

Nov. 3, 1959

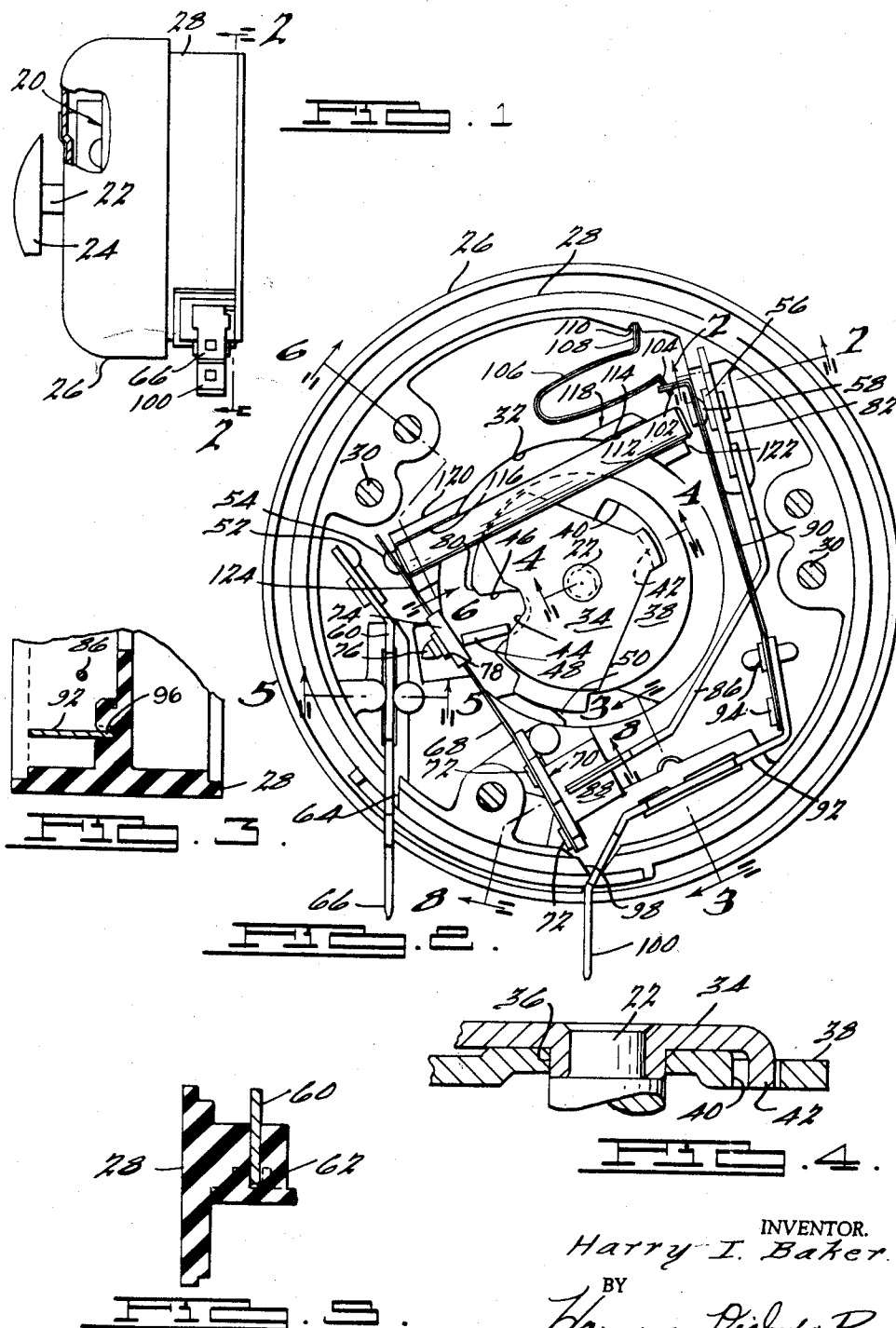
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2,911,501

