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THERMALLY CONTROLLED ELECTRIC SWITCHES

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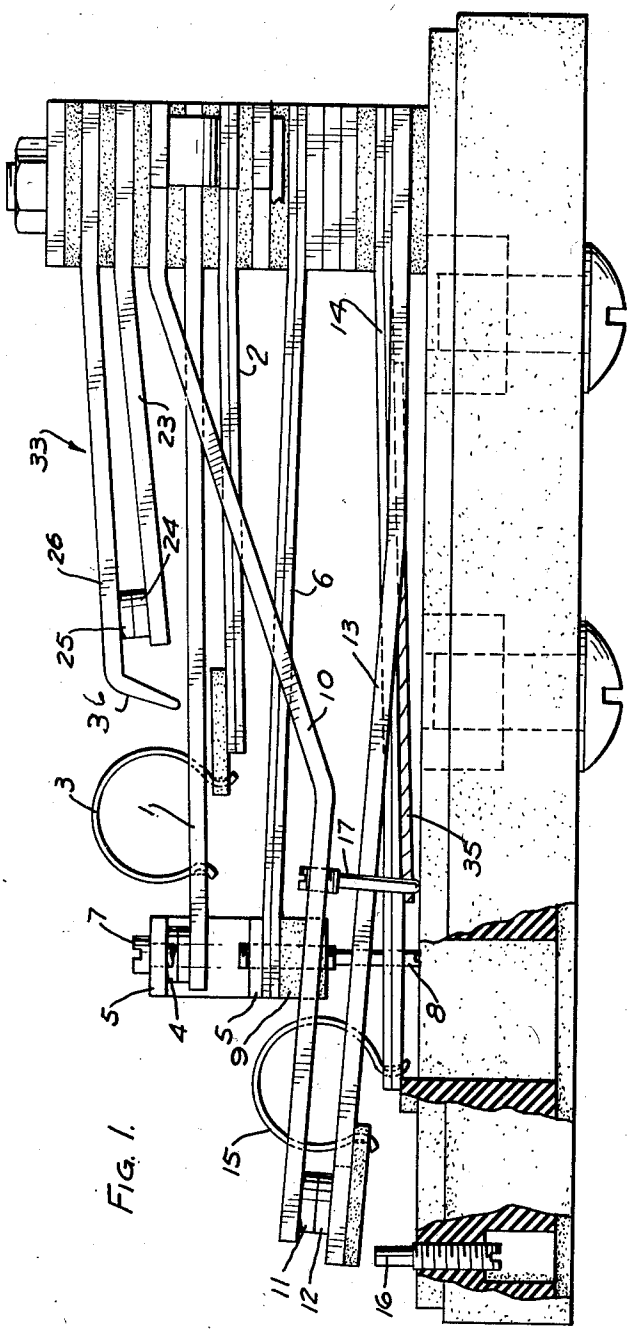


FIG. 1.

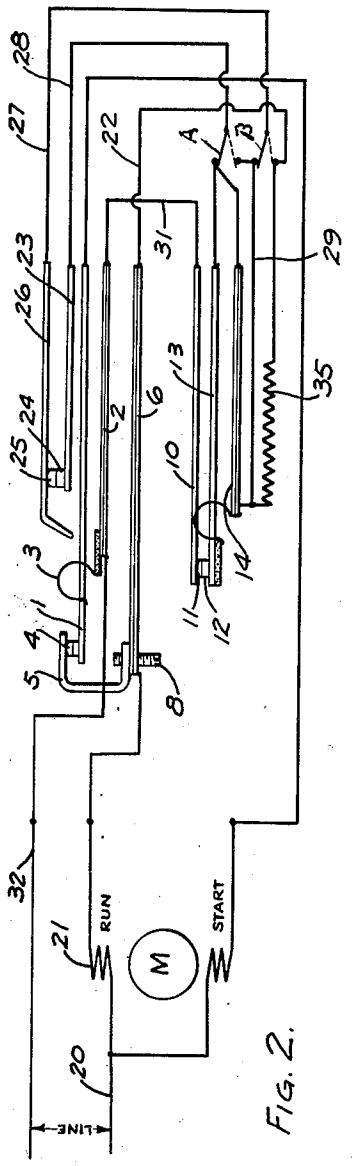


FIG. 2.

