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A. E. ANDERSON

AUTOMATIC RECLOSING CIRCUIT BREAKER SYSTEM

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Fig. 1.

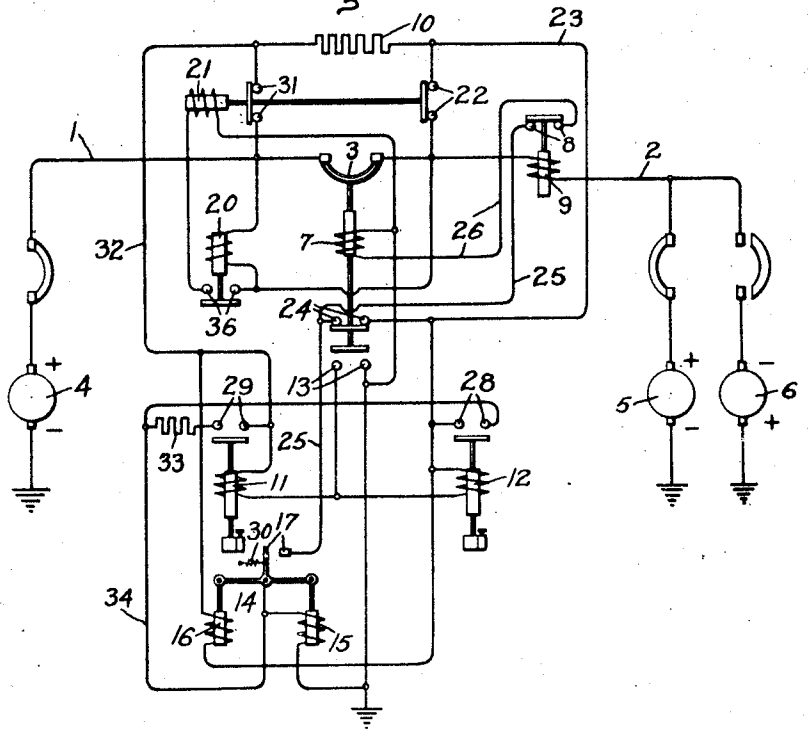
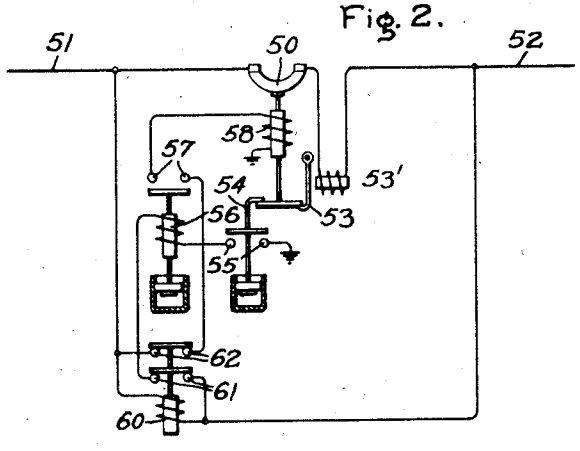


Fig. 2.



Inventor:
Arvid E. Anderson,
by Alexander S. Lent
His Attorney.

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UNITED STATES PATENT OFFICE.

ARVID E. ANDERSON, OF SCOTIA, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

AUTOMATIC RECLOSING CIRCUIT-BREAKER SYSTEM.

Application filed April 28, 1926. Serial No. 105,294.

My invention relates to automatic reclosing circuit breaker systems and particularly to a system in which both circuits, which are arranged to be connected together by the circuit breaker, are adapted to be energized independently of each other, and in such a way that at certain times they may have different polarities with respect to each other.

One object of my invention is to provide an automatic reclosing circuit breaker system which, under certain electrical conditions of the two circuits, operates to connect the two circuits together but which is rendered inoperative to effect the reclosure of the circuit breaker when the polarity of one of the circuits is reversed with respect to the other.

My invention will be better understood from the following description, taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

In the accompanying drawing, Fig. 1 is a diagram of an automatic reclosing circuit breaker system embodying my invention, and Fig. 2 is a diagram of another type of automatic reclosing circuit breaker system embodying my invention.

Referring to Fig. 1, 1 and 2 respectively represent conductors of two independently energized direct current electric circuits which are arranged to be connected together by a circuit breaker 3 which may be of any suitable type, examples of which are well known in the art. The ground constitutes the other side of both circuits, but it is evident that my invention is not limited to a grounded system, but is equally applicable to an ungrounded system in which metallic conductors constitute both sides of the system.

