

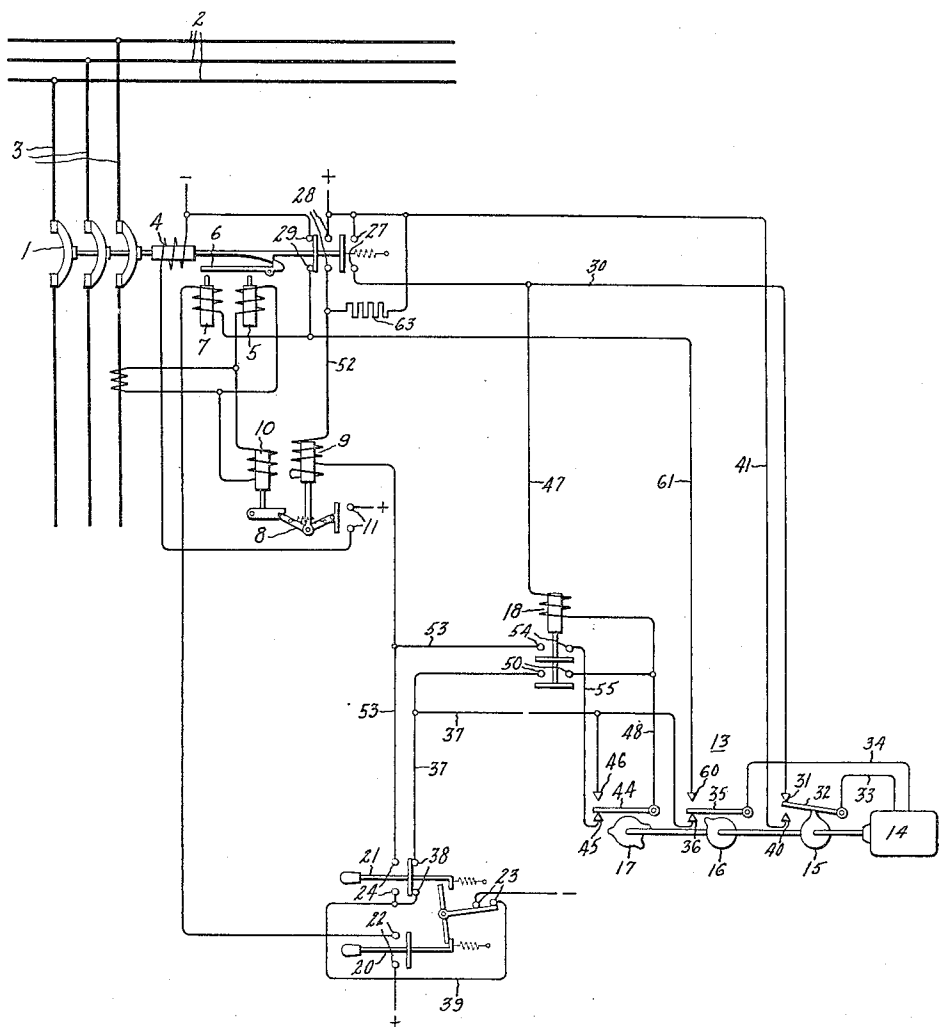
Sept. 25, 1934.

A. E. ANDERSON

1,974,978

AUTOMATIC RECLOSING CIRCUIT BREAKER SYSTEM

Filed Nov. 17, 1933



Inventor:
Arvid E. Anderson,
by Harry E. Dunham
His Attorney.

UNITED STATES PATENT OFFICE

1,974,978

AUTOMATIC RECLOSING CIRCUIT
BREAKER SYSTEMArvid E. Anderson, Drexel Hill, Pa., assignor to
General Electric Company, a corporation of
New York

Application November 17, 1933, Serial No. 698,487

5 Claims. (Cl. 175-294)

My invention relates to automatic reclosing circuit breaker systems and particularly to such a system employing means for automatically reclosing a circuit breaker a plurality of times with predetermined time intervals between successive reclosures of the circuit breaker and for preventing any further automatic reclosures of the circuit breaker if it fails to remain closed after a predetermined number of automatic reclosures. In such a system suitable manually controlled means are usually provided whereby the closing of the circuit breaker may be effected and the automatic reclosing apparatus again rendered operative after it has been locked out by the automatic reclosing apparatus and one object of my invention is to provide an improved circuit arrangement in such a system whereby pumping of the circuit breaker is prevented in case the circuit breaker is reclosed in response to the operation of the manually controlled apparatus at a time when there is a fault on the electric circuit controlled by the circuit breaker.

