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C. W. KUHN

2,158,288

THERMALLY CONTROLLED SWITCH

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Fig. 1

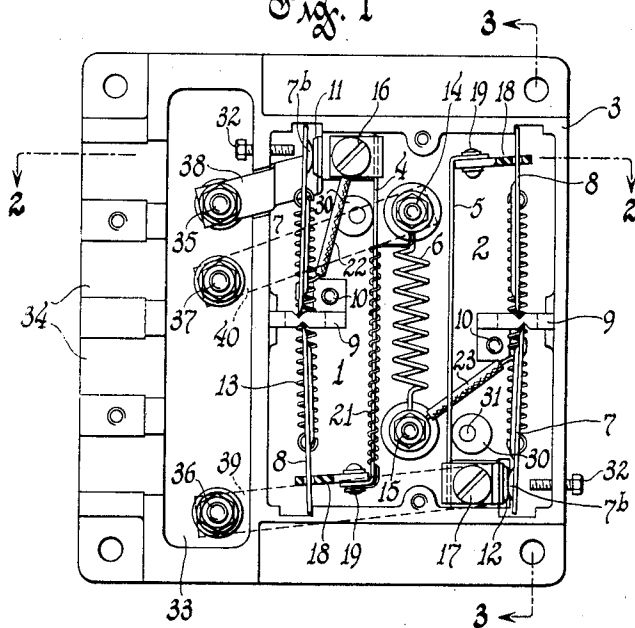


Fig. 2

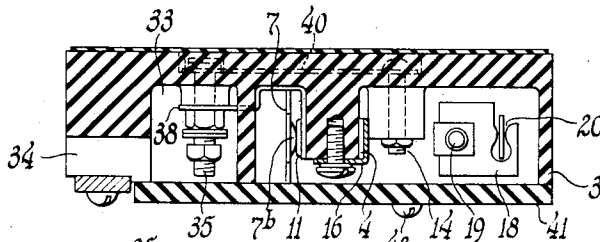


Fig. 3

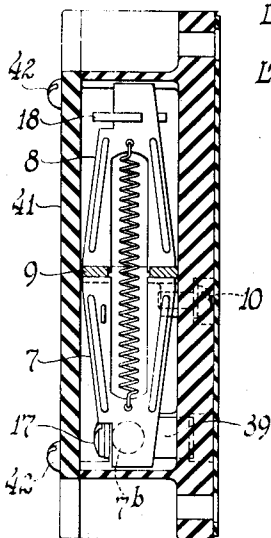


Fig. 4

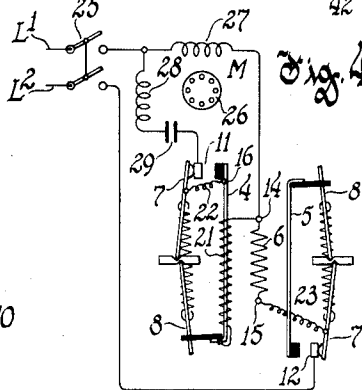


Fig. 5

Inventor
Clarence W. Kuhn
By Frank H. Hubbard
Attorney

UNITED STATES PATENT OFFICE

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THERMALLY CONTROLLED SWITCH

Clarence W. Kuhn, Wauwatosa, Wis., assignor to
Cutler-Hammer, Inc., Milwaukee, Wis., a cor-
poration of Delaware

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5 Claims. (Cl. 172-279)

This invention relates to thermally controlled switches, and is particularly applicable to switches for starting alternating current motors and for also protecting the same against overloads.

An object of the invention is to provide an improved device for controlling single phase alternating current motors of the type having a main energizing winding requiring continuous energization and an auxiliary winding which requires temporary energization for starting.

Another object is to provide a thermally controlled switch for motors of the aforesaid character which insures temporary energization of the starting winding upon establishment of power connections for the motor and which also provides for interruption of power connections for the motor upon given overload current conditions in the motor circuit.

Various other objects and advantages of the invention will hereinafter appear.

The accompanying drawing illustrates an embodiment of the invention which will now be described, it being understood that the embodiment illustrated is susceptible of modification without departing from the spirit and scope of the appended claims.

In the drawing,

Figure 1 is a front elevational view of a control device embodying the invention;

Figs. 2 and 3 are sectional views on lines 2-2 and 3-3, respectively, of Fig. 1;

Fig. 4 is a diagrammatic view illustrating the circuit connections for the device shown in Fig. 1, and

Fig. 5 is a diagrammatic view illustrating a modified form of control.

Referring to Fig. 1, the same illustrates two control switches 1 and 2 mounted within a box-shaped enclosing casing 3 formed of insulating material. The switches 1 and 2 are provided with thermally responsive operating elements 4 and 5, respectively, both of which are under the control of an electric heater 6.