INVENTOR.
CHARLES W. SLOCUM
BY
Barnes, Kisselle, Laughlin & Raisch
ATTORNEYS.

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THERMALLY CONTROLLED ELECTRIC SWITCHES

Charles W. Slocum, Adrian, Mich., assignor to Stubnitz-Greene Spring Corporation, Adrian, Mich., a corporation of Michigan

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9 Claims. (Cl. 318—221)

This invention relates to thermally controlled automatic switches for controlling multiple circuits such as the starting and running circuits in a split phase motor such as commonly used in domestic appliances, electric refrigerators, washing machines, blower fans, and etc. In my prior application, Serial 292,260, filed June 7, 1952, I have described and claimed an automatic thermally controlled switch for controlling the starting and running circuits of a motor. The improvement in this prior application involves the use of a compensating bimetallic arm that carries one of the contacts of the starting switch. This arm, together with adjustable contacts and adjustable stops, makes it possible to regulate the closing time and the opening time under almost all thermal conditions. It is desirable to get a uniform and controlled opening and closing time for the starting switch so as to make sure that it will not close too soon or not soon enough so as to, at all times, precede the closing of the running circuit switch.

It is the object of the present invention to provide an improvement on my prior switch whereby the running circuit switch will open more quickly under overload conditions and will be delayed on the cooling and the reclosing of the switch.

Referring to the drawings:

Fig. 1 is a side elevation of the switch partly in section.

Fig. 2 is a diagrammatic view of the switch and the circuits.

The main portion of this switch is the same as in my prior application. 1 designates the starting switch spring arm, 2 the starting switch bimetallic arm. These two arms are connected at their outer ends by a U spring 3. The two arms are so located and so connected by this spring that they form a toggle. 4 designates the stationary contact which, however, is not altogether stationary as it is carried on a J arm 5 which is attached to the bimetallic compensating arm 6. The screw 7 has been more fully described and shown in my prior application. It regulates the position of the stationary contact 4 and consequently the amount of movement or the arc required for the toggle arm swing to open the starting switch. This therefore will regulate the time of opening of the starting switch depending on how great the arc. The compensating arm 6, as explained in my prior application, will keep this arc and timing substantially uniform under all conditions. The screw 8 screwing into the insulation 9 on the bottom of the compensating arm forms an adjustable stop which will regulate the greatest possible downward movement of starting switch arm 1. Consequently it regulates how far open the starting switch can throw. This therefore regulates the arc of swing to close the switch when the bimetallic member cools and therefore regulates the closing time.

10 is the spring arm that carries the stationary contact 11 of the running circuit or overload switch. The movable contact of this switch is designated 12 and is carried on the spring arm 13 which is connected with

the bimetallic arm 14 by means of the U spring 15. The spring arm 13 and the bimetallic arm 14 with the intermediate U spring form a toggle. When the bimetallic arm 14 is overheated it starts to curl up and this throws the right hand arm of the U spring 15 up and causes the other arm of the U spring to throw the spring arm 13 over the center line and open the switch. 16 is an adjustable screw or stop that regulates how far the switch contacts may open; 17 is another adjustable stop on the stationary arm 10 which regulates the position of the stationary arm and hence the stationary contact 11. This regulation determines the closed position of the contacts and consequently how far the bimetallic member will have to be distorted or thrown in order to open the contacts. Consequently this stop controls the timing of the opening when an overload occurs in the circuits.

By throwing the switches A and B, the current may be made to take any one of three courses while the auxiliary switch is closed to do the shorting. With the switch arms of the switches A and B in the uppermost position, the auxiliary switch will short out the bimetallic member of the overload switch. When the switch arms of switches A and B are in the lower position as shown by the dotted lines, the auxiliary switch will normally short only the heater unit. When the switch arm of switch A is in the upper position and the switch arm of switch B is in the down position, both the bimetallic member and the resistance heater will be shorted out of the circuit.