The circuit comprising the conductor 1 and ground is arranged to be energized by a suitable source 4, and the circuit comprising the conductor 2 and ground is arranged to be energized by a suitable source 5, which has the same polarity as the source 4 and also by a suitable source 6 which has the opposite polarity. While I have shown separate sources 5 and 6 for reversing the polarity of the circuit comprising the conductor 2 and the ground, it is evident that the polarity of this circuit may be reversed in any other well known means such as by means of a reversing switch, examples of which are old and well known in the art, between either of the sources 5 or 6 and the circuit. The circuit breaker 3 is normally held closed by its closing coil 7, which is connected between conductor 2 and ground through contacts 8 of an overload relay 9, the coil of which is connected so that it is energized in accordance with the amount of current that flows from one circuit to the other when the circuit breaker is closed. Therefore, the circuit of the closing coil 7 is opened and the circuit breaker 3 opens whenever such an abnormal load is connected to either electric circuit that sufficient current flows through the overload relay to cause it to open its contacts 8.

After the circuit breaker 3 has been open for a certain length of time, it is desirable to reclose the circuit breaker as soon as the abnormal load is removed. The automatic reclosing equipment shown in this figure is similar to that disclosed and claimed in my copending application, Serial No. 733,918, filed August 23, 1924. This reclosing equipment comprises a load indicating resistor 10 which is connected in series between the conductor 1 and 2 when the circuit breaker is open, two time element voltage relays 11 and 12 which are respectively connected between the conductors 1 and 2 and the ground by the auxiliary contacts 13 on the circuit breaker when it is in its open position, and a reclosing relay 14 which is controlled by the relative voltages of the two electric circuits to effect the closing of the circuit breaker. The two time element voltage relays 11 and 12 determine from which of the two electric circuits the various control relays receive their current during the reclosing operation. These relays are arranged to pick up only in response to substantially normal voltage across the respective circuits. Therefore, only the voltage relay which is connected across the normal circuit picks up after the circuit breaker is opend by an abnormal condition on one of the circuits. This relay, after a predetermined time, connects the operating coil 15 of the reclosing relay 14 across whichever circuit is normal. The opposing coil 16 of the reclosing relay 14, which is a balance differential relay, is connected in parallel with the load indicating resistor 10. So long as an abnormal load remains connected to either circuit, sufficient current flows through the opposing coil 16 of the reclosing relay 14 to prevent the operating coil 15 from closing the relay contacts 17 which are in the closing cir-

cuit of the closing coil 7 of the circuit breaker.

It will be observed that so long as both of the electric circuits are energized by sources of the same polarity the greatest voltage that can exist across the resistor 10 and the coil 16 of the reclosing relay when the circuit breaker is open is the voltage of the normal source, and this voltage is impressed thereon only when a short circuit exists on the faulty circuit at a point near the circuit breaker 3. If, however, the circuits are energized so that they have opposite polarity, the voltage across the resistor 10 and the coil 16 of the reclosing relay 14 becomes the sum of the voltages across the two circuits instead of the difference, so that the reclosing relay maintains its contacts 17 open although the voltages of the two circuits have the proper values to effect the reclosure of the circuit breaker. Since it is customary to design the resistor 10 and the coil 16 only for the normal voltage of the circuits, it is desirable to provide an arrangement for protecting these devices from the abnormal voltage which is impressed thereon when both circuits are energized at substantially normal voltage of the opposite polarity. For accomplishing this result, I provide a lockout relay 20 which is connected between the conductors 1 and 2 when the circuit breaker 3 is open, and which is designed so that it picks up when the voltage impressed on its coil is greater than the normal voltage of either circuit in order that under normal voltage conditions the relay never operates. The lockout relay 20 controls the circuit of a control relay 21, which in turn controls the connection of the resistor 10 and the coils of the reclosing relay 14 and the time element voltage relays 11 and 12 so that they are all disconnected when the circuits are energized in such a manner that the polarity of one circuit is reversed with respect to the polarity of the other.