My invention will be better understood from the following description when taken in connection with the accompanying drawing which diagrammatically illustrates an automatic reclosing circuit breaker system embodying my invention and its scope will be pointed out in the appended claims.

In the accompanying drawing, 1 represents a circuit breaker which connects a suitable source of current, such as an alternating current supply circuit 2, to an alternating current feeder circuit 3. The circuit breaker 1 may be of any suitable type, examples of which are well known in the art. In the particular embodiment of my invention illustrated, I have shown a circuit breaker of the well known latched-in type including a closing coil 4 which, when energized, closes the circuit breaker 1, an overcurrent trip coil 5 which is energized in accordance with the current flowing through the circuit breaker 1 and which, when sufficiently energized, releases a latch 6 which holds the circuit breaker in its closed position and a remote control trip coil 7 which, when energized, also trips the latch 6. The circuit breaker 1 is also provided with suitable means, examples of which are well known in the art, whereby the circuit breaker is trip-free, namely will open and remain open although the control means, which is operated to effect the closing thereof, is still in its closing position. In the particular embodiment shown, I accomplish this result by making the hesitating control relay 8, which controls the circuit of the closing coil 4, trip-free.

This relay 8 is constructed in a manner well known in the art so that, when its operating coil 9 is energized and its trip coil 10 is deenergized, the relay will close its contacts 11. However, if the trip coil 10 is energized sufficiently while the coil 9 is energized, the relay contacts 11 are opened and it is necessary to deenergize the operating coil 9 and trip coil 10, and reenergize operating coil 9 before the contacts 11 can be reclosed. The trip coil 10 may be connected in any well known manner so that its energization is controlled by the predetermined abnormal condition which it is desired shall effect the opening of the circuit breaker 1. In the arrangement shown, the trip coil 10 of the relay 8 is connected to the feeder circuit 3 in such a manner that it operates in response to predetermined abnormal current in the feeder circuit to effect the opening of the contacts 11. Therefore, it will be seen that, although the operating winding 9 remains energized after the closing of the circuit breaker 1, this circuit breaker will open immediately in case it is reclosed on a short circuit.

For effecting the automatic reclosing of the circuit breaker a predetermined number of times and for locking it out if it fails to remain closed after a predetermined number of reclosures, I provide a motor driven timer 13, examples of which are well known in the art, which is arranged to be set into operation when the circuit breaker opens. In the particular arrangement shown, the timer 13 comprises a motor 14 for driving three cams 15, 16 and 17 which respectively control the operation of suitable contacts associated therewith in a predetermined sequence so as to effect the desired operation of the circuit breaker 1. Associated with the timer 13 is an auxiliary relay 18 which is controlled by the timer to effect the energization of the operating relay 9 of the control relay 8.

In order to control the opening and closing of the circuit breaker manually, I provide the manually controlled switches 20 and 21. The switch 20 is a trip switch and the normally open contacts 22 of this switch are connected in the circuit of the trip coil 7 so that whenever the circuit breaker 1 is closed and the switch 20 is operated the trip coil 7 is energized to effect the opening of the circuit breaker 1. In order to prevent the timer 13 from starting when the circuit breaker is opened by the operation of the switch 20, this switch is also arranged to open contacts 23 which are in the circuit of the motor 14 of the motor driven timer 13. The switch 21 is a closing switch and is arranged, when operated, to complete through its contacts 24 an energizing circuit for the operating

winding 9 of the control relay 8 provided the circuit breaker 1 is in its open position. The switch 21 is also arranged, whenever it is operated, to effect the closing of the contacts 23 so that the timer 13 is again operative to control the automatic reclosing of the circuit breaker, as soon as the switch 21 is released.