THERMALLY COMPENSATED OVERLOAD DEVICE

Filed March 25, 1957

3 Sheets-Sheet 1



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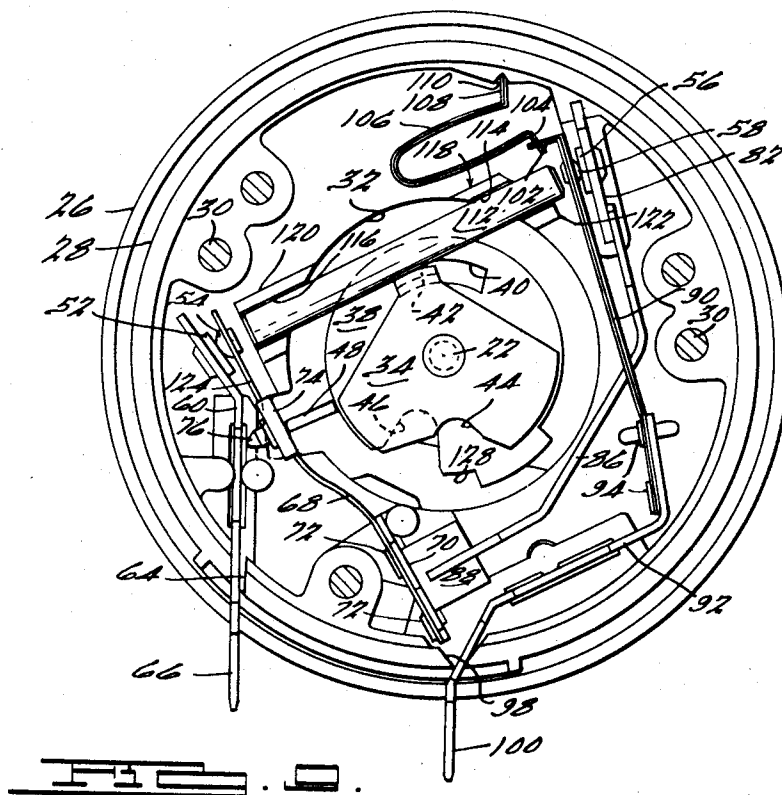
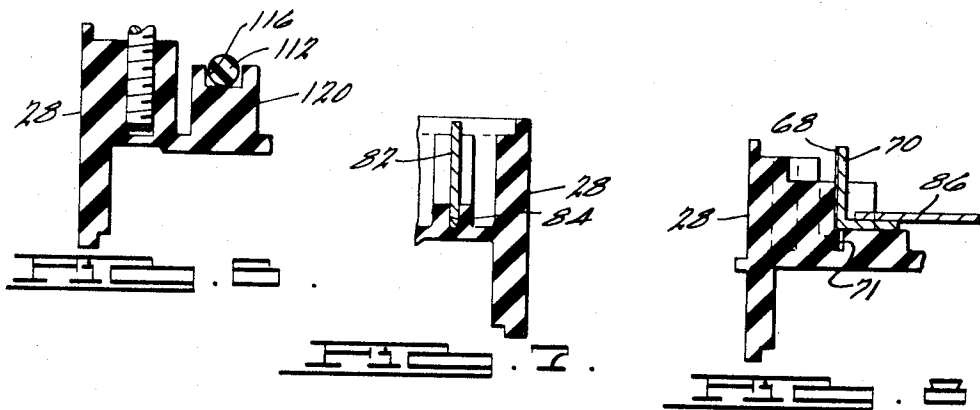
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THERMALLY COMPENSATED OVERLOAD DEVICE

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3 Sheets-Sheet 2



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THERMALLY COMPENSATED OVERLOAD DEVICE