Each of the control switches 1 and 2 is provided with a pair of U-shaped levers 7 and 8, arranged in opposed relation upon opposite sides of a supporting bracket 9 fixed within casing 3 by a screw 10. The side arms of the levers 7 and 8 are provided with knife edge portions which pivotally engage within V-shaped recesses in their associated brackets 9 and the lever 7 of switch 1 is arranged above its associated bracket and cooperates with a stationary contact 11 located to the right thereof, while the lever 7 of

switch 2 is arranged below its associated bracket and cooperates with a stationary contact 12 located to the left thereof. The free ends of the levers 7 and 8 of each switch are connected by a tension spring 13 and each of the levers 7 has a contact tip 7^b secured thereto for engaging its associated stationary contact, while each of the levers 8 has its free end operatively connected to the thermally responsive operating element of its associated switch.

The electric heater 6 comprises a vertically arranged coil of resistance wire located between the switches 1 and 2 and having its opposite ends secured to terminal devices 14 and 15 mounted within casing 3. Each of the thermally responsive elements 4 and 5 comprises an elongated bi-metallic strip, and said elements are arranged upon opposite sides of the heater 6 and adjacent thereto. Operating element 4 has its upper end secured to a terminal member 16 fixed within casing 3 and operating element 5 has its lower end secured to a terminal member 17 fixed within said casing. Each of the operating elements 4 and 5 has an insulating plate 18 secured to the free end thereof by a rivet 19 and said plates are recessed as shown at 20 (Fig. 2) to receive the free end of their associated levers 8. Operating element 4 also has an auxiliary heater 21 associated therewith comprising an insulated resistance wire wound around said element and having its lower end electrically connected to said element and its upper end electrically connected to the terminal device 14. Terminal member 16 is electrically connected to the lever 7 of switch 1 by a flexible lead 22 and terminal device 15 is electrically connected to the lever 7 of switch 2 by a flexible lead 23.

The aforescribed control device may be connected as shown in Fig. 4 to control a single phase alternating current motor M having a line switch 25 associated therewith for connecting the same to a supply circuit indicated by lines L¹-L². The motor shown is of the split phase capacitor type and includes a rotor 26, a main winding 27 and an auxiliary starting winding 28 which is connected in series with a condenser 29. The switches 1 and 2 are normally in closed position as illustrated in the drawing and upon closure of switch 25 circuit is established from line L¹ through starting winding 28 and condenser 29 to stationary contact 11 of switch 1, through lever 7 and flexible lead 22 of said switch to terminal member 16, through operating element 4 and auxiliary heater 21 to terminal device 14, through heater 6 to terminal device 15, through flexible

lead 23 and lever 7 of switch 2 to stationary contact 12, and thence to line L². Also upon closure of the switch 25 circuit is established from line L¹ through winding 27 to terminal device 14, through heater 6 to terminal device 15, through flexible lead 23 and lever 7 of switch 2 to stationary contact 12 and thence to line L². Upon establishment of the aforescribed connections motor M starts under the action of its windings 27 and 28 and the operating elements 4 and 5 of the switches 1 and 2 are both responsive to heat generated by the heater 6 while the operating element 4 of switch 1 is also responsive to heat generated by the auxiliary heater 21. The auxiliary heater 21 provides for rapid heating of the operating element 4 and after a predetermined interval said operating element responds to move its associated lever 8 and spring 13 towards the left into a position wherein the axis of said spring is located to the left of the pivot of lever 7 of switch 1. The lever 7 of switch 1 then moves with a snap action out of engagement with its associated stationary contact 11 to interrupt the aforescribed energizing circuit for starting winding 28. The auxiliary heater 21 is deenergized upon opening of switch 1 but the heater 6 then acts to maintain operating element 4 sufficiently heated to maintain switch 1 in open position.

Switch 2 remains in closed position under normal current conditions in the motor circuit. However, upon predetermined overload conditions in the motor circuit operating element 5 responds under the action of heater 6 to move its associated lever 8 and spring 13 towards the right into a position wherein the axis of said spring is located to the right of the pivot of lever 7 of switch 2. The lever 7 of switch 2 then moves with a snap action out of engagement with its associated stationary contact 12 to effect interruption of the motor circuit.

Upon interruption of the motor circuit heater 6 is deenergized and as is apparent the operating elements 4 and 5 will then cool and return to normal position to effect reclosure of switches 1 and 2 with a snap action. However, switches 1 and 2 are adjusted so that the operating element 5 requires a greater degree of cooling to effect reclosure of its associated switch than does the operating element 4. Energization of the starting winding 28 is thus insured upon restarting of the motor after an overload.

In connection with the foregoing it should be noted that the operating elements 4 and 5 are elongated to render the same relatively resilient. Each of said elements is therefore adapted to flex until sufficient energy is stored therein to move the lever 8 of its associated switch out of extreme positions. The levers 8 of switches 1 and 2 are thus quickly moved between opposite extreme positions under the action of their associated operating elements to render said switches exceedingly quick acting and positive in operation.

If desired, the auxiliary heater 21 may be omitted as shown in Fig. 5 and the flexible lead 22 associated with lever 7 of switch 1 is then directly connected to the terminal device 14. Elimination of the auxiliary heater element 21 tends to prolong the starting period since switch 1 is then dependent for response upon the heat generated in heater 6. The operation of the control device shown in Fig. 5 is otherwise similar to that shown in Fig. 4.

