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A. E. ANDERSON

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CIRCUIT BREAKER CONTROL SYSTEM

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Fig. 1.

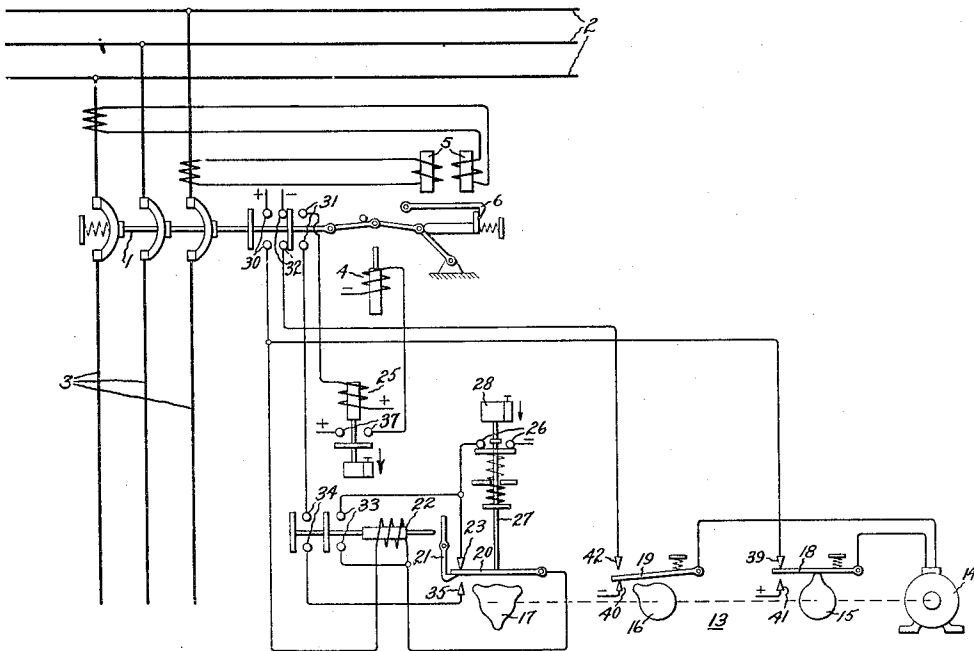


Fig. 3.

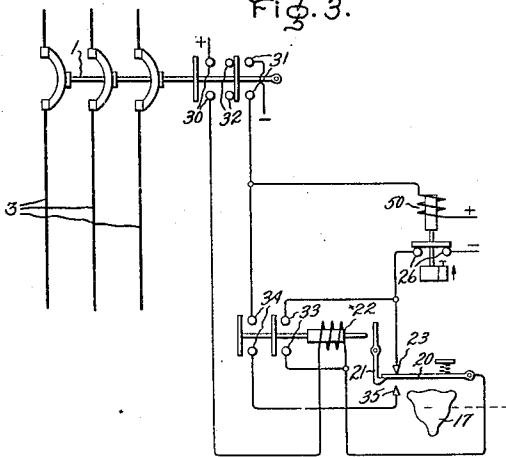
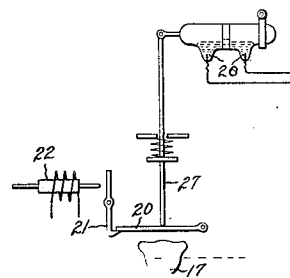


Fig. 2.



Inventor:
Arvid E. Anderson,
by *Harry E. Dinkham*
His Attorney.

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CIRCUIT BREAKER CONTROL SYSTEM

Arvid E. Anderson, Drexel Hill, Pa., assignor to
General Electric Company, a corporation of
New York

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8 Claims. (Cl. 175-294)

My invention relates to circuit breaker control systems and particularly to systems for controlling the closing of a circuit breaker, and one object of my invention is to provide an arrangement for limiting the time that the closing circuit of a circuit breaker remains energized in case the circuit breaker fails to close in response to the energization of the circuit.