The operation of the arrangement shown in the drawing is as follows: When the circuit breaker 1 is closed and the current fed to the feeder circuit 3 through the circuit breaker 1 is below a predetermined value, the control apparatus is in the condition shown. When an overload occurs on the feeder circuit 3, the overcurrent trip coil 5 is sufficiently energized to release the latch 6 thereby effecting the opening of the circuit breaker 1 so that its auxiliary contacts 27 and 28 are closed and its auxiliary contacts 29 are open. The closing of the auxiliary contacts 27 completes an energizing circuit for the motor 14 to start the motor driven timer 13 into operation. This circuit is from one side of a suitable source of control current through the auxiliary contacts 27 on the circuit breaker 1, conductor 30, contacts 31 and 32 of the timer 13, conductor 33, motor 14, conductor 34, contacts 35 and 36 of the timer 13, conductor 37, contacts 38 of control switch 21, conductor 39, contacts 23 to the other side of the control circuit.

Immediately after the motor 14 starts, the cam 15 causes contacts 32 and 31 to open and contacts 32 and 40 to close so that a circuit is completed for the motor 14 around the auxiliary contacts 27 of the circuit breaker 1.

After the motor 14 has been in operation for a predetermined time, the cam 17 opens the normally closed set of contacts 44 and 45 and closes the set of contacts 44 and 46 thereby completing an energizing circuit for the auxiliary relay 18 associated with the timer 13. This energizing circuit is from one side of the control circuit through auxiliary contacts 27 on the circuit breaker 1, conductor 47, coil of relay 18, conductor 48, contacts 44 and 46 of timer 13, conductor 37, contacts 38 of switch 21, conductor 39, contacts 23 to the other side of the control circuit. Relay 18 by closing its contacts 50 completes a locking circuit for itself which is independent of the contacts 44 and 46 of the timer 13 so that the relay 18 is not deenergized by the subsequent opening of these contacts.

Further movement of the cam 17 then effects the opening of the contacts 44 and 46 and the reclosing of the contacts 44 and 45 thereby completing an energizing circuit for the operating coil 9 of the hesitating control relay 8. This circuit is from one side of the control circuit through auxiliary contacts 28 on the circuit breaker 1, conductor 52, operating coil 9 of relay 8, conductor 53, contacts 54 of the relay 18, conductor 55, contacts 44 and 45 of timer 13, conductor 48, contacts 50 of relay 18, conductor 37, contacts 38 of the switch 21, conductor 39, contacts 23 to the other side of the control circuit.

Relay 8, by closing its contacts 11, completes an energizing circuit for the closing coil 4 to effect the closing of the circuit breaker 1. By opening its auxiliary contacts 27, the circuit breaker 1 effects the deenergization of the relay 18 which, in turn, by opening its contacts 50 and 54 interrupts its own energizing circuit and the energizing circuit for the operating coil 9 of the hesitating control relay 8. The contacts 11 of this relay, however, remain closed long enough to

insure that the closing operation of the circuit breaker is completed.

If the abnormal circuit condition still exists on the feeder 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 and also causes the trip coil 10 of the hesitating control relay 8 to effect the immediate opening of the contacts 11.

After the timer has been in operation for a second predetermined time interval, the cam 17 again effects the opening of the contacts 44 and 45, closing of the contacts 44 and 46 and the subsequent closing of the contacts 44 and 45 to effect the energization of the relay 18 and the closing of the circuit breaker 1 in the manner above described, if it is open at such time. After a third predetermined time interval, the cam 17 again effects the operation of the contacts 44, 45 and 46 in the manner above described to close the circuit breaker 1 if it opens a third time. In this manner it will be seen that the motor operated timer 13 can effect the reclosing of the circuit breaker 1 a predetermined number of times, which in the particular arrangement shown is three, during one revolution of the cam 17.

