

March 26, 1940.

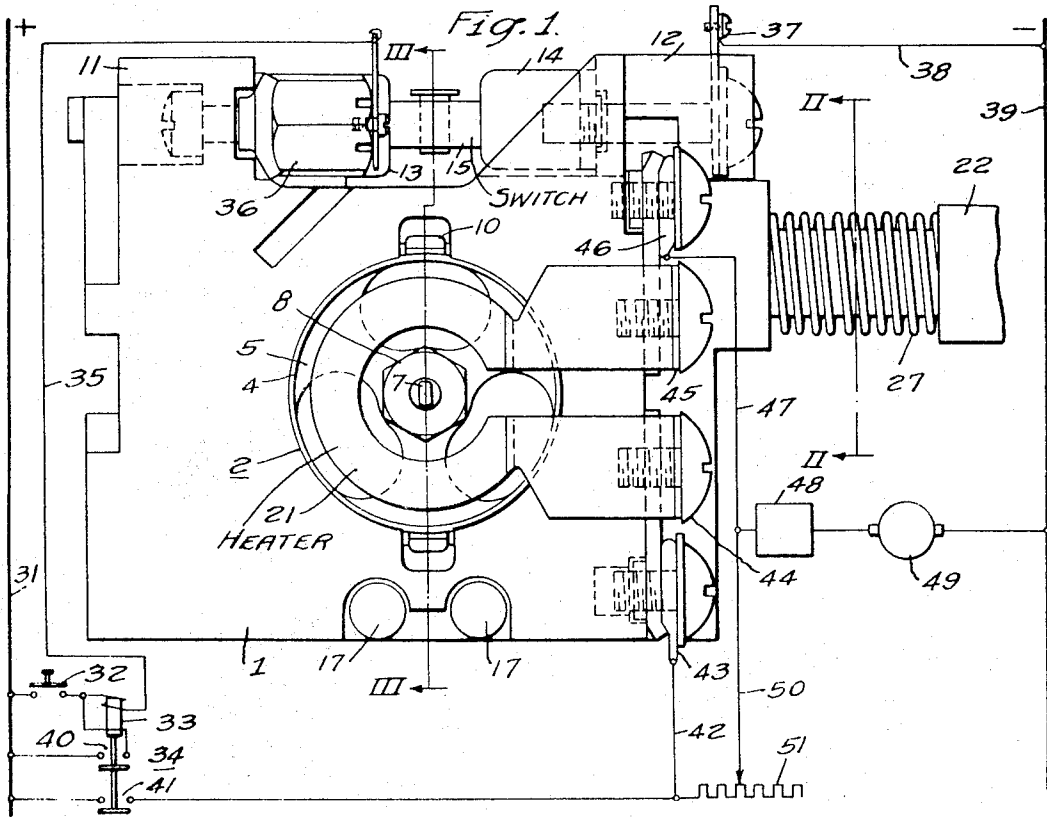
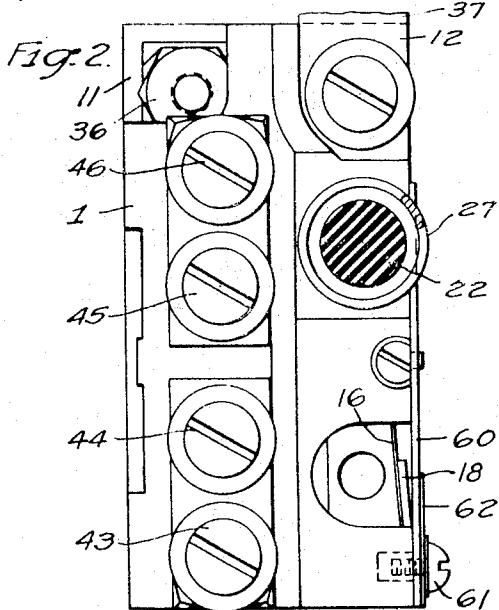
L. PIERCE