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3 Sheets-Sheet 3

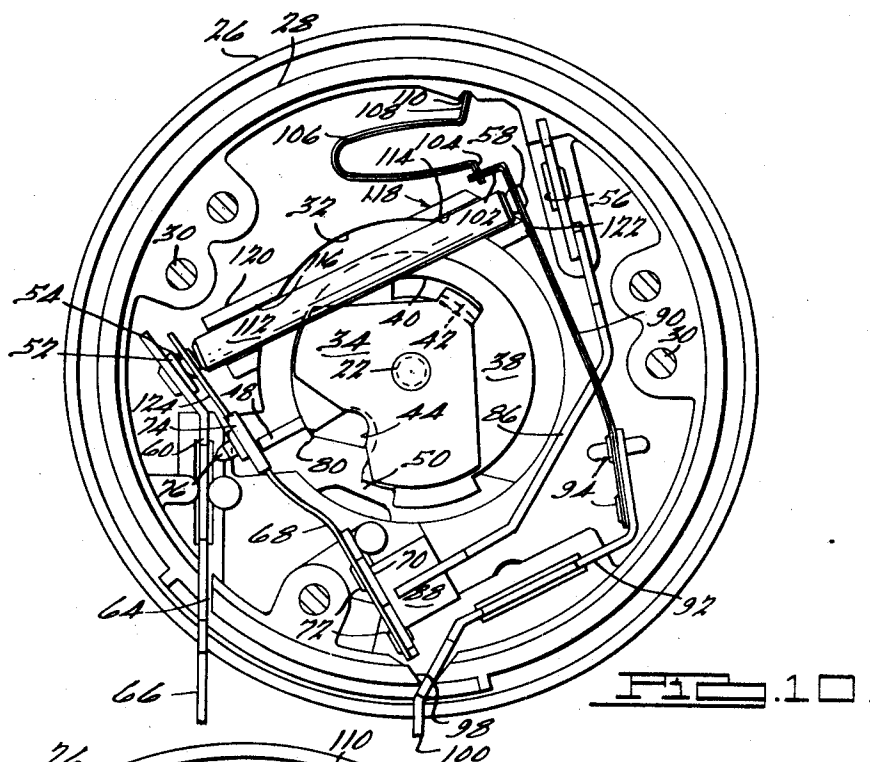


FIG. 10.

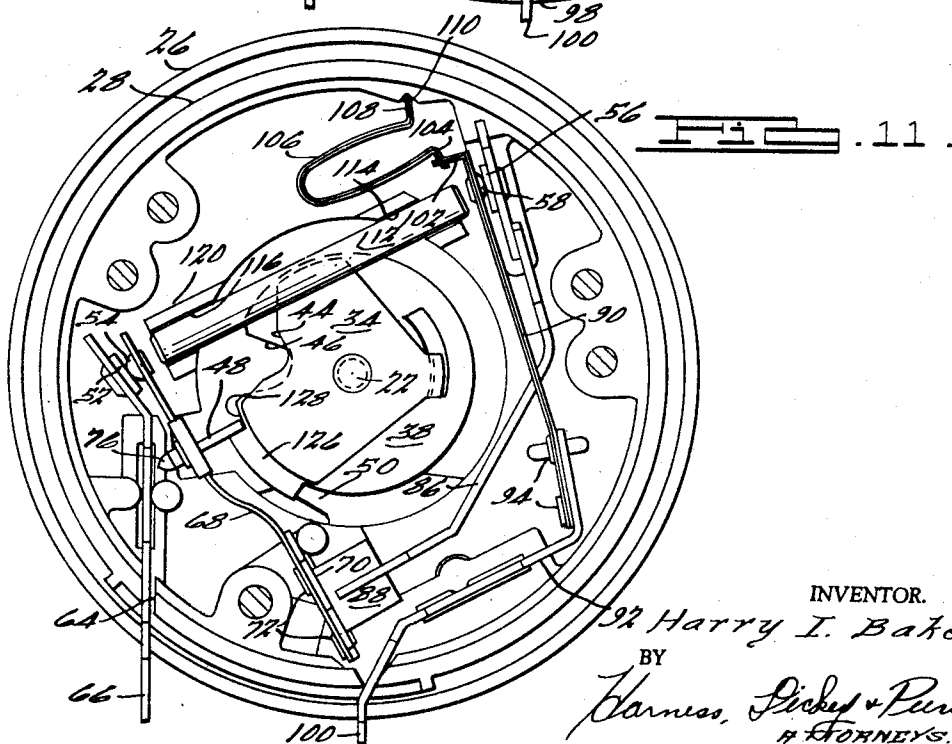


FIG. 11.

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2,911,501

THERMALLY COMPENSATED OVERLOAD DEVICE

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4 Claims. (Cl. 200—113)

The present invention relates to an improved thermally compensated overload device, and more particularly, to an improved electric circuit controlling mechanism having improved means for controlling current in an electric circuit to provide inter-related time and thermally compensated overload control of the current in the circuit.