The operation of the arrangement shown in Fig. 1 is as follows:—When both of the electric circuits are energized by sources of the same polarity and the load conditions on both circuits are normal, the circuit breaker is held closed by the closing coil 7 whose circuit is completed from the conductor 2 through contacts 22 of the control relay 21, conductor 23, auxiliary contacts 24 on the circuit breaker 3, conductor 25, contacts 8 of the overload relay 9, conductor 26, closing coil 7, to ground. The main contacts of the circuit breaker 3 short circuit the resistor 10, the coil 16 of the reclosing relay 14 and the coil of the lockout relay 20. Since the auxiliary contacts 13 on the circuit breaker 3 are open both of the voltage relays 11 and 12 are deenergized and the circuit of the operating coil 15 of reclosing relay 14 is open at the contacts of the voltage relays 11 and 12.

When an abnormal load condition occurs on either of the two electric circuits so that a current in excess of the setting of the overload relay 9 flows through the circuit breaker 3, the overload relay 9 opens its contacts 8 and effects the opening of the circuit breaker. It will be assumed for the purpose of this description that the abnormal load occurs between the conductor 2 and the ground. Therefore, when the circuit breaker 3 closes its auxiliary contacts 13, the relay 12 is not sufficiently energized to close its contacts 28. The relay 11, however, is connected across the normal circuit so that it closes its contacts 29 a predetermined time after the circuit breaker opens.

The opening of the main contacts of the circuit breaker 3 removes the short circuit from around the resistor 10, the coil 16 of the reclosing relay 14 and the coil of the lockout relay 20. The resistor 10 limits to a relatively small value the amount of current that flows from the normal circuit to the faulty circuit. The coil 16 aids the spring 30 to maintain the contacts 17 of the reclosing relay open. The lockout relay 20 remains in the position shown in the drawing if the voltage between the main contacts of the circuit breaker is less than a predetermined value.

When the time element voltage relay 11 closes its contacts 29 a circuit is completed for the operating coil 15 of the reclosing relay 14 from conductor 1 through contacts 31 of the control relay 21, conductor 32, contacts 29 of relay 11, resistor 33, conductor 34, coil 15 to ground.

So long as an abnormal load remains connected between conductor 2 and ground the voltage difference between the two circuits is such that the pull of the coil 16 of the reclosing relay 14 predominates and prevents the contacts 17 of the relay from being closed. When, however, the abnormal load is removed from between conductor 2 and ground, the pull of the coil 15 of the reclosing relay 14 predominates and causes the contacts 17 of the relay to be closed. The closing of the contacts 17 completes the closing circuit for the closing coil 7 from conductor 1, through contacts 31 of the control relay 21, conductor 32, contacts 29 of relay 11, resistor 33, conductor 34, contacts 17 of relay 14, conductor 25, contacts 8 of overload relay 9, conductor 26, closing coil 7, to ground. The circuit breaker, by closing its auxiliary contacts 24, completes the heretofore-traced locking circuit for its closing coil 7 and by opening its auxiliary contacts 13 effects the deenergizaton of the coils of the relays 11 and 12.

It is evident that if the abnormal load is connected between conductor 1 and ground the operation is similar to that above described, except that relay 12 closes its contacts 28 instead of relay 11 closing its contacts 29 in response to the opening of the cir-

cuit breaker. Therefore, the operating coil 15 and the closing circuit of the closing coil 7 are connected between conductor 2 and ground instead of between conductor 1 and ground.

Heretofore it has been assumed that the faulty circuit is separately energized when the circuit breaker is open, so that its polarity is the same as the normal circuit's, and therefore the voltage impressed upon the coil of the lockout relay 20 is not great enough to cause the relay to close its contacts 36. If, however, the faulty section should be energized so that its polarity is reversed with respect to the polarity of the normal section, the voltage impressed upon the winding of the lockout relay 20 is the sum of the two voltages across the two circuits. The relay 20 is designed to pick up at a predetermined voltage, which is somewhat greater than the maximum normal voltage of either circuit.

When the lockout relay 20 picks up and closes its contacts 36, a circuit is completed for the coil of the control relay 21 from conductor 2 through contact 36 of the lockout relay 20, coil of relay 21, to ground. The relay 21 opens its contacts 22 and 31, so that the resistor 10 and the coil 16 of the reclosing relay 14 are disconnected from between the conductors 1 and 2 and the circuits of the relays 11 and 12 and the coil 15 of the reclosing relay are opened. The reclosing equipment, therefore, is rendered inoperative to reclose the circuit breaker and the resistor 10 and coil 16 are not subjected to the abnormal voltage that exists across the main terminals of the circuit breaker.

