

May 11, 1937.

H. WEIRICH

2,080,244

THERMOSTATIC SWITCH

Filed Nov. 28, 1933

2 Sheets-Sheet 1

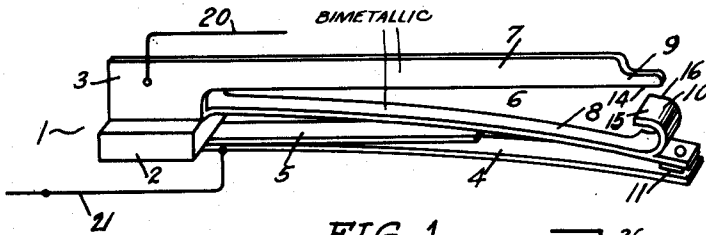


FIG. 1

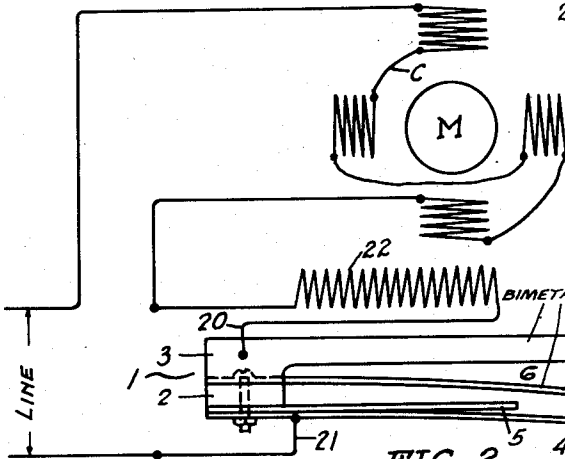


FIG. 2

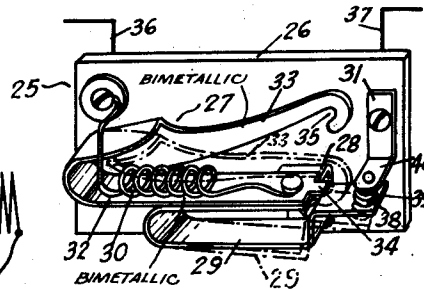


FIG. 9

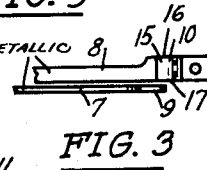


FIG. 3

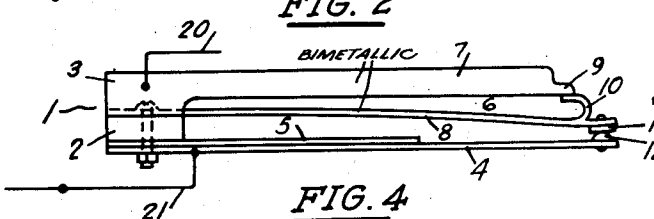


FIG. 4

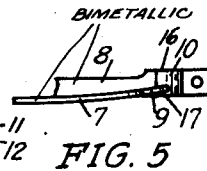


FIG. 5



FIG. 6

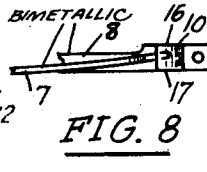


FIG. 8

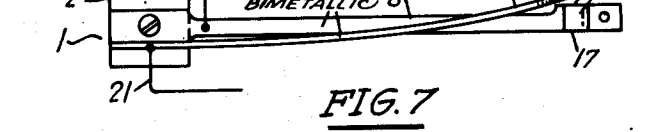


FIG. 7

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THERMOSTATIC SWITCH

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2 Sheets-Sheet 2

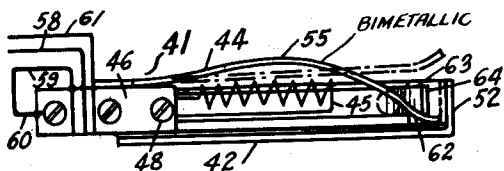


FIG. 10

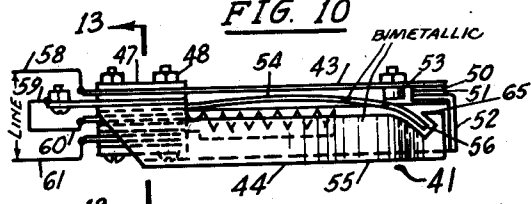


FIG. 11

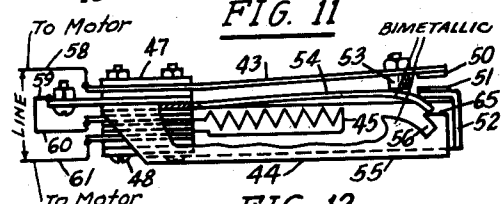


FIG. 12

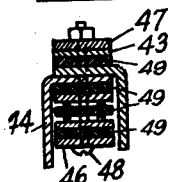


FIG. 13

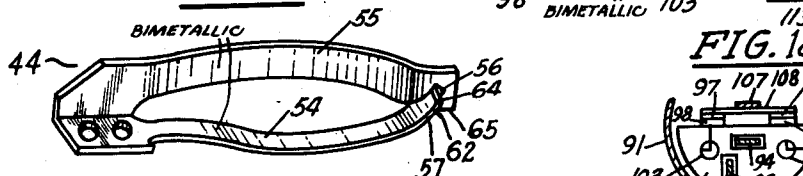


FIG. 14

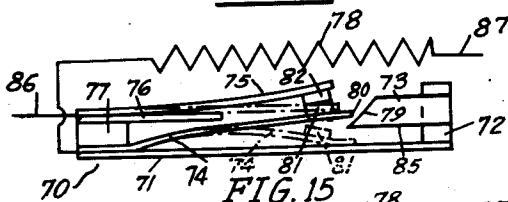


FIG. 15

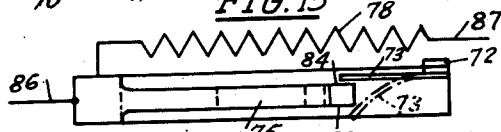


FIG. 16

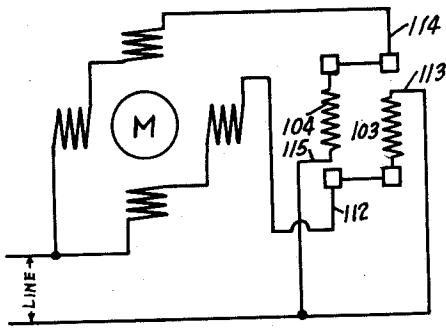


FIG. 17

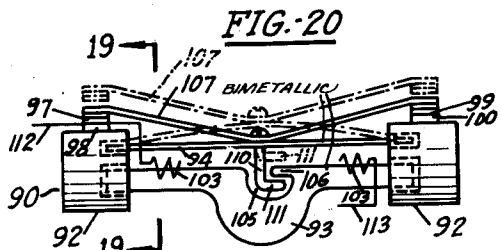


FIG. 18

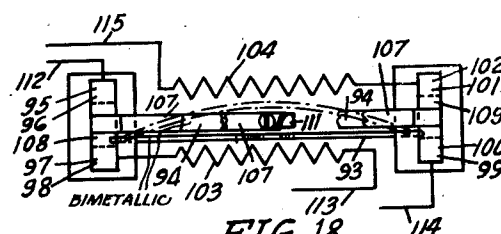


FIG. 19

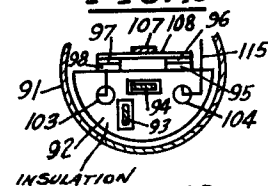


FIG. 20

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UNITED STATES PATENT OFFICE

2,080,244

THERMOSTATIC SWITCH

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Application November 28, 1933, Serial No. 700,023

6 Claims. (Cl. 200—122)

This invention relates to thermostatically controlled electric circuit breaking and making devices and has for its object the provision of a new and improved device of this type.

5 The thermostatically controlled electric circuit breaking and making devices which have been and now are in general use are so constructed that they operate slowly in the act of opening the circuit. This results in sparking at the contacts
10 with the concomitant fusing and destruction of the said contacts. Attempts have been made to build thermostatically controlled electric circuit making and breaking devices which will operate so as to cause instantaneous breaking of the circuit. These, however, are open to the objection
15 that they are comparatively complicated, that they are expensive to manufacture and produce, and, in addition, have certain objectionable structural features. It is an object of this invention to produce an electrical circuit breaking and making thermostat which will operate so as to cause