It is an object of the present invention to provide an improved thermally compensated overload device which is simple in design, economical of manufacture, sturdy of construction, reliable and efficient in operation, and which is independent of changes in the ambient temperature.

It is an object of the present invention to provide an improved thermally compensated overload device which has a minimum number of parts, which may be readily assembled by unskilled labor, and which affords accurate compensation for variations in ambient temperature.

It is also an object of the present invention to provide such an electric circuit controlling mechanism which includes a timer controlled main switch, an overload switch mechanism, compensating means compensating said overload switch mechanism for variations in the ambient temperature, and a reset mechanism adapted to automatically reset said overload switch mechanism at the end of the period set on said timer.

Other and more detailed objects of the present invention will be appreciated by those skilled in the art from a consideration of the following specification, the appended claims, and the accompanying drawings, throughout the several views of which like reference characters designate like parts and wherein:

Figure 1 is an elevational view having parts broken away of a circuit controlling mechanism constructed according to the present invention;

Figure 2 is an enlarged sectional view of the structure illustrated in Figure 1, taken substantially along the line 2—2 thereof;

Figure 3 is a sectional view of a portion of the switch casing illustrated in Figure 2, taken substantially along the line 3—3 thereof and showing the mounting of certain parts therein;

Figure 4 is an enlarged sectional view of the structure illustrated in Figure 2, taken substantially along the line 4—4 thereof;

Figures 5, 6, 7 and 8 are enlarged sectional views of portions of the switch casing illustrated in Figure 2, taken substantially along the lines 5—5, 6—6, 7—7 and 8—8 thereof, respectively, and showing the mounting of certain parts therein; and,

Figures 9, 10 and 11 are sectional views similar to Figure 2, showing other positions assumed by the parts of the circuit controlling mechanism at different stages during the operation thereof.

Referring to the drawings, and more particularly to Figure 1 thereof, the improved thermally compensated overload device of the present invention generally comprises a timer mechanism indicated at 20, having an arbor 22 provided with a knob 24 for manually rotating the arbor 22. The mechanism also includes a bell 26

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which is struck to provide an audible signal at the expiration of the period for which the timer is set and a switch mechanism housed within a switch casing 28 which is mounted on the timer 20 by means of screws 30.

The arbor 22 is rotatable by the knob 24 in one direction from a zero position to initiate operation of the timer 20, which thereupon returns the arbor 22 to its zero position at the end of the selected time interval. Timers capable of performing this function are well known and the timer 20 may be of any suitable construction, its details forming no part of the present invention.

The arbor 22 extends into the switch case 28 through an enlarged central opening 32 therein and carries a cam plate 34 fixed on the end thereof for rotation therewith. In the preferred embodiment illustrated, the cam plate 34 has a hub portion 36 which rotatably supports a generally circular latch plate 38 which has an arcuately shaped slot 40 which receives a laterally projecting finger 42 integrally formed on the cam plate 34. The engagement of the finger 42 in the slot 40 provides a lost motion connection between the cam plate 34 and the latch plate 38. These plates 34 and 38 are provided with notches 44 and 46, respectively, which receive the follower finger 48 of a hammer 50 pivotally mounted within the timer 20, when the arbor 22 is in its zero position.

Within the switch casing 28, which is formed of a suitable insulating material, are mounted a stationary main contact 52, a movable main contact 54, a stationary overload contact 56, and a movable overload contact 58. The stationary main contact 52 is mounted in a rigid metal strip 60 which is in turn mounted in a supporting recess 62 provided in the casing 28, as best illustrated in Figures 2 and 5. The strip 60 extends outwardly through an opening 64 provided in the wall of the casing and its outer end portion provides a terminal 66 for connecting the circuit controlling mechanism in the electric circuit to be controlled. The movable main contact 54 is mounted near the free end of an arm 68 formed of a spring steel or other suitable resilient material. In the preferred embodiment illustrated, this arm 68 is secured to an anchor plate 70 supported in the casing 28, as best illustrated in Figure 8, where it will be seen that the anchor plate 70 extends into recess 71 provided in the casing 28.

