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AUTOMATICALLY RECLOSING CIRCUIT BREAKER

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Fig. 1

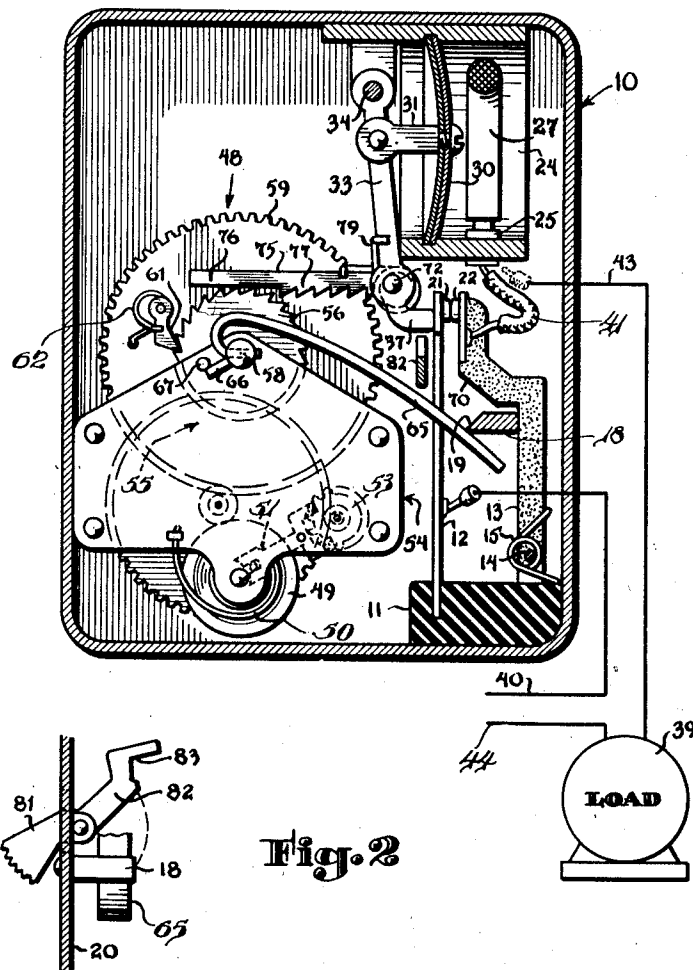


Fig. 2

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AUTOMATICALLY RECLOSING CIRCUIT
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12 Claims. (Cl. 200—122)

The present invention relates to electric switches and more particularly to the type of switch known as an overload cut-out.

The common form of overload cut-out is responsive to the amount of current flowing in a circuit, operates to open the circuit on an overload and requires manual resetting to reclose the circuit. Another type of overload cut-out intermittently opens and closes the circuit being protected when the load on the circuit is too great. Such a device is found to be satisfactory when an attendant is available to correct the difficulty should it be a continuing one.

Still another type of overload cut-out is designed to intermittently open and close the circuit a predetermined number of times on excessive current flow, and then, if the condition is not corrected, latch the mechanism in open circuit position. This last mentioned type finds special application in protecting various motor circuits in which an excessive current flow on the first or second attempt to start the motor is not necessarily an indication that the overload will be a continuing one. Such a problem is presented in connection with the starting of a refrigeration compressor motor. The difficulty with such a device is that while the motor may be given two or three chances to start when the overload cut-out is in its initial or reset position, it may be given a less number of opportunities to start on a subsequent occasion. As an example, if such a device were designed to give the motor three attempts to start and on one occasion it successfully started on the second attempt then on the next occasion the motor could only attempt to start twice before the device would positively open the circuit.

The present invention contemplates an overload cut-out which will provide the above function but which will also return to its original condition automatically during intervals of no overload.

An object of the invention is to provide an overload cut-out which will alternately open and close the circuit being protected a plurality of times when an overload exists before positively opening the circuit, but which will return automatically to its initial condition if the overload is removed before the circuit is positively opened.

Another object of the invention is to provide a device which is responsive to the current flowing in a circuit to open and close a switch alternately a number of times before positively opening the switch and which is adapted to return

to its initial condition when the alternate opening and closing of the switch ceases.