20 the practically instantaneous breaking of the circuit and yet be comparatively simple in its structure.

25 Further, thermostatic switches now in general use close slowly once they have opened. Where one of the switch contacts is mounted on a resilient arm (as is sometimes the case) and where the switch is part of a mechanism subject to vibration (as is often the case) the vibration causes intermittent closing of the switch during the period that the switch elements are returning from the open position to the full closed position. This results in premature closing of the circuit and in sparking with the resultant destruction of the switch contacts and possible
30 damage to the element which the switch is supposed to protect. It is an object of this invention to construct a thermostatic switch which will close practically instantaneously.

40 I attain the above objects by incorporating into an electric switch thermostatically responsive means which when activated will move in two planes (preferably one at right angles to the other), in so forming the said thermostatic means that movement thereof will be permitted in one of the said planes but restrained in the other of the said planes for a certain predetermined period or distance, and in so positioning the thermostat means with respect to the switch
45 contact elements that the moment the period or point of restraint is passed the thermostatic means will instantaneously move a distance sufficient to cause the opening or permit the closing
50 of the switch contacts.

Further, it often happens that the thermostat switch is so positioned with respect to the device which it is to protect that the thermostatically responsive elements are not properly affected by the thermal changes in the said device. It is an object of this invention to associate means with a thermostatic switch which will cause the proper activation of the thermostatically responsive elements when necessary no matter where the said thermostat switch is positioned relatively to the said device.

I attain this object by associating with my thermostat switch an auxiliary heating coil formed of a material which will permit the current for which the device was designed to flow through but which will heat up when an overload current is flowing through the said device and so positioning the said heating coil that it will directly affect the thermostatically responsive elements of the said thermostatic switch.