In the preferred embodiment illustrated, the anchor plate 70 has projections 72 which extend through openings provided in the spring arm 68 and are staked over the opposite surface of the spring arm 68 to rigidly secure a spring arm to the anchor plate. Intermediate the movable main switch contact 54 and the anchor plate 70, the spring arm 68 carries an insulator 74 which is generally channel shaped and has a central shank portion 76 which extends through an opening in the arm 68 and receives a push-on clip 78. This insulator 74 is disposed as illustrated in Figure 2 so that the insulator 74 rides upon the follower 48 and prevents direct engagement of the follower 48 with the spring arm 68. It will now be appreciated that upon rotation of the arbor 22, by means of the knob 24, in a counterclockwise direction as viewed in Figure 2, the cam plate 34 which rotates with the arbor 22, will move relative to the latch plate 38 until the projection 42 engages the latch plate at the opposite or counterclockwise end of the arcuate slot 40 and thereafter the latch plate 38 will move with the cam plate 34. During this movement, the clockwise side of the notch 44 in the cam plate engages the follower 48 and moves it radially outwardly relative to the arbor 22. It will be noted that the height or radial dimension of the cam plate 34 is slightly less than that of the latch plate 38 and accordingly, the final lifting of the follower 48 is completed by the engagement of the inclined surface 80 at the outer limit of the clockwise side of the latch plate notch 46. Upon continued rotation of the arbor 22 and the plates

34 and 38, the follower 48 rides on the periphery of the latch plate 38. During this raising, or radially outward movement of the follower 48, it will be appreciated that the follower 48, through its engagement with the insulator 74, on the arm 68, moves the arm 68 to move the movable main contact 54 into engagement with the stationary main contact 52.

The stationary overload contact 56 is mounted on a contact plate 82 which is in turn mounted in the casing 28 in a recess 84, as illustrated in Figure 7. The contact plate 82 is electrically connected to the anchor plate 70 by a wire 86, one end of which is secured as by welding to the contact plate 82, and the other end of which is welded or otherwise suitably secured to a laterally extending flange 88 of the anchor plate 70.

The movable overload contact 58 is mounted adjacent the free outer end of a bimetal arm 90, the other end of which is secured to a terminal strip 92 provided with a pair of projections 94 extending through apertures in the arm 90 and suitably staked against the remote surface of the arm 90. The strip 92 is mounted in the casing 28 in a recess 96 provided therein, as best illustrated in Figure 3.

The strip 92 extends outwardly of the casing 28 through an opening 98 and has an outer terminal portion 100 employed in connecting the mechanism into the electric circuit to be controlled.

Outwardly of the movable overload contact 58, the end portion of the bimetal arm 90 is turned at right angles as indicated at 102 and apertured to receive the outwardly turned end portion 104 of one leg of a U-shaped snap-acting spring 106, the other leg of which has an outwardly turned end portion 108 which is received in a notch 110 formed in the wall of the casing 28. The laminations of the bimetal arm 90 are so disposed that heating of the bimetal 90 causes it to warp in a direction to move the movable overload contact 58 away from the stationary overload contact 56. The snap-acting spring 106 applies a force opposing such movement of the bimetal arm 90. When the force developed within the bimetal arm 90, as a result of the heating thereof, is sufficient to overcome the force of the snap-acting spring 106, the outer end of the arm 90 snaps to the left as viewed in Figure 2, moving the movable overload contact 58 away from the stationary overload contact 56 with a snap action and moving the point of engagement of the snap spring portion 104 with the end portion 102 of the bimetal 90 across a line between the engagement of the snap spring end 108 in the notch 110 and the fixed end of the arm 90 which is secured to the terminal strip 92.

It is an important feature of the present invention that the snap-acting spring 106 resists movement of the arm 90 from its closed position with a force which varies with the ambient temperature. In the preferred embodiment illustrated, this snap-acting spring 106 is formed of a bimetal strip, the inner lamination of the U-shaped spring 106 having the higher coefficient of expansion and the outer lamination having the lower coefficient of expansion. With this construction, it will be seen that an increase in the ambient temperature within the casing 28 will cause the U-shaped spring 106 to tend to open up and thus exert a greater force against the end 102 of the arm 90. By selection of a bimetal material having the proper relation between the coefficients of expansion of its two laminations, the variation in the force which the spring 106 exerts on the arm 90 upon variations in the ambient temperature within the casing 28, may be made to accurately compensate for the effect of variations in the ambient temperature upon the arm 90. It will, of course, be readily understood that in the absence of compensating means, variations in the ambient temperature would cause overload switch arm 90 to move to its open position under varying current conditions in the circuit. It will be noted that this single element 106 both co-

operates in providing a snap action of the arm 90 and provides the ambient temperature compensation.