Other objects will be evident from the drawing, specification, and appended claims.

The invention will be described in connection with an overload cut-out but other applications of the invention will be obvious to those skilled in the art.

In the drawing

Figure 1 is a sectional view of an overload cut-out embodying the present invention, and

Figure 2 is a view of the manual reset mechanism of the device of Figure 1.

The overload cut-out comprises a casing 10 in which the mechanism is mounted. Secured within casing 10 at the lower right-hand corner is an insulating block 11. Mounted on this block are a flexible contact arm 12 and an insulating contact arm 13. Arm 13 is pivotally mounted on block 11 by a pin 14 and is biased in a counter-clockwise direction by a spring 15. A post 18 shown in Figure 1 and also in Figure 2 is mounted on a front cover 20, part of which is shown in Figure 2, of the mechanism and serves to limit the counter-clockwise movement of contact arm 13. A movable contact 21 is mounted at the upper end of spring contact arm 12 while a normally stationary contact 22 is mounted on contact arm 13 in a position corresponding to the location of contact 21 on arm 12. Spring contact arm 12 is of such a shape that it will normally hold contact 21 out of engagement with contact 22.

A heater chamber 24 is secured within casing 10 at the upper right-hand corner thereof. A heater socket 25 together with a similar socket (not shown) serves to support a U-shaped heater 27 and also to form an electrical connection therewith. Mounted within the heater chamber 24 and adjacent the heater 27 is a bimetallic snap action disc 30, here shown in its cold position. Attached to the center and extending to the left of disc 30 is a post 31. A lever arm 33 is pivoted at 34 to the upper portion of heater chamber 24 and is adapted to be rotated in a clockwise direction by disc 30 through post 31 when heater 27 heats disc 30 to a predetermined high temperature. At its lower extremity lever arm 33 has an extension 37 adapted to hold the movable contact 21 in engagement with stationary contact 22 when the disc 30 is in its cold position, as shown.

In the illustrated embodiment, the contacts and heater are shown in series with an electrical load 39. Current supply wire 40 is connected di-

rectly to the spring contact arm 12. The circuit then is through movable contact 21, stationary contact 22, wire 41, heater socket 25, heater 27, wire 43, load 39, and back to a supply wire 44. When a continuing overload condition exists, heater 27 will heat disc 30 which will snap to the left rotating lever arm 33 in a clockwise direction and permitting spring contact arm 12 to move the movable contact 21 out of engagement with contact 22. Since the circuit is now broken, heater 27 and disc 30 will cool down until the inherent differential of disc 30 is exceeded and disc 30 will snap back to the position shown. This sequence will be repeated if the overload condition continues.

Mounted within casing 10 at the left-hand side is a clockwork mechanism generally indicated at 48. The clock mechanism is of conventional design and comprises the usual balance wheel 49, hair spring 50, pallet lever arm 51, escapement wheel 53, and gear train 55 all mounted on a clockwork frame 54. A ratchet wheel 56 is rigidly secured to a shaft 58 journaled in frame 54 while a gear wheel 59 is free to rotate on shaft 58. A pawl 61 pivoted on gear wheel 59 is biased into engagement with ratchet wheel 56 by a spring 62. Pawl 61 allows ratchet wheel to be turned counter-clockwise with respect to gear 59 so that the clock may be wound without moving gear train 55. A leaf spring 65 serves as the main spring of the clock mechanism and has its left-hand end secured to shaft 58. Movement of shaft 58 in a clockwise direction is limited by pin 66 abutting a stop 67 mounted on the clockwork frame.

The right-hand end of spring 65 normally lies beneath post 18, which was previously described as a stop for contact arm 13, thereby tensioning the spring and tending to rotate shaft 58 in a clockwise direction. It will be seen that when the clock mechanism is wound by rotating ratchet wheel 56 in a counter-clockwise direction the right-hand end of spring 65 will be moved nearer to the left-hand edge 19 of post 18. If ratchet wheel 56 is turned counter-clockwise a sufficient amount, the right-hand end of spring 65 will disengage the edge 19 of post 18 and move upward rapidly until it strikes an inclined surface 70 on contact arm 13. This will move contact 22 to the right and out of the range of movement of contact 21 to prevent closure of the contacts.