20 The inventive concept herein set forth may take many forms. For the purpose of more clearly disclosing my invention I have shown in the drawings which form a part hereof and will now describe some of these forms.

25 In the said drawings Figure 1 is a perspective view of my thermostatic switch in the normal or switch closed position.

Figure 2 is a side view of the switch shown in Figure 1 when inserted in the pole winding circuit of a motor. The winding circuit and the motor are shown diagrammatically as is also an auxiliary heating coil which may be used either in conjunction with or as a component part of my novel thermostatic switch.

35 Figure 3 is a top view of the contact carrying end fragment of the thermostatic switch shown in Figure 2.

40 Figure 4 is a side view of the switch shown in Figure 1 when in the position it first assumes after being activated as a result of an overload or thermal change above the safety point in the motor circuit.

45 Figure 5 is a top view of the contact carrying end fragment of the thermostatic switch shown in Figure 4.

50 Figure 6 is a side view of the switch shown in Figure 1 when in the switch open position which it assumes after being activated as a result of an overload or thermal change above the safety point in the motor circuit.

Figure 7 is a top view of the disclosure in Figure 6.

55 Figure 8 is a top view of the contact carrying end fragment of the switch shown in Figure 1

when in the position it assumes during the return of normal operating conditions and preparatory to the closing of the switch.

Figure 9 is a perspective view of a modification with the full lines showing the switch elements in the closed position and the dot and dash lines showing the switch elements in the open position.

Figure 10 is a front view of another modification the full lines showing closed position of the switch elements and the dot and dash lines showing the position assumed by one of the thermostatic elements when the switch is open.

Figure 11 is a top view of the disclosure shown in Figure 10 with the switch elements in the closed position.

Figure 12 is a view similar to Figure 11 with the switch elements in the open position, parts being broken away or shown in section for the purpose of clearness.

Figure 13 is a section on the line 13—13 of Figure 11.

Figure 14 is a perspective view of the thermal member of the switch shown in Figures 10 to 13 inclusive.

Figure 15 is a side view of still another modification with the full lines showing the switch and thermal elements in the normal or closed position and the dot and dash lines showing the switch and thermal elements in the open position.

Figure 16 is a top view of the switch shown in Figure 15 with the full lines showing the switch and thermal elements in the closed position and the dot and dash lines designating the open position of the said elements.

Figure 17 is a side view of still another modification with the full lines showing the position assumed by the switch and thermal elements when the switch is closed and the dot and dash lines showing the position assumed by the switch and thermal elements when the switch is open.

Figure 18 is a top view of the disclosure shown in Figure 17 with the full lines showing the position assumed by the switch and thermal elements when the switch is in the normal or closed position and the dot and dash lines showing the position assumed by these elements when the switch is open.

Figure 19 is a section on the line 19—19 of Figure 17.

Figure 20 is a wiring diagram showing the thermostatic switch depicted in Figures 17 to 19 positioned in the circuit of the 110 volt winding of a motor wired for either 110 or 220 volts.

In the drawings aforesaid similar reference numerals denote similar parts.

Referring more particularly to Figures 1 to 8 inclusive reference numeral 1 denotes my novel thermostatic switch as a unit which consists of a base member 2 of non-conducting material to which is attached the thermal member 3 of conducting material, the contact carrying arm 4 made of resilient conducting material, and the stop plate 5.

The thermal member 3 is slotted as at 6 and bent to form the two arms 7 and 8 which are substantially at right angles to each other. In the switch shown in Figures 1 to 8 inclusive the widest surface of the arm 7 lies in the vertical and the widest surface of the arm 8 lies in the horizontal plane. When affected by heat the arms 7 and 8 will move in a plane substantially at right angles to their widest surface with the result that the arm 7 will move in the horizontal plane and the arm 8 in the vertical plane. The

thermal unit 3 is made of material which will react after a certain predetermined fixed temperature is reached.

The arm 7 terminates at its free end in a finger 9 and the arm 8 has formed near the free end thereof a hook 10 positioned for operative contact and engagement with the finger 9 in the manner which will hereinafter be more particularly described. The arm 8 has attached to the lower surface thereof and near its free edge the contact point 11 which is positioned for cooperative contact with the contact point 12 attached to the upper surface of the resilient switch arm 4.

Suitable wiring connections 20 and 21 are provided for connecting the thermostatic switch 1 with the wiring circuit of the motor or other electric unit which it will control.