In certain types of automatic circuit breaker reclosing systems, it is the practice to effect the initial reclosure as quickly as possible after the circuit breaker opens. When such a system is used with a circuit breaker that is not provided with a latch checking switch, there is the possibility that the closing circuit may be completed before the latching means of the circuit breaker has reset. When this occurs, the closing circuit remains energized for a relatively long time without effecting the closing of the circuit breaker. If the circuit breaker closing means is of the intermittently rated type, this relatively long energization of the closing circuit may result in the burning out of the operating coil of the closing means, which is connected in the closing circuit. In accordance with my invention, I provide an arrangement for limiting the time that the circuit breaker closing circuit remains energized in case the circuit breaker fails to close in response to the energization of the circuit.

My invention will be better understood from the following description when taken in connection with the accompanying drawing, Fig. 1 of which diagrammatically illustrates an automatic reclosing circuit breaker system embodying my invention, and Figs. 2 and 3 illustrate modifications of the timing means which may be employed to effect the opening of the circuit breaker closing circuit, and its scope will be pointed out in the appended claims.

Referring to Fig. 1 of the drawing, 1 represents a circuit breaker which connects a suitable source of current such as a polyphase alternating current supply circuit 2 to a polyphase load circuit 3. The circuit breaker 1 is shown as a latched-in circuit breaker having a closing coil 4 which, when energized, closes the circuit breaker 1, and over-current trip coils 5 which are arranged to be energized respectively in accordance with the current flowing in different phases of the load circuit 3 and which, when sufficiently energized, releases a latch 6 that holds the circuit breaker in its closed position.

For effecting the automatic reclosing of the circuit breaker 1, I provide a motor-driven timer 13 which is arranged to be set into operation

when the circuit breaker 1 opens. In the particular arrangement diagrammatically shown, the timer 13 comprises a motor 14 driving three cams 15, 16, and 17, which respectively operate movable contacts 18, 19, and 20. The movable contacts 18, 19, and 20 are shown in the positions they occupy when the circuit breaker 1 is closed under normal load conditions. It will be noted that under these conditions the movable contact 20 is held in engagement with the stationary contact 23 by a latch 21 which is arranged to be released by a magnet 22, the circuit of which is completed through auxiliary contacts 30 on the circuit breaker 1 as soon as it opens. The magnet 22 also controls contacts in the closing circuit of the control relay 25 so that this relay is energized immediately after the circuit breaker 1 opens, to effect an immediate reclosure of the circuit breaker, since the relay 25 when energized completes an energizing circuit for the closing coil 4 of the circuit breaker 1.

In accordance with my invention, I provide in the closing circuit of the control relay 25 the normally closed contacts 26 and provide suitable timing means for effecting the opening of these contacts 26 after the closing circuit has been completed, for a sufficient length of time to effect under normal conditions the closing of the circuit breaker 1. As shown in Fig. 1, the movement of the movable contact 20, when released by the magnet 22, allows the spring-actuated rod 27 to move downwardly against the force exerted by a suitable retarding means, such as a dashpot 28, to open the contacts 26 a predetermined time after the magnet 22 is energized.

The operation of the arrangement shown in Fig. 1 is as follows: When the circuit breaker 1 is closed and the current supplied to the load circuit 3 through the circuit breaker 1 is below a predetermined value the various devices are in the positions shown in the drawing. When an overload occurs on the load circuit 3, one or both of the over-current trip coils 5 become sufficiently energized to release the latch 6 and thereby effect the opening of the circuit breaker 1 so that its auxiliary contacts 30 and 31 are closed and its auxiliary contacts 32 are open. The closing of the contacts 30 completes an energizing circuit for the magnet 22 through the movable contact 20 and the stationary contact 23 of the timer 13 and the contacts 26. By closing its contacts 33, the magnet 22 completes a locking circuit for itself which is independent of the movable contact 20 and the stationary contact 23 so that when these contacts are subsequently separated,

the energizing circuit of the magnet 22 is not interrupted. By actuating the latch 21, the magnet 22 releases the movable contact 20 so that it immediately moves out of engagement with stationary contact 23 and into engagement with stationary contact 35. A circuit is then completed for the control relay 25 through the auxiliary contacts 31 of the circuit breaker 1, the contacts 34 of the magnet 22, contacts 35 and 20 of the timer 13, contacts 33 of the magnet 22, and the contacts 26. By closing its contacts 37, the relay 25 completes an energizing circuit for the closing coil 4 to effect a substantially instantaneous reclosure of the circuit breaker 1.