2,195,012

RESET OVERLOAD RELAY

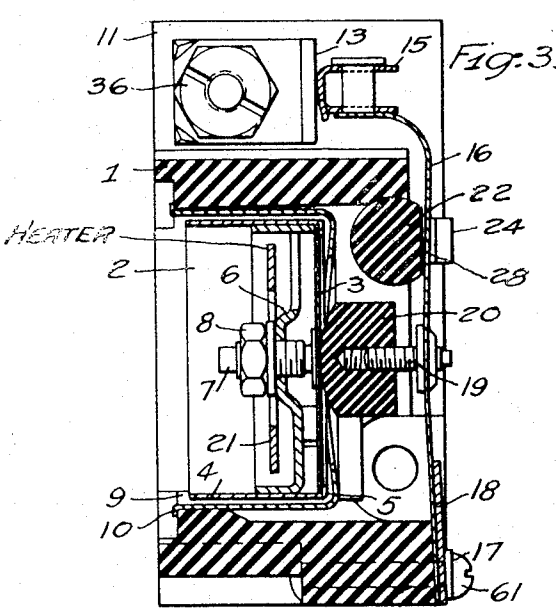
Original Filed Feb. 5, 1937

3 Sheets-Sheet 1



WITNESSES:

E. A. McLaughlin
W. C. Moore



INVENTOR

Lawrence Pierce

BY

Paul E. Friedemann
ATTORNEY

March 26, 1940.

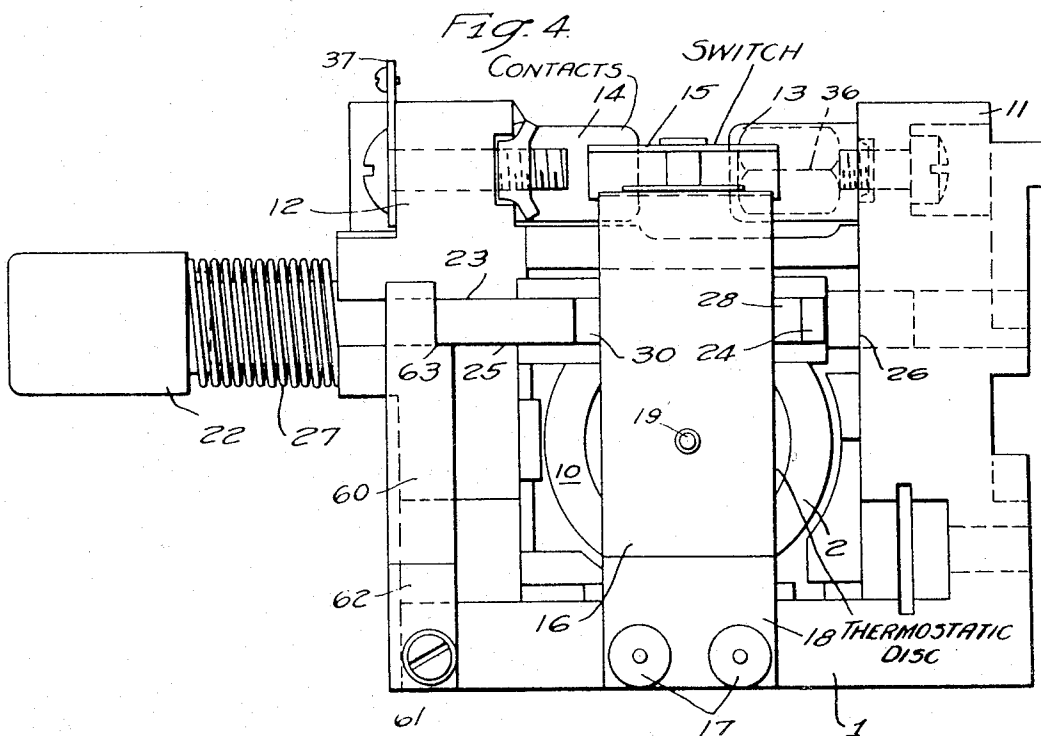
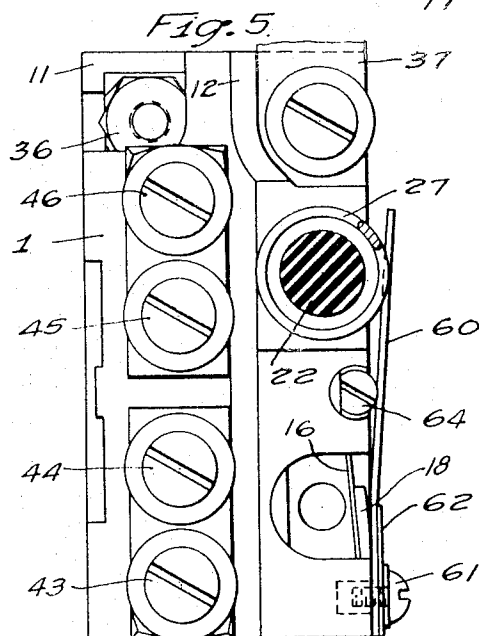
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RESET OVERLOAD RELAY

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3 Sheets-Sheet 2



WITNESSES:

E. A. M. Lasky
Wm. C. Grooms

INVENTOR

Lawrence Pierce.