My novel thermostatic switch functions as follows:

(Let it be assumed that the thermostatic switch 1 has been inserted into the wiring circuit C of the motor M and positioned so as to be affected by the temperature of the said motor; and let it be further assumed that the thermostatic member 3 is made of material which will be activated when the temperature of the motor or motor circuit reaches a point at or just above that which results under normal operating conditions plus a normal factor of safety. This point we will here call the overload or danger point.) As long as normal conditions exist the switch is closed with the switch and the thermal elements in the positions shown in Figures 1, 2 and 3. As soon as the motor is overloaded or some other condition arises which causes the motor to heat up to or beyond the danger point the thermal member 3 will be activated with the result that the arm 7 will tend to move inwardly from the position shown in Figure 3 to that shown in Figures 5 and 7, while the arm 8 will tend to move upwardly from the position shown in Figures 1 and 2 to that shown in Figures 4 and 6. As the arm 8 moves upwardly it will be followed by the resilient contact arm 4 until the arm 4 contacts with the stop plate 5, a position shown in Figure 4. The arms 7, 8, the finger 9, the hook 10, the stop plate 5, and the resilient arm 4 are so formed and positioned relatively to each other that when the arm 8 has risen from the position shown in Figure 2 to that shown in Figure 4 the arms 7 and 8 have moved from the position shown in Figure 3 to that shown in Figure 5 and the lowermost surface 14 of the finger 9 contacts with the upper surface 15 of the hook 10. From this point the arm 7 continues to move towards the position shown in Figure 7 but upward motion of the arm 8 is restrained until the finger 9 reaches the edge 16 of the hook 10. (Figure 4 is a side view of the relative position of the elements 7, 8, 9, 10, 5, 4, 11 and 12 during the entire period of restraint of the arm 8 against upward motion.) During this interval the switch is still closed. The moment the finger 9 passes the edge 16 of the hook 10 the restraint on the arm 8 against upward motion is removed and the arm 8 instantaneously rises from the position shown in Figure 4 to that shown in Figure 6 with the result that the switch is instantaneously opened. The distance which the arm 8 rises when travelling from the position shown in Figure 4 to that shown in Figure 6 is that which it would gradually have risen during the period that its upward motion was restrained had the restraining element not been there. The arms 7, 8 and the hook 10 are so formed and

positioned relatively to each other that this distance is sufficient to insure the breaking of the circuit. The proper size and arrangement of these elements for a switch to be used with a particular motor or piece of apparatus will of course vary. But, in the light of my disclosure, they can readily be determined by calculation or simple experimentation by any one skilled in the art.

As the motor cools the arms 7 and 8 will tend to move in the direction of their respective positions shown in Figures 2 and 3. The arms 7 and 8 and the hook 10 have been so formed and positioned that as the arms 7 and 8 move from the position shown in Figure 7 to that shown in Figure 3 the upper surface 18 of the finger 9 will pass under the lower surface 19 of the hook 10 assuming a position such as illustrated in Figure 8. As the arm 7 continues its movement towards its position shown in Figure 3 the arm 8 tends to return to its position shown in Figure 2. This motion, however, is arrested by reason of the contact between the upper surface 18 of the finger 9 with the lower surface 19 of the hook 10. This restraint against motion continues until the finger 9 reaches the edge 17 of the hook 10. When the finger 9 passes the edge 17 of the hook 10 the arm 8 instantaneously falls from a position approximately that shown in Figure 6 to approximately that shown in Figure 2 with the result that the switch is instantaneously closed. Intermittent opening and closing of the switch during the arm return or return to normal phase of the switch elements is prevented since the arm is positively retained in the open position. The distance which the arm 7 falls in going from the position shown in Figure 6 to that shown in Figure 2 is that which it would gradually have fallen during the period that the arm 7 moves from the position shown in Figure 8 to that shown in Figure 2 if such motion had not been restrained. It is obvious that in the movement of the arm 7 from the position shown in Figure 2 to that shown in Figure 7, and vice-versa, the finger 9 will traverse the entire width of the hook 10 from the edge 16 to the edge 17 and vice-versa. It is for this reason that the position of the arm 7 shown in Figures 5 and 8 is to be understood merely as illustrative of one of the many succeeding positions which the finger will occupy and not as indicative of the position of the said finger at any particular moment of the phase being illustrated.

Although the heat of the motor per se could function as hereinabove described to activate the thermal elements of my switch yet I prefer to assure its operation by inserting a heating coil in the circuit. This coil 22 is schematically shown in Figure 2 and is so constructed that it will permit the normal current of the motor to pass without heating appreciably. If an abnormal current due to overload or for any other reason passes through it, it will heat up and in turn affect the thermal element 3 near which it is positioned causing the arms 7 and 8 to function in the manner hereinabove described. In the particular illustration herein shown it is assumed that the unit will be used with a 220 volt $\frac{1}{4}$ H. P. motor. The normal current will be 2 amperes. The overload current has been fixed at 4.5 amperes.

The switch shown in Figure 9 differs from that shown in Figures 1 to 8 primarily in the fact that one of the thermal arms functions to kick the

switch open. It further differs from the switch shown in Figures 1 to 8 in the fact that an auxiliary heating coil is incorporated into the switch unit as an integral part thereof.

Referring more particularly to Figure 9 reference numeral 25 denotes the thermal switch as a unit which is composed of a base 26 of insulating material, a thermal element 27 attached to a bracket 28 which is carried by the base 26, a spring arm 29 carried by the said bracket 28, a heating coil 30 positioned near the arms of the thermal element as shown, and a contact carrying bracket 31.