Refer to the diagrammatic view to explain this in more detail. The current coming through the line 20 passes through the running winding 21, thence through the compensating arm 2, then through line 22 to heater 35, then back through line 29 to the switch arm B through line 27 to the spring arm 26 of the auxiliary switch, thence through contacts 24, 25, stationary arm 23, thence through line 28 to switch arm A, then through the spring arm 13 of the overload switch, through contacts 11 and 12, stationary arm 10, line 31 to the starting switch bimetallic arm 6 and line 32 to the source of the current. In this arrangement the bimetallic arm 14 of the overload switch is shorted out until such time as the overload in the circuit causes the bimetallic arm 6 of the starting switch to overheat, to curl up and strike the pointer 36 on the arm 26 of the auxiliary switch, whereupon the contacts 25 and 24 separate and the short circuit is eliminated. Thereupon the current will take this course: Come in through the line 20, through the running winding 21, compensating arm 2, line 22, to the coil of the heater 35. The current cannot pass through line 29 because this leads to the shorting circuit which is now open, so the current must pass from the heater into the bimetallic arm 14 of the overload switch and thence to the spring arm 13 of the overload switch through the contacts 11 and 12, the stationary arm 10 and the line 31 to the starting switch bimetallic arm 6 and thence by line 32 to the source of the current. So in this case, with the switch arms A and B in the upper position the current passes through both the heater and the bimetallic arm of the overload switch when the overload causes the auxiliary switch to open.

Now with the switch arms A and B in the lower position, or the dotted line position of Fig. 2, and the auxiliary switch closed, the current comes in through line 20, winding 21, bimetallic arm 2, line 22, switch arm B, thence through line 27, through the members 24, 25, 26 and 23 of the auxiliary switch, back through the line 28 to the switch arm A, line 29, and thence through the bimetallic arm 14 of the overlad switch, then back through the members 10, 11, 12 and 13 of the overload switch, through line 31 back to the bimetallic arm 6 of the starting switch

and the line 32 to the current source. Here the heater 35 has been shorted out so that in normal operation the current will not go through the heater.

A third alternative is where both the heater and the bimetallic member 14 of the overload switch are shorted out. In this case the switch arm A is in the upper position and the switch arm B in the down position. The circuit will now be traced: The current coming in through line 20, running winding 21, bimetallic member 2, line 22, to the switch arm B in the lower position, thence through line 27 and the members 23, 24, 25 and 26 of the auxiliary switch back through line 28 and switch arm A in the upper position to the spring arm 13 of the overload switch, then through contacts 11 and 12 and arm 10 and line 31 and thence through starting switch bimetallic member 6 back to the line 32. Here both the bimetallic arm of the overload switch and the heater are shorted while the current flows normally, but as soon as the overload comes and opens the auxiliary switch then the current goes through both the heater coil and the bimetallic arm 14 of the overload switch as already traced in connection with the explanation of the first alternative.

In any of these three setups the overload switch arm will open the overload switch quicker and this overheating of the bimetallic member insures a lag in the closing of the switch by delaying the cooling. This is desirable so as to give plenty of time for the motor to cool before it is subjected to another surge of current which may involve another overload. If the motor is allowed to draw current again too soon before it is sufficiently cooled, it may greatly overheat and injure the windings and/or other parts.

What I claim is:

1. A thermally controlled automatic switch provided with two separate toggle switches involving each a spring arm, a stationary arm, and a bimetallic arm, the spring arm carrying a movable contact and the stationary arm carrying a stationary contact, all of the arms being operatively coupled into a circuit for controlling electrical appliances, a resistance heating unit in heat-exchanging relation to the bimetallic arm of one switch and acting as a heater therefor when current passes therethrough, a normally closed auxiliary shorting switch having contacts shorted across said heater the bimetallic arm of the other switch being distortable and operatively engageable with the movable arm of the auxiliary switch to thereby open the latter and to open the short circuit across said heater, thereby allowing current pass through the heater and to heat the bimetallic arm of said one switch for opening the latter and to cause a lag in the normal closing of said one switch due to the heat energy contained in the heating unit as caused by the opening of the auxiliary switch.

