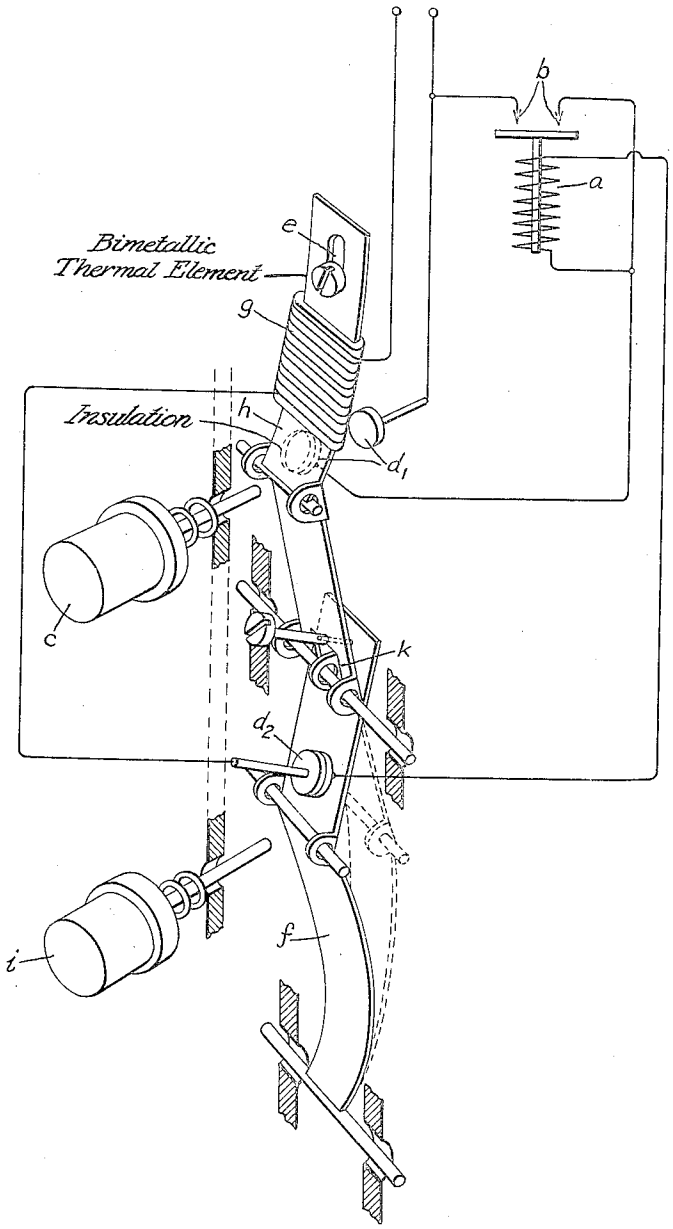
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CIRCUIT CONTROLLING DEVICE

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CIRCUIT CONTROLLING DEVICE

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My invention relates to circuit controlling devices and has for its object to provide an improved form of circuit controlling device capable of both time delay and instantaneous operation.

While not necessarily limited thereto the present invention is particularly advantageous in a combined instantaneous manual control and time element undervoltage protective switch.

It has been proposed heretofore to provide switches for electric machines with an undervoltage release, so that with the absence of voltage the machine is disconnected from the system. In order to avoid needless disconnection of the machines in the case of every short failure of the voltage, the undervoltage protective switches for the machines have been provided with mechanical devices which after the failure of the voltage open the connecting contacts only after the running down of a clock mechanism adjusted to a predetermined time. If the voltage returns within this time, then the machine remains connected. Such clock mechanism timing devices are very complicated, large and expensive, especially if the running down time is long.

By means of the present invention, the requirements of simplicity, smallness and also adjustability for a switch with automatic undervoltage time element release on voltage are fulfilled by arranging for opening or closing the switch contacts with delay by means of the change in temperature of a thermal element, for example, of a bimetallic strip, hot wire or the like in response to undervoltage conditions. The thermal element in accordance with the invention is arranged to be heated by a heating winding which is energized responsively to the system voltage. In the fully heated condition the thermal element maintains the contacts closed and upon the occurrence of undervoltage conditions, the contacts remain closed for a short time. If, during this time, the voltage returns to normal then the machine remains connected, but otherwise it is disconnected from the system.