After the cam 17 has effected the operation of the contacts 44, 45 and 46 for the third time and just before the timer 13 is restored to its normal position, the cam 16 opens the contacts 35 and 36 and closes the contacts 35 and 60 thereby opening the energizing circuit of the driving motor 14 which was completed through the contacts 35 and 36. If the circuit breaker 1 is open at the time the contacts 35 and 60 are closed, the timer remains in that position, which is called the lockout position. However, if the circuit breaker 1 is closed at the time the contacts 35 and 60 are closed, a circuit is completed for the motor 14 which then operates to move the timer 13 from the lockout position to the normal position. This circuit of the motor is from one side of the control circuit through conductor 41, contacts 40 and 32 of the timer 13, conductor 33, motor 14, conductor 34, contacts 35 and 60 of the timer 13, conductor 61, auxiliary contacts 29 on circuit breaker 1 to the other side of the control circuit. When the timer leaves its lockout position, cam 16 opens the contacts 35 and 60 and closes the contacts 35 and 36 so as to restore the original circuit for the motor 14 which then operates to restore the timer 13 to its normal position. When the timer 13 reaches its normal position, the circuit of the motor 14 is opened by the cam 15 opening the contacts 32 and 40 and closing the contacts 31 and 32 since the circuit through the contacts 31 and 32 is open at the auxiliary contacts 27 of the closed circuit breaker 1.

After the circuit breaker has been locked out, it may be reclosed by operating the control switch 21 so that it closes its contacts 24 and opens its contacts 38. The closing of the contacts 24 completes an energizing circuit for the operating coil 9 of the hesitating control relay 8 from one side of the control circuit through auxiliary contacts 28 on the circuit breaker 1, conductor 52, operating coil 9 of relay 8, conductor 53, contacts 24 of switch 21, conductor 39, contacts 23 to the other side of the control circuit. Relay 8 by closing its contacts 11 completes an energizing circuit for the closing coil 4 to effect the closing of the circuit breaker 1.

If the abnormal condition still exists on the feeder circuit 3 and the circuit breaker 1 is reclosed in response to the operation of the control

switch 21, the overcurrent trip coil 5 is again sufficiently energized to effect the opening of the circuit breaker 1 and the trip coil 10 of the hesitating control relay 8 is also sufficiently energized to effect the opening of the contacts 11, although the circuit of the operating winding 9 may still be maintained at the contacts 24 of the control switch 21. In order to insure that the coil 9 remains energized as long as the contacts 24 of the control switch 21 are closed, a suitable shunt resistor 63 may be provided around the auxiliary contacts 28 on the circuit breaker 1. Resistor 63 connected in this manner insures only one closing operation of the circuit breaker 1 for each operation of the control switch 21, thereby eliminating pumping action of breaker 1 in case it is closed on a short circuit through the medium of control switch 21. In order to close the circuit breaker 1, a second time under these conditions, it will be necessary to open contacts 24 for a sufficient time so that relay 8 may reset. After the reset operation has been completed the closing switch 21 may be operated again to effect the closing of circuit breaker 1. The ohmic value of resistor 63 is such that coil 9 is not sufficiently energized so as to effect the energization of closing coil 4 when contact 28 is open and contacts 23 and 24 closed.

By providing the contacts 54 of relay 18 between the conductors 53 and 55, it will be seen that the relay 18 is prevented from being energized by the closing of the contacts 24 of the control switch 21. If these normally open contacts 54 were not provided, an energizing circuit would be completed for relay 18 through the normally closed contacts 44 and 45 of the timer 13 whenever the contacts 24 were closed and relay 18 would immediately pick up. Therefore, if the switch 21 should be released quickly while the relay 18 were energized, the closing of the contacts 38 would complete a locking circuit for relay 18 through its contacts 50 before the relay 18 could drop out. Consequently, the circuit of the operating coil 9 would also be maintained through the normally closed contacts 44 and 45 of the timer 13, until these contacts were opened by the cam 17. Since the current taken by the coil 9 is relatively large, it would require relatively large contacts 44 and 45 to interrupt this current. By means of my improved circuit arrangement these contacts only have to interrupt the relatively small current taken by the auxiliary relay 18. Contacts 44, 46 and 50 are connected in parallel arrangement so as to provide the initiating and holding action, respectively, through the medium of devices 13 and 18. Contacts 44, 45 and 50, of devices 13 and 18 respectively, are connected in series arrangement, which permits devices 13 and 18, functioning as a unit, to be connected in parallel with another control means, such as switch 21, without obtaining undesired operation on the part of either set of devices.