The closing of the contacts 30 when the circuit breaker 1 opens also completes a starting circuit for the driving motor 14 of the timer 13 through the stationary contact 39 and the movable contact 18 of the timer 13, the driving motor 14, and the movable contact 19 and the stationary contact 40 of the timer 13. Immediately after the motor 14 starts, the cam 15, which is rotated in a counter-clockwise direction, causes the movable contact 18 to move out of engagement with contact 39 and into engagement with contact 41 so as to maintain an energizing circuit for the motor 14 completed after the circuit breaker 1 closes.

If the circuit breaker 1 remains closed after the initial reclosure, the operation of the timer 13 effects no change in the energization of the circuits until the timer reaches its lockout position, in which position the cam 16 moves the movable contact 19 out of engagement with the contact 40 so that the circuit of the motor 14 is interrupted and moves the contact 19 into engagement with the contact 42. Since the circuit breaker 1 is closed, the circuit of the motor 14 is then closed through the auxiliary contacts 32 on the circuit breaker 1 to complete an energizing circuit for the motor 14 so that the timer is moved to its normal position, in which position the circuit of the motor 14 is open at the auxiliary contacts 30 of the circuit breaker 1.

If the abnormal condition still exists on the load circuit 3 when the circuit breaker 1 recloses, the trip coil 5 is again energized sufficiently to effect the immediate opening of the circuit breaker 1. The circuit breaker 1 is not immediately reclosed after this opening because the movable contact 20 is now in engagement with contact 35 instead of being held in engagement with contact 23 by the latch 21. The circuit breaker 1 remains open until the timer has been in operation for a sufficient length of time for the cam 17 to effect first the movement of the movable contact 20 into engagement with contact 23 so as to complete the above-described energizing circuit for the magnet 22 and then has effected the movement of the movable contact 20 into engagement with contact 35 to complete the above-described energizing circuit of the control relay 25 to effect the reclosing of the circuit breaker 1.

If the circuit breaker fails to remain closed after its second reclosure, the motor-operated timer 13, in the particular arrangement shown in the drawing is arranged to effect another reclosure of the circuit breaker in the manner above-described. When the timer reaches its lockout position, contacts 19 and 40 are opened and 19 and 42 closed. If the circuit breaker 1 is open, the energizing circuit of the motor 14 is open at the auxiliary contacts 32 of the open

circuit breaker 1 so that the timer remains in this lockout position.

If for any reason the latch 6 fails to reset before the closing coil 4 is energized after the circuit breaker 1 opens, the energization of the closing coil 4 does not effect the closing of the circuit breaker 1 and consequently the magnet 22 and the control relay 25 and the closing coil 4 remain energized. A predetermined time after the movable contact 20 moves out of engagement with the contact 23, the spring-actuated rod 27 effects the opening of the contacts 26 in the circuits of the magnet 22 and the control relay 25 so as to effect the deenergization of these electromagnetic responsive devices as well as the closing coil 4 in order to prevent any of them from being damaged due to overheating. The dashpot 28 is adjusted so that the contacts 26 open substantially immediately after the closing circuit has remained energized long enough to effect normally the closing of said circuit breaker. When the cam 17 again moves the movable contact 20 into engagement with the contact 23, it also restores the spring actuated rod 27 to its normal position so that the contacts 26 are closed to permit the timer 13 to attempt another reclosure of the circuit breaker.

In the modification shown in Fig. 2, the contacts 26 are shown as contacts of a time delay mercury switch, examples of which are well known in the art, which is arranged to be tilted by the actuation of the spring-actuated rod 27 so that when the contact 20 is moved out of engagement with contact 23, the switch is tilted in such a manner that the mercury moves away from the contacts 26 through a small orifice and after a predetermined time opens the circuit through these contacts.