Pivoted at 72 near the lower end of lever arm 33 is a ratchet arm 75 having a straight portion 76 and a toothed portion 77. A spring 79 biases ratchet arm 75 in a counter-clockwise direction against ratchet wheel 56. It will be seen that when disc 30 is in its cold position, the straight portion 76 of ratchet arm 75 lies over ratchet wheel 56 so that wheel 56 is permitted to rotate in a clockwise direction when pin 66 is not in engagement with stop 67.

Thus when heater 27 becomes excessively hot, disc 30 will be snapped to the left, lever arm 33 will be rotated in a clockwise direction, contact 21 will be moved out of engagement with contact 22, and the toothed portion 77 of ratchet arm 75 will engage ratchet wheel 56 to wind the clock mechanism 48 a predetermined amount. The right-hand end of spring 65 will then be moved one step nearer the edge 19 of post 18 but it will not disengage post 18. Since disc 30 has now started to cool, it will soon return to the cold position as shown and move ratchet arm 75 to a position in which the ratchet wheel 56 will be

permitted to rotate clockwise and permit spring 65 to return the clock mechanism to initial position.

In case an overload condition still exists in the circuit, the above operation will be repeated in a short time so that before the clock mechanism has returned the right-hand end of spring 65 to its initial position beneath post 18 ratchet arm 75 will have operated to wind the clock an additional amount and move the right-hand end of spring 65 closer to the edge 19 of post 18 than it was on the first overload operation of the device. After a predetermined number of successive operations spring 65 will disengage the edge 19 of post 18 to positively open the circuit.

Thus it will be seen that the device will positively open the circuit in case a continued overload condition exists. However, if there is a sufficient interval between overloads in the circuit, clock mechanism 48 will return spring 65 to its initial position and the predetermined number of openings of the circuit due to overload will again be available before the circuit is positively opened.

In order that the device may be reset after it has operated to positively open the circuit, a manual reset mechanism shown in Figure 2 is provided. A manual reset lever 81 extends through the front cover 20 upon which is also mounted post 18 previously described. When successive overload conditions have occurred in the circuit, spring 65 will disengage post 18, strike the inclined portion 82 of the manual reset lever and slide along inclined portion 82 until it strikes inclined portion 70 of contact arm 13 to open the contacts. When spring 65 is in engagement with inclined portion 70 of contact arm 13, it will also lie within a hooked portion 83 of manual reset lever 81. As manual reset lever 81 is rotated clockwise from the position shown in Figure 2, it will serve to move the right-hand end of spring 65 to the right and down in such a path as to clear the end of post 18 and again assume its normal position under post 18. It should be noted that it will be impossible to reset the spring 65 until the clock mechanism 48 has had sufficient time to move spring 65 some distance to the right.

While in the illustrated embodiment, contacts 21 and 22 and heater 27 are located in the same circuit, it will be apparent that the same result could be obtained by locating the contacts in a pilot or control circuit. It is also apparent that the same device can be used as a time switch in which opening of the contacts depends on the length of time current is applied to the heater. Other forms and adaptations of the invention will be apparent to those skilled in the art, and it is to be understood that the scope of the invention is to be determined only by the appended claims.

I claim as my invention:

1. In an overload cut-out, in combination, an electric circuit, a pair of mating contacts in control of said circuit, thermostatic means operable to open the contacts in response to excessive heating of a portion of the electric circuit and to reclose the contacts a predetermined time thereafter, supplemental means movable by the thermostatic means from an initial position to a final position in which operation of the thermostatic means to reclose the contacts will be inhibited, and means adapted to return the supplemental means to initial position if the excessive heating of the portion of the electric circuit

ceases before the supplemental means reaches its final position.

2. In an overload cut-out, in combination, an electric circuit, contacting means in control of said circuit, thermostatic means for causing the contacting means to open in response to excessive heating of a portion of the circuit and to reclose a predetermined time thereafter, and supplemental means movable from an initial position to a final position in which operation of the thermostatic means to reclose the contacting means is inhibited, said thermostatic means controlling the movement of the supplemental means, and the supplemental means being adapted to return to initial position if the excessive heating of the portion of the electric circuit ceases before the supplemental means reaches its final position.