The thermal element 27 originally consisted of a flat piece of electricity conducting heat responsive material which had been cut and bent to form the arms 32 and 33 positioned substantially at right angles to each other as shown. The arm 32 terminates at its free end in the finger 34 and the free end of the arm 33 is fashioned into a hook 35. The arms 32 and 33 are so formed and positioned relatively to each other that the finger 34 will be cooperatively engaged by the hook 35 when the thermal unit is activated. The auxiliary heating coil 30 is so made that it will permit the normal motor current to pass through without heating but will heat up under abnormal current conditions.

The thermal switch 25 functions as follows:

(Let it be assumed that the thermal switch 25 has been inserted at a suitable point in the motor circuit by means of suitable connections 36—37.) As long as the current which is flowing through the motor circuit is normal the arm 33 of the switch 25 will be in the position shown by the full lines in Figure 9. Under such circumstances the current flows from the connection 36 through the heating coil 30, which does not heat up since the current is normal, thence through the spring arm 29, thence through the contact element 38 carried thereby to the contact element 39 carried by the arm 40 of the bracket 31, thence through bracket 31 and out through the connection 37. As soon as an overload current begins to flow through the motor circuit the coil 30 begins to heat up, this in turn activates the thermal element 27 with the result that the arm 33 begins to move downwardly and outwardly from the position shown by the full lines in Figure 9 to that shown by the dot and dash lines in the said figure. But the arm 33 is so formed and positioned with respect to the arm 32 that the lower surface of the hook 35 will contact with the upper surface of the finger 34 when the hook reaches the plane of the finger. This arrests further travel of the arm 33 in the downward direction without, however, interfering with the movement of the said arm in the outward direction. Movement of the arm in the outward direction or horizontal plane continues until the hook 35 reaches the outer edge of the finger 34 when it instantaneously moves to assume the position shown by the dot and dash lines in Figure 9. During this movement it pushes the spring arm 29 from the position shown by the full lines in Figure 9 to that shown by the dotted lines in Figure 9 thereby breaking the circuit. The distance which the arm 33 falls after leaving the finger 34 is the distance which the arm 33 would have moved in the downward direction or vertical plane during the interval that its motion was arrested had no restraint been present. As the coil 30 cools the arm 33 tends to move inwardly and upwardly from the position shown by the dot and dash lines in Figure 9 to that shown by the full lines in the

said figure. However, the arms 32 and 33 are so formed and positioned relatively to each other that when the inner surface of the hook 35 reaches the plane of the lower surface of the finger 34 it will contact with the said lower surface. From this point on the arm 33 will continue to move only inwardly or in the horizontal plane. Motion in an upward direction, that is a vertical plane, will be arrested because of the contact between the hook 35 and the finger 34. This will continue until the hook 35 reaches the inner end of the finger 34 when it will instantaneously rise to the position shown by the full lines in Figure 9. This movement releases the pressure upon the spring arm 29 which immediately returns from the position shown by the dot and dash lines in Figure 9 to that shown by the full lines in said figure thus instantaneously closing the circuit. The distance which the arm 33 moves upwardly immediately after it ceases to contact with the finger 34 is equal to the distance which the arm would gradually have moved upwardly, that is, in the vertical plane, during the period that its upward motion had been arrested if such motion has not been restrained. It is to be noted that the opening and closing of the circuit in this case is instantaneous. It is further to be noted that intermittent opening and closing of the circuit due to vibration during the period when the switch elements are returning to their normal or closed positions is entirely eliminated.

Referring more particularly to Figures 10 to 14 inclusive, the switch 41 consists of a base member of conducting material having an arm 42 formed on one of the ends thereof to which is attached by means of the clamping plates 46 and 47 of conducting material and the screws 48 a spring arm 43 of conducting material, a thermal unit 44 of conducting material and an auxiliary heating coil 45. The elements 42, 43, 46, 47 and 48 are properly insulated from each other by suitable insulating material 49 wherever the same is necessary as shown.

The spring arm 43 has a contact element 50 attached thereto near one of the ends thereof which cooperates with a contact 51 carried by a bracket arm 52 formed on the other end of the member 42. The spring arm 43 has also attached thereto near the free end thereof a nodule or bumper 53 of insulating material which cooperates with an arm 54 of the thermal unit 44 in the manner hereinafter to be more specifically described. The thermal element 44 consists of a piece of thermal responsive material which had been slotted and then bent to form the two arms 54 and 55 positioned substantially at right angles to each other as shown in Figure 14. The arm 55 has a slot 56 formed therein near the free end thereof. The arm 54 is so formed and positioned with respect to the arm 55 that its free end 57 is normally received within the slot 56 of the arm 55.

