would bridge contacts 83 and 84, for it is absolutely necessary entirely to release the actuator 87 after it has moved the trigger into the position as shown in Fig. 6, in which it engages the detent 75, in order to permit the movable contact 85 to bridge contacts 83 and 84. Thus the destructive practice of tying a protective switch of this kind in its operative position, even when the system demands that the switch be opened for protective purposes, is substantially impossible with this structure.

Referring now to the Fig. 10 in which a two-phase circuit is depicted, the numeral 100 designates one side of the one phase circuit while the numeral 101 designates the other side. The side 101 has the terminal 275 which connects with a stationary contact 163 of the switch, which is adapted to be connected with the other stationary contact 164 by the bridging element 160. The contact 164 is connected with heater terminal 179 by conductor 102. The other heater terminal 178 is connected with terminal 103 of this side of the first phase line. The second phase circuit has two lines 105 and 125. Line 105 has a terminal 183 which is connected with a stationary contact 63a, adapted to be connected to stationary contact 64a by the bridging element 60a. The stationary contact 64a is connected with terminal 107 which in turn is connected with a continuation of line 105. Terminal 183 is in direct electrical connection with the stationary contact 283 of the thermostatically controlled switch, while the other stationary contact 284 thereof is connected with the terminal 184.

The line 125 has a terminal 175 which is connected with the stationary contact 63 of the main switch, adapted to be connected to the stationary terminal 64 by the bridging element 60. Stationary contact 64 is connected with a terminal 79 of heater coil 76, the other end of the heater coil having a terminal 78 which is connected to the terminal 103a. Electro-magnet coil 40 has two windings both of which lead to the respective terminals 184 and 185. Terminal 185 is connected to the line 186 while terminal 184 is in electrical connection with the stationary contacts 284 which is adapted to be connected with the stationary terminal 283 by the movable contact 285 of the thermostatic switch whose actuator is designated by the numeral 287. The stationary terminal 283 of this thermostatic switch as has been mentioned is connected by terminal 183 to the stationary contact 63a of the main switch. The other line 135 connectible with line 186 by the manually controlled switch 136 has a terminal 137 connected with the stationary contact 83 of this thermostatic switch which is adapted to be connected with stationary terminal 84 by the movable contact 85 whose actuator is designated by the numeral 87. In this thermostatic switch the trigger is designated by the numeral 74, the trigger spring by the numeral 82, the detent by 75 and the actuator by the numeral 80 87. Closing of the switch 136 will permit the second phase of this circuit to energize the electro-magnet coil 40 so that its armature 45 will be moved to actuate the contact carrier 52 into contact closing position to complete both phase circuits through the main switch. It will of course be understood that actuators 287 and 87 have previously been operated to close the respective contacts 83 and 84 and 283 and 284. If for any reason excessive currents flow through the first phase circuit, heater 176 will provide a temperature that will cause the thermostatic detent 275 to flex to release trigger 274 which in turn will move the actuator 287 to shift movable contact 285 out of engagement with its associate contacts 283 and 284 and thus break the electro-magnet coil circuit thereby causing opening of the main switch. On the other hand if the abnormal conditions arise in the second phase circuit, the heating coil 76 will be affected to cause flexure of the thermostatic detent 75 whereby the trigger 74 will be released to move the actuator 87 to break engagement of contacts 83 and 84. Under no circumstances will the construction of the thermostatic switches in this instance

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permit these switches to be held or tied in such a position in which contacts 283 and 284 or 83 and 84 would be bridged while abnormal conditions exists in either phase circuit. Extra terminals 300—301 are provided on the switch where different phase electrical circuits are to be controlled.

From the foregoing it may be seen that applicant has provided an automatic electric switch adapted to protect electrical circuits so that under abnormal circumstances this switch will disconnect the main circuit, the construction of the switch being such that it cannot be held or maintained in circuit-closing position in any manner while such abnormal condition exists. He has also provided a switch in which short circuiting by the building up of a metallic film in the housing, caused by arcing, is substantially eliminated and humming due to air gaps between the armature and its associate pole pieces is also practically eliminated by the provision of relatively movable laminations in one of the elements which permits alignment of the laminations between both elements.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. In an automatic switch, a stationary contact; a movable contact; an actuator; a spring interposed between the actuator and movable contact and adapted to move the movable contact into engagement with the stationary contact responsive to movement of the actuator; a spring loaded trigger also moved by the actuator; a detent adapted to engage the trigger when it is moved into a certain position and to retain said trigger in said position; a plurality of instrumentalities for rendering said movable contact ineffective to engage the stationary contact while the trigger is free of the detent.

2. In an automatic switch, a stationary contact; a movable contact; an actuator having yieldable means engaging the movable contact to effect movement thereof into engagement with the stationary contact; a spring loaded trigger also moved by the actuator; a detent adapted to engage the trigger when it is moved into a certain position and to retain said trigger in said position; and means interposed between the trigger and movable contact for rendering the said contact ineffective to engage the stationary contact while the trigger is free of the detent.

3. In an automatic switch, a stationary contact; a movable contact; an actuator; resilient means interposed between the actuator and movable contact and adapted to move the movable contact toward engagement with the stationary contact; a spring loaded trigger moved by the actuator; a detent adapted to engage the trigger when it is moved into a certain position and to retain said trigger in said position; and means associated with the actuator, interposed between the trigger and the movable contact for engaging said contact and preventing its engagement with the stationary contact while the trigger is free of the detent.