Where it is desired to use the same switch contacts also for manual control to effect the unretarded disconnection of the machine, then the difficulty is encountered that after a manual operation lasting only a short time the heat element has not cooled down and in consequence the contacts will return again into their original position so that the machine again becomes connected. In order to avoid this difficulty, according to the invention, the switch is arranged so that in case of manual operation, a pawl, tension spring, or the like is actuated to hold or lock the switch contacts in the open position. In order that the locking may be securely effected, special interrupting contacts are arranged upon the actuation of which the locking device is brought into its position for locking the main switching-in contacts. To permit reswitching in, the arrangement is so made that with the actuation of the switching-in contacts the locking is released.

In the drawing the single figure shows diagrammatically a combined manual and undervoltage time element switch embodying the invention. In this case the combined manual and undervoltage switch is not intended to connect and disconnect the machine directly but by means of the switch magnet a.

The switch is represented in its disconnected position as occurs when the switch has opened automatically in response to undervoltage conditions. The switching-in contacts d_1 are open and the disconnecting contacts d_2 are closed. The switching-in contacts d_1 and the disconnecting contacts d_2 are connected with one another by individual members in such a manner that when the disconnecting contacts are closed the switching-in contacts can be opened and closed independently of them. The switching-in contact d_1 carried on the bimetallic thermal element h is electrically insulated therefrom as indicated in the drawing and the disconnecting contact d_2 carried on the spring member f also may be insulated therefrom in a similar manner.

In operation the push button c is pressed, so that the contacts d_1 become closed. Thereby a circuit is established from "+" through the heating winding g for the bimetallic

spring h, the disconnecting contacts d_2, the coil of the switching magnet a and the connecting contacts d_1 to "−". The switch magnet switches in and thereby closes its self-holding contact b, so that the press-knob c can be again released and the switching-in contacts d_1 be again opened. The current for the switch magnet then flows through the self-holding contacts b in place of through d_1. However, soon after the switching-in, the bimetallic spring h is heated by the heating winding g in such a manner that it snaps over and closes again the switching-in contacts d_1.

Now, if the actuating voltage is absent for a short time, then the heated bimetallic spring holds the contacts d_1 closed and the magnet a remains connected. If, however, the voltage is absent for a longer period, then the bimetallic spring cools down and opens the switching-in contacts d_1 with a snap movement. Since with the absence of the voltage the self-holding contacts b of the switch magnet a open, upon the return of the voltage there is no exciting circuit for magnet a so that the switching-in has to be effected anew. By means of the adjustment e the tension of the bimetallic spring may be varied so as to control the period required to effect the snapping over. In this way the time can be varied within wide limits.

If the switch magnet a is to be disconnected without retardation, then the disconnecting push knob i is pressed. Thereby the spring f is brought into the position indicated by the broken lines and the disconnecting contacts d_2 are opened. The disconnecting and switching-in contacts are coupled with one another through a connecting member at k in such a manner that with the opening of the disconnecting contacts, the connecting member is also raised and thereby the switching-in contacts d_1 are opened. Through the opening of d_2 and d_1 the switch magnet a is disconnected. The spring f is bent in such a manner that it has two stable positions of rest, the one position is indicated in full lines and the other in broken lines. After the release of push knob i, the spring f remains in its second stable position in which its energy is sufficient to act in opposition to the energy of the heated bimetallic spring h and it is thus able to keep the switching-in contacts open. With the reswitching-in by pressing the press-knob c, the spring f is also brought back again into the first stable position. The opening and closing of the connecting and disconnecting contacts need not be effected by a snap movement as described but can take place steadily. Also, if desired, the heating winding can be connected to an appropriate transformer (bell transformer) or the element be heated in any other suitable manner. The spring f and the bimetallic spring h of course can also be replaced by other similar elements, if desired.

What I claim as new and desire to secure by Letters Patent in the United States is:

1. A combined time delay and instantaneous circuit controlling device including a switch, means for closing the switch, a movable thermal element having electrical heating means connected to be energized upon closure of the switch, mechanical connections between said thermal element and said switch for biasing the switch to the closed position when the thermal element becomes heated and for controlling the opening of the switch with a time delay dependent upon the cooling of the thermal element, and means for opening the switch instantaneously and maintaining the same open independently of the time delay control of the thermal element.

2. In a circuit controlling device, the combination of a switch, a thermal element for operating the switch from a predetermined position to another position when the thermal element becomes heated and for returning the switch to said predetermined position with a time-delay dependent upon the cooling of the thermal element, heating means for the thermal element controlled by the switch, and means for operating the switch to and maintaining the same in said predetermined position independently of the control of the thermal element.