The thermal switch 41 functions as follows:

As long as the current in the motor circuit is normal current will flow through the thermal switch. (Current flows from the lead 58, to the arm 43, thence through the contacts 50 and 51 to the bracket 52, thence to the member 42, thence through the connectors 59, 60 to the heating coil 45, thence out through the lead 61.) If an overload current flows through the circuit it will heat up the auxiliary coil 45 which in turn will activate the thermal element 44 with the result that the arm 55 will move in the direction

shown by the dot and dash lines in Figure 10. The arm 54 will tend to move from the position shown in Figure 11 to that shown in Figure 12. Movement of the arm 54 in this direction will, however, be restrained due to the fact that its edge 57 is within the slot 56. This condition will prevail until the arm 55 reaches the edge 62 of the arm 54 when the arm 54 will instantaneously move from the position shown in Figure 11 to that shown in Figure 12 with the result that it will contact the nodule 53 and kick the spring arm from the position shown in Figure 11 to that shown in Figure 12 thereby breaking the circuit. As the auxiliary coil cools the arms 54 and 55 tend to return from the positions shown in Figure 12 and by the dot and dash lines in Figure 10 to the positions which they occupied when the circuit was closed. The arms 54 and 55 are so formed and positioned relatively to each other that as the arm 55 is returning to the position 20 shown by the full lines in Figure 10 it receives the edge 64 of the arm 54 upon its nose or edge 65. This contact restrains the arm 54 from movement in the direction of its position shown in Figure 11 until it reaches the edge 62 of the surface 64 when it instantaneously jumps from substantially the position shown in Figure 12 to that shown in Figure 11 with the result that the circuit is instantaneously closed. The distance which the arm 54 moves instantaneously when going from the position shown in Figure 11 to that in Figure 12 and vice-versa is equal to the distance that this arm would gradually have moved during the period of its restraint had it been free to move. It is obvious from the above disclosure that the opening and closing of the switch in this modification is instantaneous and the intermittent opening and closing of the said circuit due to vibration during the period when the switch elements are returning to their normal or closed position is entirely eliminated.

Referring more particularly to Figures 15 and 16 the reference numeral 70 denotes the thermostatic switch as a unit. The switch 70 consists of a base element 71 of non-conducting material which supports the arms 72 and 77 of non-conducting material, the thermostatic element 74 of conducting material and the heating coil 78. The arm 72 carries the thermostatic element 73 while the arm 77 supports the resilient arm 75 and the stop element 76. The normal or switch closed position of the thermostatic elements 73 and 74 is shown by the full lines in Figures 15 and 16. It is to be noted that the elements 73 and 74 are so positioned that their respective wide surfaces are in planes substantially at right angles to each other. As a result the elements 73 and 74 will move in planes at right angles to each other when activated by a thermal change. The heating coil 78 is formed of material which will permit the normal current for which the unit which is being protected was designed to pass through but which will heat up when an overload current is present.

The thermostatic switch 70 functions as follows:—

As long as the current is normal the arm 75 and the thermal element 74 are in the position shown by the full lines in Figures 15 and 16 with the result that the circuit is closed. Current flows from the lead line 86 to the arm 75, thence through the contacts 82 and 81 respectively carried by the elements 75 and 74 respectively to the thermostatic element 74, thence through the heating coil 78 and out through the lead 87. As soon as an abnormal current appears in the line 75

the coil 78 begins to heat up. This activates the thermostatic elements 73 and 74 with the result that these elements tend to move from their respective positions shown by the full lines in Figures 15 and 16 to their positions shown by the dot and dash lines in the said figures. The elements 73 and 74 are so formed and positioned relatively to each other that as the element 73 moves inwardly its edge 79 contacts with the edge 80 of the element 74 with the result that downward motion of the element 74 is halted until the element 73 passes the edge 83 of the element 74 when the element 74 instantaneously jumps to the position shown by the dot and dash lines in Figure 15 thereby breaking the circuit. Downward motion of the arm 75 beyond the position shown by the dot and dash lines in Figure 15 is prevented by the stop 76. As the coil 78 cools the elements 73 and 74 tend to return to their switch closed or normal positions. The elements 73 and 74 are so formed and positioned, however, that as the element 74 rises it contacts the lower edge 85 of the element 73 with the result that the upward motion of the element 74 is restrained until the element 73 reaches the edge 84 of the element 74 when the element 74 instantaneously rises to approximately the position shown by the full lines in Figure 15 thereby closing the circuit. (The distance which the element 74 instantaneously rises and falls is equal to the distance which this element would gradually rise or fall during the period when the motion of this element upward or downward was restrained.)

The switch 90, shown in Figures 17 to 19, consists of a casing 91 which carries the two piers 92—92 which support the thermostatic elements 93, 94, the contact elements 95, 96, 99 and 102, and the heating coils 103 and 104. The heating coils 103, 104 are designed to permit the passage of the normal current which the device it is intended to protect requires and to heat up in the event an abnormal current is present. The thermostatic element 93 has a slot 105 formed therein and has a finger 106 formed thereon so as to overhang the said slot. The thermostatic element 94 has attached to the upper surface thereof the resilient contact carrying arm 107 to which are attached the cross bars 108 and 109. The cross bars 108 and 109 are of electricity conducting material and are properly insulated from the arm 107 in the manner well known in the art. The bar 108 has attached to the lower surface thereof the contacts 96 and 97 and the bar 109 has attached to its lower surface the contacts 100 and 101. The thermostatic element 94 has attached to the lower surface thereof the hook 110 positioned so as to normally rest inside the slot 105 as shown by the full lines in Figure 17. When viewed from the top as in Figure 18 the portion 111 of the hook 110 is as wide as the thermal element 94. It is to be noted that the wide surfaces of the elements 93 and 94 are in planes at right angles to each other and that when these elements are activated by a thermal change they move in planes at right angles to each other.