BY

Paul E. Friedemann
ATTORNEY

March 26, 1940.

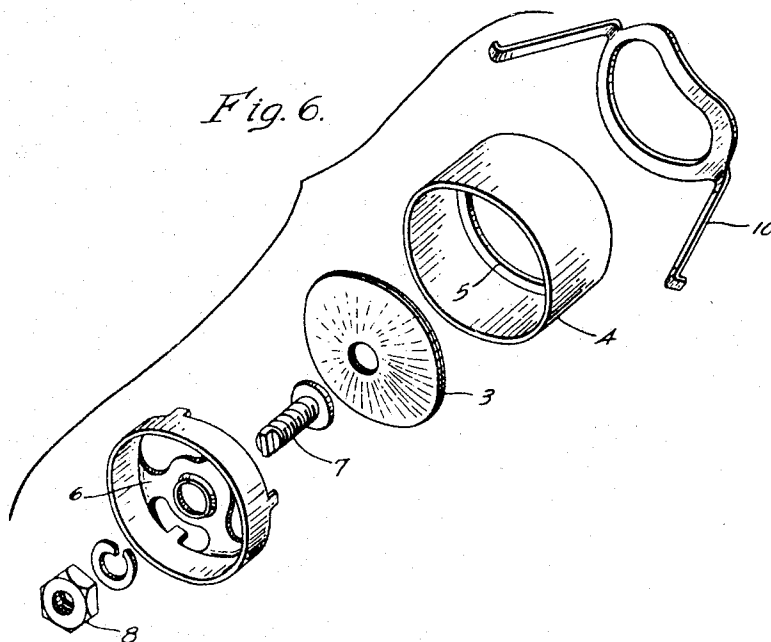
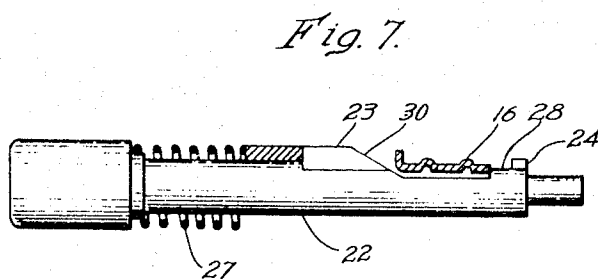
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RESET OVERLOAD RELAY

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3 Sheets-Sheet 3



WITNESSES:

C. J. Miller.
Wm. C. Grooms

INVENTOR

Lawrence Pierce.

BY

Paul E. Friedenmann
ATTORNEY

UNITED STATES PATENT OFFICE

2,195,012

RESET OVERLOAD RELAY

Lawrence Pierce, Pittsburgh, Pa., assignor to
Westinghouse Electric & Manufacturing Com-
pany, East Pittsburgh, Pa., a corporation of
Pennsylvania

Application February 5, 1937, Serial No. 124,266
Renewed October 11, 1939

19 Claims. (Cl. 200—122)

My invention relates to thermostatic devices, and more particularly to reset thermostatic overload relays for the protection of electric devices.

5 One object of my invention is to provide a thermal relay having novel resetting means for the relay after such relay has operated by reason of an overload.

10 Another object of my invention is to provide a thermal overload control relay that shall be efficient in operation, economical to manufacture, small in size, and easily installed.

15 A still further object of my invention is to provide a thermal relay having novel adjustable resetting means for the relay for controlling the time of resetting of said relay after such relay has operated by reason of an overload.

20 It is also an object of my invention to provide a thermal relay with time-limit adjusting resetting means wherein the time-limit may be adjusted from a given time interval to larger time intervals including also time intervals of indefinite length.

25 Other objects and advantages of my invention will become more apparent from a study of the following specification and the accompanying drawings, in which:

30 Figure 1 is a view of one side of my thermal overload relay illustrated in combination with a diagrammatic showing of a line switch and a motor which the relay is to protect;

35 Fig. 2 is a sectional view of my invention taken on line II—II of Fig. 1 and looking in the direction indicated by the arrows at the ends of the section line;

40 Fig. 3 is a vertical sectional view of my invention taken at a region generally indicated by the section line III—III shown in Fig. 1;

45 Fig. 4 is a side view of my relay showing the side opposite to that shown in Fig. 1;

50 Fig. 5 is a sectional view similar to the sectional view of Fig. 2 except that a certain feature is shown in adjusted position for a resetting time of the relay of an indefinite time interval;