3. A time element undervoltage circuit protective device comprising a switch, a thermal element for holding the switch closed when the thermal element becomes heated and for controlling the opening of the switch with a time delay dependent upon the cooling of the element, an electrical heating means for the thermal element connected to be energized responsively to the voltage of the circuit upon the closure of the switch, and means for opening the switch and maintaining the same open independently of the control of the thermal element.

4. A time delay undervoltage circuit protective device comprising a control switch, manual means for closing said switch, a thermal element for biasing the switch to the closed position when the thermal element becomes heated and for controlling the opening of the switch with a time delay dependent upon the cooling of the element, electrical heating means for the thermal element connected to be energized responsively to the voltage of the circuit upon the closure of the switch, and manually operable means for opening the switch and maintaining the same open independently of the control of the thermal element.

5. A time element undervoltage circuit protective device comprising a control switch, manual means for closing the switch, a thermal element for biasing the switch to the closed position when the thermal element be-

comes heated and for controlling the opening of the switch with a time delay dependent upon the cooling of the element, heating means for the thermal element connected to be energized responsively to the voltage of the circuit upon the closure of the switch, an electromagnetic switch connected to be energized upon the closure of the control switch for maintaining said heating means energized, and manually operable means for opening the control switch and maintaining the same open independently of the control of the thermal element.

6. In a circuit controlling device, the combination of a switch, a thermal element for operating the switch from a predetermined position to another position when the thermal element becomes heated and for returning the switch to said predetermined position upon the cooling of the thermal element, means for operating the switch from said predetermined position to said other position independently of the thermal element and means for operating the switch to and maintaining the same in said predetermined position independently of the control of the thermal element.

7. In a circuit controlling device, the combination of a switch, a thermal element for biasing the switch to the closed position when the thermal element becomes heated and for controlling the opening of the switch upon the cooling of the element, means effective upon the closing of the switch for heating the thermal element, means independent of the thermal element for closing the switch, and means for opening the switch and maintaining the same open independently of the control of the thermal element.

8. A time element undervoltage circuit protective device comprising a thermal responsive switch having an electrical heating coil, means for closing the switch independently of the operation of the heating coil, an electromagnetic switch connected to be energized upon closure of the thermal switch and having contacts connected to establish an energizing circuit for said heating coil to render said thermal switch effective to control the deenergization of the electromagnetic switch with a time delay dependent upon the cooling of said thermal switch responsively to a sufficient drop in the voltage of said energizing circuit to reduce the heating effect of said heating coil, and a switch for deenergizing said heating coil independently of said drop in voltage.

9. A time element undervoltage circuit protective device comprising an electromagnetic switch, a normally open control switch operable to the closed position to establish an energizing circuit for the electromagnetic switch, a thermal responsive element having electrical heating means connected to be heated upon closure of the magnetic switch for biasing the normally open control switch to the closed position and maintaining the same therein responsively to the voltage of the energizing circuit of the electromagnetic switch, and means for opening the control switch against the bias of said thermal element and maintaining the same open during the cooling of said thermal element.

10. A time element undervoltage circuit protective device comprising an electromagnetic switch, a normally open control switch operable to the closed position to establish an energizing circuit for the electromagnetic switch, a thermal responsive element having electrical heating means connected to be heated upon closure of the magnetic switch for biasing the normally open control switch to the closed position and maintaining the same therein responsively to the voltage of the energizing circuit of the electromagnetic switch, a normally closed control switch connected in the heating circuit of said thermal element and having means for biasing the switch to the open position upon operation thereto, and means associated with said normally open control switch for operating the second control switch to the closed position upon closure of said first control switch.

11. In a circuit controlling device, the combination of a switch, an electrically heated thermal element for operating the switch between two positions dependent upon the heating and cooling of the thermal element, a second switch for controlling the heating and cooling of the thermal element, and connections between the said switches whereby upon the opening of the second switch, the first switch is opened and upon the closure of the first switch, the second switch is closed.

12. In a circuit controlling device, the combination of a switch, a thermal element for operating the switch, a second switch mechanically connected with the first switch to be operated to the closed position when the first switch is closed, means for closing the first switch independently of the operation of the thermal element, and an electrical heating circuit for the thermal element jointly controlled by the two switches.

13. In a circuit controlling device, the combination of a switch, a thermal element for operating the switch, a second switch mechanically connected with the first switch to be operated to the closed position when the first switch is closed, means for closing the first switch independently of the operation of the thermal element, and an electrical heating circuit for the thermal element jointly controlled by the two switches and having included therein an electromagnetic switch connected to be energized upon closure of said first switch.

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