The switch 90 is primarily designed for use with a polyphase motor but can also be used with a motor wired interchangeably for either 110 or 220 volts.

The switch 90 functions as follows:

A. In use with a two (2) phase motor

We assume that the switch 90 has been de-

signed for use with a one-half horsepower, poly-phase motor having two (2) phases. Then the current which will normally flow in each phase is 2 amperes. The overload current is assumed to be 4.5 amperes. The heating coils in this case will permit a current up to 4.5 amperes to pass through without being affected but will heat up in the event the current exceeds 4.5 amperes. The leads 112 and 113 are connected to one phase winding and the leads 114 and 115 are connected to the other phase winding. When the circuit is closed, that is under normal operating conditions, the current flows as follows: In phase 1: from the lead 112 through the contacts 95, 96 to the bar 108, thence through the contacts 98, 97 to the heating coil 103 thence out through the lead 113. In phase 2: from the lead 114 through the contacts 99, 100 to the bar 109, thence through the contacts 102, 101 to the heating coil 104 thence out through the lead 115. As soon as an overload current, that is, a current of 4.5 amperes or greater, appears in either phase the coil (103 or 104 as the case may be) of the said phase will heat up with the result that the thermal elements 93 and 94 will be activated with the result that the elements 93 and 94 will tend to assume the positions shown by the dot and dash lines in Figures 17 and 18. The hook 110 and the finger 106 are so formed and positioned relatively to each other that as the arm 94 begins to bend to assume the position shown by the dot and dash lines in Figure 17 and the arm 93 begins to bend to assume the position shown by the dot and dash lines in Figure 18, the element 111 of the hook 110 is still below the lower surface of the finger 106. This structure enables the element 111 to enter the slot 105. As the arm 93 continues its movement to its ultimate position shown by the dot and dash lines in Figure 18 the upper surface of the element 111 engages the lower surface of the finger 106 for a certain predetermined period thereby preventing the rise of the element 94 during the said period. As soon as the finger 106 reaches the outer edge of the hook element 111 this restraint is released and the element 94 instantaneously rises from approximately its position shown by the full lines in Figure 17 to that shown by the dot and dash lines in the said figure, thereby breaking the circuit in both phases. (It is to be noted that an overload in either phase circuit will break the circuit of both phases.) As the coil cools the elements 93 and 94 will tend to return to their switch closed positions. The finger 106 and the hook 110 are so formed and positioned relatively to each other that as the elements 93 and 94 begin to return to their respective switch closed positions the lower surface of the hook element 111 remains above the upper surface of the finger 106 until the said finger has assumed a position beneath the said surface of the said element 111. Thereafter the said lower surface of the said element 111 contacts the upper surface of the finger 106 for a period terminating when the finger 106 passes the inner edge of the said element 111. During this period motion of the element 94 in a downward direction is restrained and the switch remains open. As soon as the finger 106 passes the inner edge of the element 111 the element 94 drops from approximately its position shown by the dot and dash lines in Figure 17 to that shown by the full lines in the said figure thereby closing all circuits. (The distance which the element 94 instantaneously rises or falls when the restraint to its motion in either

the upward or downward direction is removed is equal to the distance which this element would have gradually risen or fallen over the entire period of restraint had no restraining influence been present.)

B. In use with a motor wired interchangeably for use with either 220 or 110 volts

Let it be assumed that the motor in question is a $\frac{1}{4}$ horse power motor. When used in a 220 volt line the normal current would be about 2 amperes and the overload current has been assumed to be about 4.5 amperes. When used in a 110 volt line the normal current in each pair of poles will be about 2 amperes, and the overload current has again been assumed to be 4.5 amperes.

When the switch 80 is used with the motor when in a 220 volt line it is only necessary to connect the switch through one pair of leads, such as the leads 112 and 113 into the motor line. In such an event the other pair of leads would not be used. An overload current will result in the heating of the coil 103 and results in the functioning of the switch in the manner hereinabove described.

When the switch 80 is used with the motor when in a 110 volt line the connections are as shown in Figure 20. The current from one pair of poles flows through the lead 112, the coil 103 and the lead 113 while the current from the other pair of poles will flow through the lead 114, the heating coil 104 and the lead 115. An overload current in either of the pole circuits will result in the heating of the heating coil associated with the said circuit and the functioning of the switch in the manner hereinabove more particularly described.

Definition.—The term "angle" as used in the claims and specifications is used to denote any angle other than a straight angle.

It is to be distinctly understood that the foregoing disclosure is by the way of illustration only and not by the way of limitation since many changes may be made in the disclosure herein shown without departing from the spirit of my invention. In addition to the modifications herein set forth these changes may include changes in form, size, shape, and the materials of which the switch and its component elements are made. In addition, these changes may include the change in the relative angles of the planes of the thermostatic arms to some angle other than a right angle or the building of a switch having some but not all of the novel concepts herein set forth. It is for this reason that it is my desire that the claims which are hereunto appended for the purpose of defining my invention should be limited only by the prior art.