55 Fig. 6 is an exploded view of the thermostatic device of my relay, and includes a thermostatic disc and several elements associated therewith; and

60 Fig. 7 is a bottom view of the actuating plunger for the switch, or contact element, of my relay.

For a better understanding of the objects of my invention, it is to be noted that in the cases where electric motors are used to drive pumps, compressors, etc., or any other apparatus likely to overload the motors, and wherein the operation of such motors may be controlled by a float controlled switch, a pressure responsive switch, thermostatically controlled switches, etc.,

it is necessary, when the overload relay operates to stop the motor in case of overload, that the overload relay remain in the operated, or tripped, position until manually reset in order to prevent the immediate restarting of the motor which would occur were the overload relay to automatically return to the non-operated, or reset, position with the switch in controls in the operating position. In many installations automatic restarting of the motor is desirable provided the time interval between the tripping of the overload relay and its operation to a reset position is of the desired length.

15 In the drawings, the reference character 1 designates a support, or base, of insulating material to which all the other members of the relay are directly or indirectly secured. A thermostatic device generally designated by 2 and including, a disc element 3 of thermostatic metal, a retaining cylinder 4 having a shoulder 5, and 20 a calibrating spider 6 secured in the cylinder and carrying the adjusting screw 7, which screw is held in place by the lock nut 8, is secured in the support or base 1 by being held against the shoulder 9 by the securing member 10. The 25 spider 6 is secured by press fit or other means in the cylinder 4 and holds the outer edge of disc 3 against shoulder 5.

The upper portion of the base 1 shows the switch terminal supporting lugs 11 and 12 to 30 which the terminals 13 and 14 are suitably secured. These terminals are disposed to be connected to each other by the switch or contact element 15. This switch 15 is pivotally mounted on the spring 16 secured to the base 1 by rivets, 35 or other means 17. A backing member 18 is disposed against the spring 16 to give it more rigidity at its point of flexure during operation.

A threaded stud 19 is rigidly secured to the spring 16 at or near its mid portion and threaded 40 button 20 of insulating material is mounted on the stud 19. The stud 19 and the button 20 have tightly engaging threads so that the position of the button 20 on the stud 19 will remain in the position to which it may be adjusted. It will be 45 noted that the switch 15 may be caused to interrupt the interconnection of the terminals 13 and 14 when the button 20 is actuated toward the right. See Figs. 3 and 4.

In operation a suitable heater element 21 is 50 secured in the opening at the right of base 1 and the motor current which flows through the heater element generates heat which is a direct function of the amount of current flowing. The heat so generated is transferred to the thermostatic 55 disc, which may be of the type disclosed in the patent to John A. Spencer, No. 1,448,240, entitled Thermostat.

This disc has such characteristics that when the temperature is below a predetermined value, 60

the shape thereof may be substantially as shown in Figs. 3 and 7 of the drawings but when heated to a higher temperature of predetermined value the disc will assume a reverse curve position with a snap action thereby moving button 20 to the right, which movement is transmitted through stud 19 and spring 16. The spring is thus deflected in a clockwise direction (see Fig. 3) about the general region of the rivets 17. The connection established between terminals 13 and 14 is thus interrupted by the movement of the switch 15 toward the right.

The use of the relay is such that the operation of switch 15 in the manner explained opens the circuit for the electric heater element 21 whereby heat is no longer transmitted to the disc 3. As soon as disc 3 is cooled to a predetermined lower temperature, it snaps back into the position shown. The result is that the connection between terminals 13 and 14 is re-established. The time interval between the opening of the circuit between terminals 13 and 14 and the reestablishment of the circuit connection can be adjusted to some extent by the proper positioning relative to each other of the screw 7, and the disc 3. Normally, button 20 is adjusted on stud 19 to contact screw 7 after the switch 15 engages terminals 13 and 14. Ordinarily the thermostat is adjusted at the factory and operates automatically to reset itself within a fixed time interval, but when my relay is not arranged for automatic resetting, then the time of manual resetting of the relay is dependent on the will of the attendant. The resetting time of disc 3 is substantially constant for a constant ambient temperature but varies somewhat with the difference in temperature between the ambient temperature and the tripping temperature of disc 3. The time constant of the disc 3, even for a constant ambient temperature, may be varied somewhat by subjecting the disc 3 to an initial stress by a proper positioning of screw 7 on the spider 8. The arrangement for automatic resetting may be effected by other means described hereinafter.