Intermediate the movable main switch contact 54 and the movable overload contact 58, is a reset rod 112 formed of a suitable insulating material which is mounted in spaced, aligned grooves 114 and 116 formed in bosses 118 and 120 which are an integral part of the casing 28. The boss 118 has an end portion indicated at 122 which is engaged by the bimetal arm 90 to limit movement of the arm when it snaps to its tripped position in which the movable overload contact 58 is moved away from the stationary overload contact 56. Also, the boss 120 on the casing 28 has a portion indicated at 124 which provides an abutment limiting movement of the spring arm 68 in a direction to move the movable main switch contact 54 away from the stationary main switch contact 52. The length of the reset rod 112 is such that when the movable overload contact 58 is in engagement with the stationary overload contact 56, and the arm 68 is against the abutment 124, the distance between the movable main switch contact 54 and the movable overload contact 58 is slightly greater than the length of the rod 112.

The amount of movement of the movable overload contact 58 is such that when the movable main switch contact 54 is in engagement with the stationary main switch contact 52, and the bimetal arm 90 carrying the movable overload contact 58 is in engagement with the abutment 122, the distance between the movable contacts 54 and 58 is slightly greater than the length of the reset rod 112. Similarly, when the movable overload contact 58 is in engagement with the stationary overload contact 56 and the spring arm 68 carrying the movable main switch contact 54 is in engagement with the abutment 124, the distance between the movable main switch contact 54 and the movable overload contact 58 is slightly greater than the length of the reset rod 112. It will now be appreciated that upon rotation of the arbor 22 in a counterclockwise direction from the zero position illustrated in Figure 2, the follower 48 will be raised or moved radially outwardly as above described, moving the movable main contact 54 into engagement with the stationary main contact 52. The terminal 66 is then connected to the terminal 100 through a circuit including the stationary main contact strip 60, the main stationary contact 52, the movable main contact 54, the spring arm 68, the anchor plate 70, the wire 86, the overload stationary contact plate 82, the stationary overload contact 56, the movable overload contact 58, the bimetal movable overload contact arm 90, and the terminal strip 92. It will thus be seen that the main contacts 52 and 54 are connected in series with the overload contacts 56 and 58. In the event that a predetermined overload condition occurs, the bimetal 90 will be warped by a force sufficient to overcome the snap spring 106 and snap the outer end of the bimetal arm 90 to the left as above described, and thereby open the circuit by moving the movable overload contact 58 out of engagement with the stationary overload contact 56. During this movement the reset rod 112, if it has up to this time remained in the position illustrated in Figure 2, is moved to the left by the engagement of the movable overload contact 58 with the right-hand end of the rod. This movement of the rod is permitted because of the fact that the movable main contact 54 has previously been moved to the left from the position illustrated in Figure 2 and into engagement with the stationary main contact 52. As pointed out above, after the overload mechanism has tripped and the bimetal arm 90 is engaging the abutment 122, the distance between the movable contacts 54 and 58 is only slightly greater than the length of the reset rod 112. At the expiration of the time interval for which the timer mechanism has been set by rotation of the arbor 22, the follower 48 drops into the notches 44 and 46 in the cam plate 34 and latch plate 38, permitting the spring arm 68 to move to the right to the position illustrated in Figure 2, during which move-

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ment the reset rod 112 is forced to the right to the position illustrated and forces the movable overload contact 58 and the bimetal overload arm 90, upon which it is carried, over center causing the overload mechanism to be reset by snapping the arm 90 to the position illustrated in which the movable overload contact 58 engages the stationary overload contact 56.