4. In an automatic switch, a stationary contact; a movable contact; a resilient member urging the movable contact toward the stationary contact; an actuator adapted to move the movable contact into engagement with the stationary contact; a trigger also moved by the actuator; a

spring stronger than said resilient member biasing the trigger toward the movable contact; a detent adapted to engage the trigger when it is moved into a certain position and to retain said trigger in said position; and instrumentalities including a member interposed between the trigger and movable contact, said member being urged by said trigger to hold the movable contact out of engagement with the stationary contact while the trigger is free of the detent.

5. In an automatic switch, a stationary contact; a movable contact having a cam portion; an actuator adapted to move the movable contact into engagement with the stationary contact and having a camming surface engageable with the cam portion of the movable contact; a trigger adapted to be moved by the actuator; a spring resisting movement of the trigger by the actuator; a detent adapted to engage the trigger and retain it in a certain position; and a member interposed between the trigger and movable contact, said member being actuated by the spring pressed trigger to engage the movable contact and said member, cam and camming surface preventing engagement of the movable contact with the stationary contact while the actuator is manually depressed.

6. In an automatic switch, a stationary contact; a movable contact; a manually operable actuator for moving said movable contact into engagement with the stationary contact; a detent; a spring loaded trigger adapted to be moved by the actuator into locking engagement with the detent for preventing immediate return of the actuator into normal position; a lost motion connection between the actuator and trigger permitting a partial return of the actuator toward normal position upon being released; means for preventing engagement of the movable contact with the stationary contact while the trigger is moved toward engagement with the detent; and means for preventing such engagement of the contacts while the manual force upon the actuator is maintained after the last mentioned means becomes ineffective.

7. In an automatic switch, a stationary contact; a movable contact; a manually operable actuator for moving said movable contact into engagement with the stationary contact, said movable contact having a yieldable connection with the actuator; a detent normally in one position but adapted to be flexed into another position in response to a predetermined change of temperature; a spring loaded trigger movable by the actuator into locking engagement with the detent when said detent is in normal position, said trigger, when so locked, preventing the return of the actuator to normal position; a lost motion connection between the actuator and trigger, permitting a partial return of the actuator toward normal position; a floating member interposed between the trigger and movable contact, and urged by the trigger to hold the movable contact out of engagement with the stationary contact during a portion of the movement of the actuator; and cam means for preventing engagement of the movable contact with the stationary contact during a portion of the movement of the actuator.

8. In an automatic switch a pair of stationary contacts; a movable contact for bridging the stationary contacts and having a projecting cam portion; a manually operable actuator for moving said movable contact into engagement with the stationary contacts; yieldable means con-

necting the movable contact and actuator; a detent; a spring loaded trigger adapted to be moved by the actuator into locking engagement with the detent for preventing immediate return of the actuator into normal position; a lost motion connection between the actuator and trigger permitting a partial return of the actuator toward normal position upon being released; means for preventing engagement of the movable contact with both of the stationary contacts during a portion of the movement of the trigger toward the engagement thereof by the detent; and a cam on the actuator, adapted to engage the cam portion of the movable contact and urge it away from one of the stationary contacts immediately before the trigger engages the detent and while the manual force is exerted upon the actuator after said trigger engages the detent.

9. In an automatic switch, a pair of stationary contacts; a movable contact for bridging the stationary contacts and having a projecting cam portion; a manually operable actuator for moving said movable contacts into engagement with the stationary contacts; a detent; a spring loaded trigger adapted to be moved by the actuator into locking engagement with the detent for preventing immediate return of the actuator into normal position; a lost motion connection between the actuator and trigger permitting a partial return of the actuator toward normal position upon being released; means for preventing engagement of the movable contact with both of the stationary contacts until the trigger is moved and actually engaged by the detent, said means including a flange on the actuator, said flange having a sloping surface adapted to engage cam portion of the movable contact and move it away from one of the stationary contacts immediately prior to the engagement of the trigger with the detent, said flange maintaining the movable contact out of engagement with the stationary contacts until

the actuator is released and permitted to move said partial distance toward normal position.

10. In an automatic switch, a stationary contact; a movable contact adapted to engage the stationary contact; an actuator for manually effecting engagement of the contacts; a member biased against a portion of the actuator in such a direction that movement of the actuator toward effecting engagement of the contacts is resisted; means supported by the actuator and substantially freely movable with respect to the actuator, said means engaging the movable contact and said member to bias the movable contact away from the stationary contact for a portion of the movement of the actuator toward effecting engagement of the contacts.

11. An electric switch comprising, in combination, a housing of insulating material providing compartments having walls; a thermostatically controlled switch in one compartment; a switch in the other compartment comprising stationary contacts secured to opposing walls of the compartment and a cooperating movable switch element for electrically connecting the stationary contacts; the walls intermediate the stationary contacts having recesses therein interrupting the substantially smooth surface between the stationary contacts to prevent the formation of a short circuiting film on said walls.

12. An electric switch comprising, in combination, a housing of insulating material providing compartments having walls; a thermostatically controlled switch in one compartment; a switch in the other compartment comprising spaced stationary contacts secured to the housing and a cooperating movable switch element for electrically connecting the stationary contacts; the walls intermediate the stationary contacts having grooves therein to prevent the formation of a short circuiting film on the walls.

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