The heater is made so as to be readily changed to make the entire relay usable with motors of different ratings. Ordinarily, the heater is not provided with a shunt but such shunt, comprising load 50 and resistor 51, may be used as indicated.

From the description hereinbefore given, it is apparent that the relay operates automatically to open a circuit and to close the same circuit after a predetermined time interval. If the relay is to protect a motor, it is evident that the relay may be so connected that an overload will cause the relay to operate to disconnect the motor from its source of energy but since it resets itself the motor circuit will be reestablished after a short time interval. If the overload is still present, the relay will function again and again till the circuit breakers operate. Such operation may be highly undesirable. The preferred operation may be such that the relay produces an effective restarting only if manually reset.

To accomplish the dual and selective effect of automatic and manual reset, I provide the relay with a plunger 22. The plunger is circular in section for the major portion of its length and is disposed to slide back and forth in the base 1. The plunger 22 is provided with two rectangular projections or lugs 23 and 24. The lug 23 projects out and beyond the face of the base 1 as

shown at the slit 25 in the base 1. The projection or lug 24 projects beyond the face of the base but the base 1 is not provided with a slit at the right with the result that the inward movement of the plunger 22 is limited by the engagement of the lug 24 at the edge 26. The lug 23 coacting with the slit 25 in the base permits reciprocatory movement of the plunger 22 but does not permit the turning of the plunger.

The plunger has a spring 27 so that it tends to move the plunger outwardly. A ledge portion 28, less in height than the main portion of lug 24, is disposed beside lug 24. This ledge portion 28 engages the right-hand edge of spring 16 through the action of spring 27. When the thermostatic disc operates the spring 16 is moved clockwise (see Fig. 3) and in consequence, the switch 15 opens the connection between terminals 13 and 14 and the spring 16, being moved clockwise, permits the plunger 22, through the action of spring 27, to move toward the left (see Fig. 4). Plunger 22 is thus drawn under the spring 16 so that the lug 24 engages the right-hand edge of the spring. When the thermostatic disc snaps back to its original, or shown, position, the connection at the terminals 13 and 14 thus remains open, since the spring 16 remains on the ledge 28. If the connection is to be reestablished, the plunger must be moved inwardly—toward the right in Figs. 4 and 7 so that the spring 16 snaps off the ledge 28 to the position shown.

The plunger 22 at the lug 23 is also provided with an incline plane portion 30 which, when the plunger is manually actuated toward the right, see Figs. 4 and 7, may act like a wedge under the spring 16 to lift it to thus actuate switch 15 provided the plunger is moved toward the right a sufficient distance. The plunger thus acts as a stop switch as well as a means for manually resetting the relay.

From the description thus far given, it is apparent that the switch 15, in the absence of the plunger 22, automatically and in a selected time interval resets itself, that is, interconnects contact members 13 and 14, and with the plunger 22 the switch 15 is not automatically reclosed but may, even after the thermostat has reset itself automatically, be manually reset. In the absence of the plunger, there is no chance of using the relay also as a manually operable stop switch. In fact, when such automatic operation is contemplated, the spring 16 need merely be deflected a sufficient distance to permit the projection 24 to pass under the spring 16. The plunger 22 and spring 27 may then be readily removed for storage in a convenient place.

When the relay is to have a substantially definite resetting time interval, and yet be operable as a stop switch by the plunger 22, the flat retaining member 60 is positioned as shown in Figs. 2 and 4. This member 60 is secured to the base 1 at 61 and has the backing piece 62 to firmly hold it against the base 1. The upper end of the member 60 is provided with a notch 63 adapted to coact with projection 23 to prevent the movement of the plunger 22 toward the left (see Fig. 4). When the plunger 22 is thus restrained, the thermostatic device breaks and makes the circuit at switch 15 and thus resets the relay automatically after a definite time as if the plunger 22 were not present, because the ledge 28 does not interfere with the movement of spring 16. The member 60 does, however, not prevent the inward movement of the plunger 22. The inclined portion 30 may thus cause the op-

eration of switch 15 to stop the motor or other device protected by the relay.

When the relay is to function as manual reset only, the screw 64 may be turned to the position shown in Fig. 5. In such position, member 60 is so deflected that plunger 22 is not restrained in its movements.

A still better understanding of my invention can be had from a study of its function in conjunction with a motor the invention is called upon to protect. In Fig. 1, buses 31 and 39 designate the source of energy for the motor 49. The accelerating controller 48 is shown schematically because it does not constitute part of my invention.