In the modification shown in Fig. 3, the contacts 26 are shown as contacts of a time delay relay 50 which may be of any suitable type, examples of which are well known in the art. The circuit of this relay 50 is completed when the contacts 34 of the magnet 22 are closed and the movable contact 20 of the timer 13 is in engagement with the contact 35.

While I have, in accordance with the patent statutes, shown and described my invention as applied to a particular system and as embodying various devices diagrammatically indicated, changes and modifications will be obvious to those skilled in the art, and I therefore aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

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

1. In combination, a circuit breaker, a closing circuit, means responsive to the energization of said circuit for effecting the closing of said circuit breaker, means responsive to the closing of said circuit breaker for opening said circuit, means for opening said circuit breaker, and means responsive to the opening of said circuit breaker for effecting the energization of said closing circuit and the opening of said circuit substantially immediately after said circuit has remained energized long enough to effect normally the closing of said circuit breaker.

2. In combination, a circuit breaker, a closing circuit, means responsive to the energization of said circuit for effecting the closing of said circuit breaker, means responsive to the closing of said circuit breaker for opening said circuit, means for opening said circuit breaker, normally closed

contacts in said circuit, means responsive to the opening of said circuit breaker for energizing said circuit, and timing means for opening said contacts a predetermined time after said circuit is energized.

3. In combination, a circuit breaker, a closing circuit, means responsive to the energization of said circuit for effecting the closing of said circuit breaker, means responsive to the closing of said circuit breaker for opening said circuit, means for opening said circuit breaker, normally closed contacts in said circuit, reclosing means responsive to the opening of said circuit breaker for effecting an immediate energization of said circuit, and timing means responsive to the operation of said reclosing means for opening said normally closed contacts a predetermined time after said circuit is energized.

4. In combination, a circuit breaker, a closing circuit, means responsive to the energization of said circuit for effecting the closing of said circuit breaker, means responsive to the closing of said circuit breaker for opening said circuit, means for opening said circuit breaker, normally closed contacts in said circuit, reclosing means responsive to the opening of said circuit breaker for effecting a plurality of energizations of said circuit with predetermined time intervals between successive energizations, and timing means operative after each energization of said circuit to effect the opening of said normally closed contacts.

5. In combination, a circuit breaker, a closing circuit, means responsive to the energization of said circuit for effecting the closing of said circuit breaker, means responsive to the closing of said circuit breaker for opening said circuit, means for opening said circuit breaker, normally closed contacts in said circuit, means for biasing said contacts to their open position, a latch for holding said contacts in their closed position, means for delaying the opening of said contacts when said latch is released, and means responsive to the opening of said circuit breaker for effecting the reclosure of said circuit breaker and the release of said latch.

6. In combination, a circuit breaker, a closing circuit, means responsive to the energization of said circuit for effecting the closing of said circuit breaker, means responsive to the closing of said circuit breaker for opening said circuit, means for opening said circuit breaker, normally closed contacts in said circuit, means for biasing said contacts to their open position, a latch for holding said contacts in their closed position, means for delaying the opening of said contacts when said latch is released, means responsive to the opening of said circuit breaker for effecting a plurality of energizations of said circuit with predetermined time intervals between successive energizations, and means responsive to each energization of said circuit for effecting the release of said latch.

7. In combination, a circuit breaker, a closing circuit, means responsive to the energization of said circuit for effecting the closing of said circuit breaker, means responsive to the closing of said circuit breaker for opening said circuit, means for opening said circuit breaker, normally closed contacts in said circuit, means responsive to the opening of said circuit breaker for effecting a plurality of energizations of said circuit with predetermined time intervals between successive energizations, and means responsive to each energization of said circuit for effecting the opening of said normally closed contacts after a predetermined time.

8. In combination, a circuit breaker having intermittently rated closing means, means responsive to the closing of said circuit breaker for rendering said closing means inoperative, means for opening said circuit breaker, and means responsive to the opening of said circuit breaker for effecting the operation of said closing means and for rendering said closing means inoperative substantially immediately after said closing means has been in operation long enough to effect normally the closing of said circuit breaker.

ARVID E. ANDERSON.