2. A switching mechanism for use in controlling the operation of an electric motor having starting and running windings comprising two switches operatively coupled in series, two switch control elements cooperatively positioned with respect to said two switches for controlling the operation thereof, said elements being movable in response to temperature changes and coupled in series with said switches whereby operation of said switches is effected when said elements are subjected to predetermined temperatures, an electrical heating device also coupled in series with said switches and said elements and positioned to impart heat energy to one of said elements, said device serving to elevate the temperature of said one element for controlling the operation of the respective switch, first means for normally disabling said heating device, and second means operatively connecting said first means to said other element for actuating said first means whereby said heating device is rendered operable.

3. A switching system for use in controlling the operation of an electric motor having starting and running windings comprising a motor-energizing circuit, said circuit comprising a first starting switch having normally closed contacts, a first current sensitive thermal member

operatively connected to said starting switch for controlling the opening and closing of the latter, said first member serving to open said contacts upon attaining a first predetermined temperature; a second switch having two normally closed contacts, a second thermal member operatively connected to said second switch for controlling the opening and closing thereof; said second member, said first member and said second switch being connected in series and serving to open the second switch contacts upon attaining a predetermined temperature; a current sensitive thermal device series connected in said circuit and positioned adjacent said second thermal member for imparting heat energy thereto, said thermal device causing said second member to separate said second switch contacts when the current through said circuit exceeds a predetermined value, disabling means for controlling the operation of said thermal device, and operating means for controlling the operation of said disabling means interposed between said disabling means and said first thermal member whereby said disabling means is actuated upon operation of said first thermal member.

4. A switching system for use in controlling the operation of an electric motor having starting and running windings comprising a motor-energizing circuit, said circuit comprising a first starting switch having normally closed contacts, a first current sensitive thermal member operatively connected to said starting switch for controlling the opening and closing of the latter, said first member serving to open said contacts upon attaining a first predetermined temperature; a second switch having two normally closed contacts, a second thermal member operatively connected to said second switch for controlling the opening and closing thereof; said second member, said first member and said second switch being connected in series with said circuit and serving to open the second switch contacts upon attaining a predetermined temperature; a current sensitive thermal device connected in series with said circuit and positioned adjacent said second thermal member for imparting heat energy thereto, said thermal device causing said second member to separate said second switch contacts when the current through said circuit exceeds a predetermined value; and a third switch having normally closed contacts in series with said circuit and having an operative connection with said first member whereby it is opened when said first member has attained a predetermined temperature.

5. A switching system for use in controlling the operation of an electric motor having starting and running windings comprising a motor-running circuit and a motor-starting circuit, said starting circuit comprising a first starting switch having normally closed contacts, a first current sensitive thermal member operatively connected to said starting switch for controlling the opening and closing of the latter, said first member being connected in series with both said running and starting circuits, said first member serving to open said contacts upon attaining a first predetermined temperature; said running circuit including a second switch having two normally closed contacts, a second thermal member operatively connected to said second switch for controlling the opening and closing thereof, said second member being connected in series with both said starting and running circuits and serving to open the second switch contacts upon attaining a predetermined temperature; a current sensitive thermal device connected in series with at least the running circuit and positioned adjacent said second thermal member for imparting heat energy thereto, said thermal device causing said second member to separate said second switch contacts when the current through said starting and running circuits exceeds a predetermined value; and a third switch having normally closed contacts in series with both running and starting circuits and shunted across said second thermal member, said first member being operatively connected to said third switch and serving to open said third switch contacts upon attaining a predetermined temperature whereby said second thermal

member is introduced into the running and starting circuits for controlling the operation of said second switch.