Each of the switches 1 and 2 has an eccentric cam 30 associated therewith which is rotatably

mounted upon a pin 31 fixed within enclosing casing 3. The cam 30 associated with switch 1 is arranged to the left of operating element 4 and engages the same adjacent the upper end thereof while the cam 30 associated with switch 2 is arranged to the right of operating element 5 and engages the same adjacent the lower end thereof. As is apparent, the normal positions of the operating elements 4 and 5 can be varied by adjustment of the cams 30 to effect variation of the temperature values at which the switches 1 and 2 are moved into open position. Each of the levers 7 of switches 1 and 2 also has a stop 32 associated therewith for limiting opening movement thereof. The stops 32 are adjustably mounted upon casing 3 and as is apparent adjustment of said stops provides for variation of the temperature values at which the switches 1 and 2 are adapted to move into closed position.

The enclosing casing 3 has an extension on one side thereof which is formed to provide a terminal compartment 33 having wiring openings 34 in one side thereof. The terminal compartment 33 has binding posts 35, 36 and 37 mounted therein, and the binding posts 35 and 36 are connected to contacts 11 and 12, respectively, by connector strips 38 and 39 and the binding post 37 is connected to terminal 14 by a connector strip 40. Also the enclosing casing 3 is provided with a cover 41 which is secured thereto by screws 42.

What I claim as new and desire to secure by Letters Patent is:

1. The combination with an alternating current motor having main and auxiliary energizing windings, of a pair of normally closed switches, one for controlling power connections for said motor and the other for establishing an energizing circuit for said auxiliary winding through the medium of said former switch, an operating thermostat associated with each of said switches, a main electric heater traversed by the current supplied to said motor and arranged in heat transferring relation to said thermostats and an auxiliary electric heater traversed by the current supplied to said auxiliary winding and arranged in heat transferring relation to the operating thermostat of said second mentioned switch.

2. The combination with an electric motor having a starting winding and a running winding, of a pair of normally closed snap switches, one for controlling power connections for said motor and the other for establishing an energizing circuit for said starting winding through the medium of said former switch, a single electric heater connected in the energizing circuit of said motor, a pair of bi-metal operating elements each subjected to control by said heater, one of said bi-metal operating elements being responsive under the action of said heater to open said second mentioned switch after a predetermined interval upon establishment of power connections for said motor, and the other of said bi-metal elements being responsive under the action of said heater to open said first mentioned switch upon a predetermined overload on said motor, and means for adjusting said bi-metal elements with respect to said heater to separately vary the conditions under which said switches are opened under the action of said heater.

3. The combination with an electric motor having a starting winding and a running winding, of a pair of normally closed switches each having a snap operating mechanism associated therewith including an over-center spring, one of said

switches being arranged to establish power connections for said motor, and the other being arranged to establish an energizing circuit for said starting winding through the medium of said former switch, an elongated bi-metal operating element associated with each of said switches, each of said bi-metal elements having one end fixed and its opposite end operatively connected to the over-center spring of its associated switch, and a single electric heater connected in the energizing circuit of said motor and associated with said bi-metal elements to effect opening of said first mentioned switch after a given interval upon establishment of power connections for said motor and opening of said second mentioned switch upon a predetermined overload condition in the motor circuit.

4. The combination with an electric motor having a starting winding and a running winding, of a pair of normally closed switches each having a snap operating mechanism associated therewith including an over-center spring, one of said switches being arranged to establish power connections for said motor, and the other being arranged to establish an energizing circuit for said starting winding through the medium of said former switch, an elongated bi-metal operating element associated with each of said switches, each of said bi-metal elements having one end fixed and its opposite end operatively connected to the over-center spring of its associated switch, and a single electric heater connected in the energizing circuit of said motor and associated with said bi-metal elements to effect opening of said first mentioned switch after a given inter-

val upon establishment of power connections for said motor and opening of said second mentioned switch upon a predetermined overload condition in the motor circuit, said bi-metal elements acting upon interruption of power connections to reclose their associated switches and to insure reclosure of said second mentioned switch prior to reclosure of said first mentioned switch.

5. The combination with an electric motor having a starting winding and a running winding, of a pair of normally closed switches each having a snap operating mechanism associated therewith including an over-center spring, one of said switches being arranged to control power connections for said motor, and the other being arranged to establish an energizing circuit for said starting winding through the medium of said former switch, a bi-metal operating element associated with each of said switches, each of said bi-metal elements having one end fixed and its opposite end operatively connected to the over-center spring of its associated switch, and a single electric heater connected in the energizing circuit of said motor and associated with said bi-metal elements to effect opening of said first mentioned switch after a given interval upon establishment of power connections for said motor and opening of said second mentioned switch upon a predetermined overload condition in the motor circuit, each of said bi-metal elements being adjustable with respect to said heater to vary the conditions under which said switches are opened under the action of said heater.

CLARENCE W. KUHN. 35