Having described my invention what I claim as new and useful is:—

1. A thermostatic switch consisting of a base member; two arms mounted for movement upon the said base member one of the said arms being made of thermal responsive material; an electrical contact element carried by each of the said arms, each of said contact elements being positioned for cooperative contact with the other to close the said switch; a second arm of thermal responsive material carried by the said base member and positioned for movement in a plane disposed at an angle to that in which the first said arm of thermal responsive material moves; and cooperating means carried by each of the said thermal responsive arms and positioned for

sliding contact each with the other for a certain predetermined period both during the cycle terminating in the movement of one of the said contacts away from the other and the cycle terminating in the movement of the said contacts toward each other thereby permitting the movement of said non-contact carrying thermal element while restraining the movement of the said contact carrying thermal element for a certain predetermined period during each of said cycles.

2. A thermostatic switch consisting of a base member; two arms mounted for movement upon the said base member one of the said arms being made of thermal responsive material; an electrical contact element carried by each of the said arms, each of said contact elements being positioned for cooperative contact with the other to close the said switch; a second arm of thermal responsive material carried by the said base member and positioned for movement in a plane disposed at right angles to that in which the first said arm of thermal responsive material moves; and cooperating means carried by each of the said thermal responsive arms and positioned for sliding contact each with the other for a certain predetermined period both during the cycle terminating in the movement of one of the said contacts away from the other and the cycle terminating in the movement of the said contacts toward each other thereby permitting the movement of said non-contact carrying thermal element while restraining the movement of the said contact carrying thermal element for a certain predetermined period during each of said cycles.

3. A thermostatic switch consisting of a base member; two arms mounted for movement upon the said base member one of the said arms being made of thermal responsive material; an electrical contact element carried by each of the said arms, each of said contact elements being positioned for cooperative contact with the other to close the said switch; a second arm of thermal responsive material carried by the said base member and positioned for movement in a plane substantially at right angles to that in which the first said arm of thermal responsive material moves; a hook formed on one of said thermal responsive arms and a finger formed on the other of said thermal responsive arms, the said hook and finger being so positioned that the finger will contact with the outer surface of the hook for a certain predetermined period during the cycle terminating in the movement of one of the said contacts away from the other and with the inner surface of the hook during the cycle terminating in the movement of the said contacts towards each other thereby permitting the movement of said non-contact carrying thermal element while restraining the movement of the said contact carrying thermal element for a certain predetermined period during each of said cycles.

4. A thermostatic switch consisting of a base member; two arms mounted for movement upon the said base member one of the said arms being made of thermal responsive material; an electrical contact element carried by each of the said arms, each of said contact elements being positioned for cooperative contact with the other to close the said switch; a second arm of thermal responsive material carried by the said base member and positioned for movement in a plane substantially at right angles to that in which the first said arm of thermal responsive material

moves; a hook formed on one of said thermal responsive arms and a finger formed on the other of said thermal responsive arms, the said hook and finger being so positioned that the finger will contact with the inner surface of the hook for a certain predetermined period during the cycle terminating in the movement of one of the said contacts away from the other and with the outer surface of the hook during the cycle terminating in the movement of the said contacts toward each other thereby permitting the movement of the said non-contact carrying thermal element while restraining the movement of the said contact carrying thermal element for a certain predetermined period during each of said cycles.

5. A thermostatic switch consisting of a base member; two arms mounted for movement upon the said base member one of the said arms being made of thermal responsive material; an electrical contact element carried by each of the said arms and positioned for cooperative contact with each other to close the said switch; a second arm of thermal responsive material carried by the said base member and positioned for movement in a plane disposed at an angle to that in which the first said thermal responsive arm moves; cooperating means carried by each of the said thermal responsive arms for permitting the movement of the said noncontact carrying thermal element while restraining the movement of the said contact carrying thermal element for a certain predetermined period both during the cycle terminating in the movement of one of the said contacts away from the other and the cycle terminating in the movement of one of said contacts towards the other; and a heating coil posi-

tioned for activating the said thermal responsive elements, the said heating coil being formed of material which will permit the ready flow of the normal current which is intended to flow through the device to be protected by the said thermostatic switch but which will heat up upon the presence of an overload current.

6. A thermostatic switch consisting of a base member; two arms mounted for movement upon the said base member one of the said arms being made of thermal responsive material; an electrical contact element carried by each of the said arms and positioned for cooperative contact with each other to close the said switch; a second arm of thermal responsive material carried by the said base member and positioned for movement in planes disposed substantially at right angles to each other; cooperating means carried by each of the said thermal responsive arms for permitting the movement of the said noncontact carrying thermal element while restraining the movement of the said contact carrying thermal element for a certain predetermined period both during the cycle terminating in the movement of one of the said contacts away from the other and the cycle terminating in the movement of one of said contacts towards the other; and a heating coil positioned for activating the said thermal responsive elements, the said heating coil being formed of material which will permit the ready flow of the normal current which is intended to flow through the device to be protected by the said thermostatic switch but which will heat up upon the presence of an overload current.

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