3. In an overload cut-out, in combination, an electric circuit, contacting means in control of said circuit, thermostatic means for causing the contacting means to open in response to excessive heating of a portion of the circuit and to reclose a predetermined time thereafter, supplemental means movable from an initial position to a final position in which operation of the thermostatic means to reclose the contacting means is inhibited, said thermostatic means controlling the movement of the supplemental means, and the supplemental means being adapted to return to initial position if the excessive heating of the portion of the electric circuit ceases before the supplemental means reaches its final position, and manually operable means to return the supplemental means to initial position.

4. In an electric switch, in combination, a pair of contacts, a thermostatic element operatively connected to the contacts to open the contacts at a predetermined high temperature and to close the contacts at a predetermined lower temperature, a member movable from an initial position in steps by action of the thermostatic element to open the contacts to a final position in which it serves to positively open the contacts, and a clockwork constantly tending to move said member to its initial position.

5. An overload cut-out comprising in combination, a spring, a contact adapted to be moved by said spring, thermal timing means for storing energy in said spring in response to an overload condition, a second contact cooperable with said first contact, said second contact being moved by said timing means, and means for slowly dissipating stored energy from said spring when said overload condition is absent.

6. An overload cut-out comprising in combination, a resilient means, a contact adapted to be moved by said resilient means, thermal timing means for storing energy in said resilient means in response to an overload condition, a second contact cooperable with said first contact, said second contact being moved by said timing means, and means for slowly dissipating stored energy from said resilient means when said overload condition is absent.

7. In an electric switch, in combination, a pair of cooperating electrical contacts, a thermostatic element operatively connected to one of said contacts to open the contacts at a first predetermined temperature and to close the contacts at a second predetermined temperature, a ratchet member moved by said element, a ratchet wheel

cooperable with said member, clockwork mechanism connected to said wheel and adapted to be wound thereby when said wheel is moved by said member, and a main spring secured to said wheel at one end and adapted to be tensioned thereby when said mechanism is wound, the other end of said spring engaging a stop in a manner so that said spring can move away from said stop when said mechanism is wound beyond a predetermined degree, said last end of said spring being adapted upon disengaging said stop to engage the second of said contacts and move it to a position wherein closure of said contacts will be inhibited.

8. In an electric switch, in combination, a pair of cooperating electrical contacts, a thermostatic element operatively connected to one of said contacts to open the contacts at a first predetermined temperature and to close the contacts at a second predetermined temperature, a ratchet member moved by said element, a ratchet wheel cooperable with said member, time delay means connected to said wheel, and a spring secured at one end to said wheel and having a free end, said free end of said spring being adapted to actuate the second of said contacts and move it to a position wherein closure of said contacts will be inhibited.

9. In an electric switch, in combination, a pair of cooperating electrical contacts, a thermostatic element operatively connected to one of said contacts to open the contacts at a first predetermined temperature and to close the contacts at a second predetermined temperature, and spring means tensioned by the movement of said element, said spring means being adapted to move the second of said contacts to a position wherein closure of said contacts will be inhibited.

10. In an electric switch, in combination, a pair of cooperating electrical contacts, automatic means including a member, said member operating to open and close said contacts in response to an overload condition, and a spring, said spring being tensioned by said automatic means and operable upon a predetermined number of successive overload conditions to move one of said contacts to a position wherein closure of said contacts will be inhibited.

11. In an electric switch, in combination, a pair of cooperating electrical contacts, a thermostatic element operatively connected to one of said contacts to open the contacts at a first predetermined temperature and to close the contacts at a second predetermined temperature, spring means tensioned by the movement of said element, said spring means being adapted to move the second of said contacts to a position wherein closure of said contacts will be inhibited and time delay means for causing said spring means to return slowly to its initial position.

12. In an electric switch, in combination, a pair of cooperating electrical contacts, automatic means including a member, said member operating to open and close said contacts in response to an overload condition, a spring, said spring being tensioned by said automatic means and operable upon a predetermined number of successive overload conditions to move one of said contacts to a position wherein closure of said contacts will be inhibited, and time delay means for causing said spring to return slowly to its initial position.

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