6. A switching system for use in controlling the operation of an electric motor having starting and running windings comprising a motor-running circuit and a motor-starting circuit, said starting circuit comprising a first starting switch having normally closed contacts, a first current sensitive thermal member operatively connected to said starting switch for controlling the opening and closing of the latter, said first member being connected in series with both said running and starting circuits, said first member serving to open said contacts upon attaining a first predetermined temperature; said running circuit including a second switch having two normally closed contacts, a second thermal member operatively connected to said second switch for controlling the opening and closing thereof, said second member being connected in series with both said starting and running circuits and serving to open the second switch contacts upon attaining a predetermined temperature; a current sensitive thermal device connected in series with at least the running circuit and positioned adjacent said second thermal member for imparting heat energy thereto, said thermal device causing said second member to separate said second switch contacts when the current through said starting and running circuits exceeds a predetermined value; and a third switch having normally closed contacts in series with both running and starting circuits and shunted across said thermal device, said first member being operatively connected to said third switch and serving to open said third switch contacts upon attaining a predetermined temperature whereby said thermal device is introduced into the running and starting circuits for controlling the operation of said second switch.

7. A switching system for use in controlling the operation of an electric motor having starting and running windings comprising a motor-running circuit and a motor-starting circuit, said starting circuit comprising a first starting switch having normally closed contacts, a first current sensitive thermal member operatively connected to said starting switch for controlling the opening and closing of the latter, said first member being connected in series with both said running and starting circuits, said first member serving to open said contacts upon attaining a first predetermined temperature; said running circuit including a second switch having two normally closed contacts, a second thermal member operatively connected to said second switch for controlling the opening and closing thereof, said second member being connected in series with both said starting and running circuits and serving to open the second switch contacts upon attaining a predetermined temperature; a current sensitive thermal device connected in series with at least the running circuit and positioned adjacent said second thermal member for imparting heat energy thereto, said thermal device causing said second member to separate said second switch contacts when the current through said starting and running circuits exceeds a predetermined value; and a third switch having normally closed contacts in series with both running and starting circuits and shunted across both said second thermal member and said thermal device, said first member being operatively connected to said third switch and serving to open said third switch contacts upon attaining a predetermined temperature

whereby said second thermal member and said thermal device are introduced into the running and starting circuits for controlling the operation of said second switch.

8. A switching system for use in controlling the operation of an electric motor having starting and running windings comprising a motor-running circuit and a motor-starting circuit, said starting circuit comprising a first starting switch having normally closed contacts, a first current sensitive thermal member operatively connected to said starting switch for controlling the opening and closing of the latter, said first member being connected in series with both said running and starting circuits, said first member serving to open said contacts upon attaining a first predetermined temperature; said running circuit including a second switch having two normally closed contacts, a second thermal member operatively connected to said second switch for controlling the opening and closing thereof, said second member being connected in series with both said starting and running circuits and serving to open the second switch contacts upon attaining a predetermined temperature; a current sensitive thermal device connected in series with at least the running circuit and positioned adjacent said second thermal member for imparting heat energy thereto, said thermal device causing said second member to separate said second switch contacts when the current through said starting and running circuits exceeds a predetermined value; and a fourth current sensitive thermal member constituting an ambient temperature control connected in series with both running and starting circuits and carrying one of said first switch contacts, said fourth member being operable with respect to said first and second members to effect closure of said first switch prior to the closure of said second switch following an opening of both said first and second switches by an overheating condition.

9. A switching mechanism for use in controlling the operation of an electric motor having starting and running windings comprising a plurality of switches connected in series, said switches being normally closed and provided with electrical disabling devices respectively which are also connected in series therewith, said devices being actuable by a predetermined flow of current to open said switches respectively, the disabling device for one of said switches including heater means whereby said predetermined current will retain said disabling device in actuated condition for a period of time longer than the other disabling devices when the flow of said predetermined current ceases, and auxiliary means controlling the operation of said heater means, and operating means for actuating said auxiliary means in response to actuation of another of said disabling devices.

References Cited in the file of this patent

UNITED STATES PATENTS

2,169,989	Pearce	Aug. 15, 1939
2,304,018	Raney	Dec. 1, 1942
2,358,372	Wolfner	Sept. 19, 1944
2,379,602	Stickel	July 3, 1945
2,521,277	Aubert	Sept. 5, 1950
2,568,323	Dales	Sept. 18, 1951
2,573,404	Clark	Oct. 30, 1951
2,618,721	Clark	Nov. 18, 1952