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, an electric circuit, a circuit breaker in said circuit, control means for said circuit breaker including a normally deenergized

winding, means responsive to the energization of said winding for effecting the closing of said circuit breaker only when said winding is initially energized while said circuit breaker is open, and means responsive to a predetermined abnormal condition of said circuit for effecting the opening of said circuit breaker while said winding remains energized, means for effecting the energization of said winding including a circuit for said winding, a set of contacts in said winding circuit controlled by said circuit breaker so that they are closed when said circuit breaker is open, a set of normally open manually controlled contacts in said winding circuit, a shunt circuit around said manually controlled contacts including in series a set of normally closed contacts and a set of normally open contacts, and means responsive to the opening of said circuit breaker for effecting the opening of said normally closed contacts, the closing of said last mentioned normally open contacts and the subsequent closing of said normally closed contacts while said last mentioned normally open contacts remain closed.

2. In combination, an electric circuit, a circuit breaker in said circuit, control means for said circuit breaker including a normally deenergized winding, means responsive to the energization of said winding for effecting the closing of said circuit breaker only when said winding is initially energized while said circuit breaker is open, and means responsive to a predetermined abnormal condition of said circuit for effecting the opening of said circuit breaker while said winding remains energized, means for effecting the energization of said winding including a circuit for said winding, a set of contacts in said winding circuit controlled by said circuit breaker so that they are closed when said circuit breaker is open, a set of normally open manually controlled contacts in said winding circuit, a shunt circuit around said manually controlled contacts including in series a set of normally closed contacts and a set of normally open contacts, and timing means responsive to the opening of said circuit breaker for effecting after predetermined time intervals the opening of said normally closed contacts, the closing of said last mentioned normally open contacts and the subsequent closing of said normally closed contacts while said last mentioned normally open contacts remain closed.

3. In combination, an electric circuit, a circuit breaker in said circuit, control means for said circuit breaker including a normally deenergized winding, means responsive to the energization of said winding for effecting the closing of said circuit breaker only when said winding is initially energized while said circuit breaker is open, and means responsive to a predetermined abnormal condition of said circuit for effecting the opening of said circuit breaker while said winding remains energized, means for effecting the energization of said winding including a circuit for said winding, a set of contacts in said winding circuit controlled by said circuit breaker so that they are closed when said circuit breaker is open, a set of normally open manually controlled contacts in said winding circuit, a shunt circuit around said manually controlled contacts including in series a set of normally closed contacts associated with said manually controlled contacts so that said last mentioned set of normally closed contacts is open when said manually controlled set of contacts is closed, a second set of normally closed contacts, and a set of normally open contacts, and timing means responsive to

the opening of said circuit breaker when said first set of normally closed contacts are closed for effecting after predetermined time intervals, the opening of said second set of contacts and	
5 the closing of said last mentioned normally open contacts and then the subsequent closing of said second set of normally closed contacts while said last mentioned normally open contacts remain closed.	
10 4. In combination, a circuit controlling device, and means for effecting a predetermined operation of said device when it is in a predetermined position including an electroresponsive device having a winding, means for effecting the energization of said winding including a circuit for	
15 said winding, a set of normally open contacts in said winding circuit, means for closing said contacts, a shunt circuit around said normally open contacts including in series a set of normally closed contacts and a second set of normally open contacts, and means operative while	
20 said circuit controlling device is in said predetermined position for effecting the opening of said normally closed contacts and the closing of said second set of normally open contacts and then the	
subsequent closing of said second set of normally closed contacts.	
5. In combination, a circuit controlling device, and means for effecting a predetermined operation of said device when it is in a predetermined position including an electroresponsive device	80
having a winding, means for effecting the energization of said winding including a circuit for said winding, a set of normally open contacts in	
said winding circuit, means for closing said con-	85
tacts, a shunt circuit around said normally open contacts including in series a set of normally closed contacts and two sets of normally open	
contacts, a relay for closing said two sets of normally open contacts when energized, a circuit	90
for said relay including normally open contacts, and means operative while said circuit controlling device is in said predetermined position for	
sequentially effecting the opening of said normally closed contacts, the closing of said nor-	95
mally open contacts in said relay circuit, and the subsequent closing of said normally closed con-	
tacts while said relay is energized.	
ARVID E. ANDERSON.	100
30	105
35	110
40	115
45	120
50	125
55	130
60	135
65	140
70	145
75	150