If the motor is to be started, the starting switch 32 is actuated whereupon a circuit is established from bus 31 through switch 32, actuating coil 33 of the line switch 34, conductor 35, binding post 36, terminal 13, switch 15, terminal 14, binding post 37, and conductor 38 to the bus 39. Operation of the line switch 34 causes the closing of contact members 40 and 41. The closure of contact members 40 establishes a holding circuit for the coil 33 so that switch 32 may be released. The closure of contact members 41 establishes a circuit for the motor 49, which circuit may be traced from bus 31 through contact members 41, and conductor 42, binding posts 43 and 44, heater element 21, binding posts 45 and 46, connected in parallel with adjustable resistor 51 and lead 50, conductor 47, accelerating controller 48, motor 49, to the bus 39.

The use of the four binding posts 43, 44, 45 and 46, instead of only two as 44 and 45, has the advantage that re-rating the relay by a change of the size of the heater element 21 does not disturb the motor leads connected to binding posts 43 and 46. Similarly, any change that needs to be made at the motor leads does not disturb the connections of the heater element.

If the motor is subjected to an overload for a predetermined time interval, the heater element will cause the disc 3 to snap to an opposite curvature than shown in Fig. 3 to thus open the circuit for coil 33 at the switch 15. The ledge 28 will move below spring 16 and thus prevent reestablishment of the circuit at the terminals 13 and 14. To restart the motor, the plunger 22 has to be moved inwardly manually a sufficient distance to permit the spring 16 to move counterclockwise (see Fig. 4) to close the circuit at switch 15 and also to expose the ledge 28 so that plunger 22 remains in the reset position. The circuit arrangement may be such that movement of plunger 22 to reset the relay is alone sufficient to restart the motor or the arrangement may be as shown which requires also the operation of switch 32 to restart the motor.

If the member 60 is in the position shown in Figs. 2 and 4, the automatic return of the thermostatic disc to its cooler position will restart the motor by the closing of switch 15 and the plunger 22 may be used as a stopping device. If the member is in the position shown in Fig. 5, the relay, while still automatic in operation as far as its thermostatic feature goes, is manually reset. When the plunger 22 is removed, the relay is automatic only and cannot be readily actuated as a stop switch.

The disclosure herein made is believed to be illustrative of my invention and I do not wish to be limited to the specific details illustrated and described but wish to be limited only by the

claims hereto appended and such prior art as may be pertinent.

I claim as my invention:

1. An overload protective relay, in combination, a crescent-shaped heater element connected to be responsive to an electrical current, a disc-shaped thermostatic element disposed adjacent and substantially parallel to the plane of the crescent-shaped heater element and adapted to change its shape with a snap action when its temperature is increased by the heater element above a given relatively high value and adapted to resume its original shape when its temperature is decreased to a given relatively lower value, switching means operated by said thermostatic element to open the circuit to said heater element and said device, resetting means adapted to hold said switching means in open position, after having been caused to open by said thermostatic element, and means operating on said resetting means adapted to effect the automatic closing as well as the automatic opening of said switching means with changes in the shape of said thermostatic element.

2. In an electrical control apparatus for electric devices, in combination, a switch spring biased to closed position, control means adapted to control the position of said switch, said control means comprising a thermostat for opening the switch when said thermostat is subjected to a given relatively high temperature, a switch operating member designed to occupy any one of three positions, which may be designated a left-hand position, a mid-position and a right-hand position, means for moving the switch operating member to its left-hand position when said switch is operated to open position by said thermostat whereby said switch operating member maintains the switch in open position, means for holding the switch operating member out of the left-hand position whereby the thermostat may automatically open and close said switch as the temperature of the thermostat fluctuates between a given high temperature and a given lower temperature, and means for moving the switch operating member to the right-hand position to thus effect the opening of said switch.

3. In a control means for an electric switch, in combination, a switch spring biased to closing position, a switch operating member designed to take any one of three positions which may be designated a left-hand position, a mid-position, and a right-hand position, an electrical piece of apparatus carrying varying load currents, means responsive to the load currents of said apparatus adapted to automatically open and close said switch with variations in load currents from a given high value to a given lower value when said switch operating member occupies its mid position, said means responsive to the load currents of said apparatus also initiating the operation of said switch operating member to its left-hand position when operated to the open position by a predetermined rise in load current of said apparatus, and means for operating said switch operating member to its right-hand position to open said switch.