Figure 9 illustrates the relative position of the parts when the arbor 22 has been turned counterclockwise from the position illustrated in Figure 2, to a position in which the timer has been set for a selected time interval. Upon release of the knob 24, operation of the timer mechanism will be initiated and during the initial movement of the arbor 22 by the timer mechanism in a clockwise direction, the latch plate 38 will remain stationary and the cam plate 34 will turn with the arbor until the finger 42 engages the latch plate 38 at the opposite or clockwise end of the arcuate slot 40. Thereafter, the latch plate 38 will turn with the arbor 22 and the cam plate 34.

Figure 10 shows the overload arm 90 in its tripped position with the movable overload contact 58 out of engagement with the stationary overload contact 56. Upon continued clockwise rotation of the arbor 22 from the position illustrated in Figure 10, the inclined cam surface 80 on the latch plate 38 moves under the follower 48 causing the latch plate 38 to quickly advance relative to the arbor 22 and the cam plate 34. This is permitted because of the lost motion connection between the latch plate 38 and the cam plate 34. This results in a quick opening movement of the movable main contact 54 and during this movement the reset rod 112 is pushed to the right, causing the bimetal overload arm 90 to be snapped to the right to the position illustrated in Figure 2.

While only one specific embodiment of the invention has been illustrated and described in detail herein, it will be readily appreciated by those skilled in the art that numerous modifications and changes may be made without departing from the spirit of the invention.

What is claimed is:

1. Means for controlling the current in an electric circuit comprising a normally closed overload switch including a contact carrier movable to open and close said switch, temperature responsive means for effecting movement of said carrier to open said switch upon the occurrence of a predetermined overload condition in said circuit, and a temperature responsive and snap-acting over-center spring opposing said movement of said carrier with a force proportional to the ambient temperature, said temperature responsive means and said spring being adapted to continuously hold said carrier in position to hold said switch closed during a continuous normal load condition in said circuit.

2. Means for controlling the current in an electric circuit comprising a normally open main switch, timer mechanism settable for a selected desired period and effective upon setting thereof to close said switch and hold said switch closed for said selected period and open said switch at the end of said period, temperature responsive resettable overload switch mechanism for automatically opening said circuit upon the occurrence of a predetermined overload condition in said circuit, means for compensating said overload switch mechanism for variations in the ambient temperature to which said overload switch mechanism is subjected, and reset mechanism automatically operated at the end of said selected period for resetting said overload switch mechanism.

3. Means for controlling the current in an electric circuit comprising a normally open main switch, timer mechanism

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settable for a selected desired period and effective upon setting thereof to close said switch and hold said switch closed for said selected period and open said switch at the end of said period, temperature responsive resettable overload switch mechanism for automatically opening said circuit upon the occurrence of a predetermined overload condition in said circuit, means for compensating said overload switch mechanism for variations in the ambient temperature to which said overload switch mechanism is subjected, reset mechanism automatically operated at the end of said selected period for resetting said overload switch mechanism, said overload switch mechanism including an overload switch and a contact carrier movable between an open position and a closed position to open and close said overload switch, and said compensating means including temperature responsive means acting upon said carrier to oppose movement from said closed position with a force proportional to the ambient temperature.

4. Means for controlling the current in an electric circuit comprising a normally open main switch, timer mechanism settable for a selected desired period and effective upon setting thereof to close said switch and hold said switch closed for said selected period and open said switch at the end of said period, temperature responsive resettable overload switch mechanism for automatically opening said circuit upon the occurrence of a predetermined overload condition in said circuit, means for compensating said overload switch mechanism for variations in the ambient temperature to which said overload switch mechanism is subjected, and reset mechanism automatically operated at the end of said selected period for resetting said overload switch mechanism, said overload switch mechanism including a casing having an overload switch chamber, a normally closed overload switch mounted in said chamber and including a contact carrier movable between an open position and a closed position to open and close said overload switch, temperature responsive means for effecting movement of said carrier to open said overload switch upon the occurrence of a predetermined overload condition in said circuit, and said compensating means comprising means on said casing providing a stationary spring support, a generally U-shaped spring formed of a strip of bimetal, one end of said spring engaging said stationary support on said casing, the other end of said spring engaging said carrier and co-operating therewith to provide a snap action of said overload switch, said spring being responsive to changes in the ambient temperature in said overload switch chamber and exerting a force on said carrier when the latter is in said closed position which is proportional to said ambient temperature and opposes movement of said carrier from said closed position.

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