4. In a control switch for controlling the operation of an electrical device, in combination, a source of electrical energy, a circuit for said control switch, means adapted to interconnect said circuit in circuit relation with said source of electrical energy, a contact element in the said circuit, means biasing said contact to cir-

cuit closing position, a thermostat having a heater element also connected in said circuit, said thermostat being adapted to move the contact element to such a position as to open the said circuit whereby the heater element becomes deenergized and the thermostat ceases to act on said contact element after a substantially definite time interval, a plunger biased to a given position which may be designated a left-hand position but held in a mid-position by said contact element when in closed circuit position, a latch ledge on the plunger adapted to hold the contact element in open circuit position once actuated to such position by the thermostat, and means on said plunger adapted to operate the plunger to one position to thus remove said contact element from said ledge and permit said contact element to close, and in another position to positively hold said contact element open.

5. A switch element biased to a given position, a plunger so biased that a ledge on the plunger contacts the switch at one edge and is thus held in a mid-position by the switch element, means for moving the switch against its bias out of a given position and out of the edge contact with the ledge on the plunger whereby the plunger, being biased as stated, moves to one side of the mid-position and in such manner that the switch element rides on the top of the ledge and thus remains in its actuated position as long as the plunger is not moved to its mid-position, and means on said plunger adapted to also move said switch element against its bias out of a given position, when said plunger is moved from its mid-position to the other side of the mid-position.

6. A switch element biased to a given position, a plunger so biased that a ledge on the plunger contacts the switch at one edge and is thus held in a mid-position by the switch element, means for moving the switch against its bias out of a given position and out of the edge contact with the ledge on the plunger whereby the plunger, being biased as stated, moves to one side of the mid-position and in such manner that the switch element rides on the top of the ledge and thus remains in its actuated position as long as the plunger is not moved to its mid-position, and means on said plunger adapted to also move said switch element against its bias out of a given position, when said plunger is moved from its mid-position to the other side of the mid-position and adjustable means adapted, for one adjustment, to limit the movement of said plunger to its mid-position and to one side of the mid-position.

7. A switch element biased to a given position, a plunger so biased that a ledge on the plunger contacts the switch at one edge and is thus held in a mid-position by the switch element, means for moving the switch against its bias out of a given position and out of the edge contact with the ledge on the plunger whereby the plunger, being biased as stated, moves to one side of the mid-position and in such manner that the switch element rides on the top of the ledge and thus remains in its actuated position as long as the plunger is not moved to its mid-position, and means on said plunger adapted to release said switch element and to also move said switch element against its bias out of a given position, when said plunger is moved from its mid-position to the other side of the mid-position.

8. In an electric circuit interrupter for interrupting a circuit including an electric device for

protecting said device against overload, the combination of, a relay having switching means for opening said circuit, a reset plunger for manually operating said switching means to open circuit position, a snap-action thermostatic disc for operating said switching means, an electric heater element so connected as to carry a current proportional to the load current of the device to be protected, said reset plunger, having biasing means, so biased in relation to the relay switching means as to maintain the said switching means, after actuation by said thermostatic disc in open circuit position, and means for making the biasing means for said plunger ineffective.

9. The combination of thermally controlled means for overload protection of electric devices comprising a relay having a snap-acting bimetallic member, a heater element for the member, said heater element being adapted to heat the member as a function of the load current taken by the electric device to be protected, relay contact members adapted to be operated by the snap-action of the bimetallic member, a reset plunger so disposed in relation to the relay contact members as to maintain the latter in the tripped position when the said contact members have been actuated thereto until said plunger is manually actuated to reset position, and means for securing the plunger in the resetting position to thus provide for automatic resetting of the contact members.

10. In an electric circuit interrupter for the protection of electric devices against overload, the combination of an electric circuit including a device to be protected, a relay having switching means for opening said circuit, a snap-action thermostatic disc for operating said switching means, an electric heater element so connected in said circuit as to carry a current proportional to the load current of the device to be protected, and a reset plunger so biased in relation to the relay switching means as to maintain the said switching means, after actuation by said thermostatic disc, in open circuit position.

11. In an electrical circuit interrupter, switching means biased to move to closed-circuit position, manually operable means for normally causing movement of said switching means to open-circuit position and to closed-circuit position, a current responsive element movable by energy taken from the electrical circuit upon the occurrence of a predetermined condition for applying a force to said switching means to move it to open-circuit position against its bias, and holding means for retaining said switching means in open-circuit position after movement to that position by said current-responsive element, said holding means being releasable to permit said switching means to return to closed-circuit position.

12. In an electrical circuit interrupter, switching means biased to move to closed-circuit position, manually operable means for normally causing movement of said switching means to open-circuit position and to closed-circuit position, a current responsive element movable by energy taken from the electrical circuit upon the occurrence of a predetermined condition for applying a force to said switching means to move it to open-circuit position against its bias, said current-responsive element being operable to move the switching means to open-circuit position irrespective of the position in which said manually operable means may be held, and holding means for retaining said switching means in open-circuit position.

circuit position after movement to that position by said current-responsive element, said holding means being releasable to permit said switching means to return to closed-circuit position.

13. In an electrical circuit interrupter, switching means biased to move to closed-circuit position, manually operable means for normally causing movement of said switching means to open-circuit position and to closed-circuit position, a current responsive element movable by energy taken from the electrical circuit upon the occurrence of a predetermined condition for applying a force to said switching means to move it to open-circuit position against its bias, said current-responsive element being thermally actuated to thus be operable, with changes of ambient temperature, to move the switching means to open-circuit position irrespective of the position in which said manually operable means may be held, and holding means for retaining said switching means in open-circuit position after movement to that position by said current-responsive element, said holding means being releasable to permit said switching means to return to closed-circuit position.

14. In an electrical circuit interrupter, switching means biased to move to closed-circuit position, manually operable means for normally causing movement of said switching means to open-circuit position and to closed-circuit position, a current responsive element movable by energy taken from the electrical circuit upon the occurrence of a predetermined condition for applying a force to said switching means to move it to open-circuit position against its bias, said current-responsive element comprising a bimetallic member acting with a snap-action to thus be operable, with changes of ambient temperature, to move the switching means with a snap-action to open-circuit position irrespective of the position in which said manually operable means may be held, and holding means for retaining said switching means in open-circuit position after movement to that position by said current-responsive element, said holding means being releasable to permit said switching means to return to closed-circuit position.

15. In an electrical circuit interrupter, switching means biased to move to closed-circuit position, manually operable means for normally causing movement of said switching means to open-circuit position, a current responsive element movable by energy taken from the electrical circuit upon the occurrence of a predetermined condition for applying a force to said switching means to move it to open-circuit position against its bias, said switching means remaining in open-circuit position when moved thereto by said current responsive means, and said manually operable means being movable to cause the return of said switching means to closed-circuit position.

16. In an electrical circuit interrupter, switching means biased to move to closed-circuit position, a single manually operable member for normally causing movement of said switching means to open-circuit position, a current responsive element movable by energy taken from the electrical circuit upon the occurrence of a predetermined condition for applying a force to said switching means to move it to open-circuit position against its bias, said current-responsive element being thermally actuated to thus be oper-

able, with changes in ambient temperature, to move the switching means to open-circuit position irrespective of the position in which said manually operable member may be held, and holding means for retaining said switching means in open-circuit position after movement to that position by said current-responsive element, said holding means being releasable by movement of said manually operable member to permit said switching means to return to closed-circuit position.

17. In an electrical circuit interrupter, switching means biased to move to closed-circuit position, manually operable means for normally causing movement of said switching means to open-circuit position, a current responsive element movable by energy taken from the electrical circuit upon the occurrence of a predetermined condition for applying a force to said switching means to move it to open-circuit position against its bias, said current-responsive element being thermally actuated and comprising a bimetallic member acting with a snap action to thus be operable, with changes of ambient temperature, to move the switching means with a snap action to open-circuit position irrespective of the position in which said manually operable means may be held, said movement of the switching means causing movement of said manually operable means to indicate the opening of the switching means, and holding means for retaining said switching means in open-circuit position after movement to that position by said current-responsive element, said holding means being releasable to permit said switching means to return to closed-circuit position.

18. In an electrical control device, in combination, a switch, biasing means adapted to normally hold said switch closed, control means, having a neutral or inoperative position and two operating positions, adapted for one operating position to open the switch and adapted for the other operating position to hold the switch open, biasing means for biasing the control means to the second operating position, means associated with said switching means adapted to maintain the control means in the inoperative position as long as said switch has not been opened but permitting free movement of the control means to the first operating position, and further control means for opening said switch.

19. In an electrical control device, in combination, a switch, biasing means adapted to normally hold said switch closed, control means, having a neutral or inoperative position and two operating positions, adapted for one operating position to open the switch and adapted for the other operating position to hold the switch open, biasing means for biasing the control means to the second operating position, means associated with said switching means adapted to maintain the control means in the inoperative position as long as said switch has not been opened but permitting free movement of the control means to the first operating position, further control means for automatically opening and closing said switch, and means for making the biasing means for the first named control means ineffective to thus permit the automatic operation of said switch by said further control means.