As soon as the two electric circuits are again energized so that they have the same polarity, the relay 20 opens its contacts 36, thereby effecting the deenergization of the relay 21 and the closing of the contacts 22 and 31 to render the automatic reclosing equipment again operative to reclose the circuit breaker as soon as the load conditions are normal.

In Fig. 2 I have shown my invention in connection with a different type of automatic reclosing circuit breaker system, which, however, is old and well known in the art. In this embodiment of my invention the circuit breaker is reclosed only when both circuits are independently energized and the voltage across each circuit is substantially normal. As shown, the circuit breaker 50, which is arranged to connect together the conductors 51 and 52 of two independently energized electric circuits, is of the well known latched-in type which is held in its closed position by a latch 53. The latch is arranged to be released by an overload coil 53′ which is connected so as to be energized in accordance with the current flowing from one conductor to the other when the circuit breaker is closed. When the circuit breaker 50 is opened, a time delay device 54, which may be of any suitable type, examples of which are well known in the art, is released, which closes the contacts 55 a predetermined time after the circuit breaker opens. The closing of the contacts 55 connects the coil of a voltage relay 56 between conductor 52 and the other side of the circuit, which, in the arrangement shown, is the ground. As soon as the voltage of the circuit comprising the conductor 52 and ground exceeds a predetermined value, the relay 56 closes its contacts 57 and connects the closing coil 58 of the circuit breaker 50 between conductor 51 and ground. The closing coil 58 is so designed that it closes the circuit breaker when the voltage impressed across it is above a predetermined value. It is obvious, therefore, that whenever the circuit breaker is open, each circuit has to be independently energized and the voltage across each circuit has to be above a certain value in order to close the circuit breaker.

In order to prevent the circuit breaker from being reclosed when the circuits are independently energized by sources of opposite polarity, I provide the lockout relay 60 which is connected across the main terminals of the circuit breaker. This relay 60 is so designed that it does not pick up and open its contacts 61 and 62 unless the voltage between conductors 51 and 52 exceeds a predetermined value which is greater than the normal voltage of either circuit. The contacts 61 are in the circuit of the coil of relay 56 and the contacts 62 are in the circuit of the closing coil so that when relay 60 is operated by one of the circuits being energized with an opposite polarity, the reclosing equipment is rendered inoperative to effect the closing of the circuit breaker.

While I have, in accordance with the patent statutes, shown and described my invention in connection with particular systems 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 an automatic reclosing circuit breaker system, two direct current electric circuits arranged to be energized independently of each other, a circuit breaker for connecting said circuits together, means for effecting the opening of said circuit breaker, electroresponsive means responsive to predetermined electrical conditions of said circuits for effecting the reclosing of said circuit breaker, and means controlled by the relative polarities of said electric circuits for controlling the connections of said electroresponsive means so as to render said electroresponsive means un-

responsive to said predetermined electrical conditions when the polarity of one of said circuits is reversed with respect to the other while said circuit breaker is open.

2. In an automatic reclosing circuit breaker system, two electric circuits arranged to be energized independently of each other, a circuit breaker for connecting said circuits together, means for effecting the opening of said circuit breaker, current limiting means arranged to be connected in series between said circuits when said circuit breaker is open, means for reclosing said circuit breaker in response to predetermined electrical conditions of said circuits, and means arranged to render said reclosing means inoperative and to disconnect said current limiting means from between said circuits when the polarity of one of said circuits is reversed with respect to the other while said circuit breaker is open.

3. In an automatic reclosing circuit breaker system, two electric circuits arranged to be energized independently of each other, a circuit breaker for connecting said circuits together, means for effecting the opening of said circuit breaker, means controlled by the difference between the voltages of said circuits for effecting the reclosure of said circuit breaker, and a relay connected so as to be responsive to the difference between the voltages of said circuits and operative in response to a predetermined voltage which is higher than the normal voltage of either circuit to render said reclosing means inoperative.

4. In an automatic reclosing circuit breaker system, two electric circuits arranged to be energized independently of each other, a circuit breaker for connecting said circuits together, means for effecting the opening of said circuit breaker, current limiting means arranged to be connected in series between said circuits when said circuit breaker is open, means controlled by the difference between the voltages of said circuits for effecting the reclosure of said circuit breaker, and a relay connected so as to be responsive to the difference between the voltages of said circuits when said circuit breaker is open and operative in response to a predetermined voltage which is higher than the normal voltage of either circuit to render said reclosing means inoperative and to disconnect said current limiting means from between said circuits.

5. In an automatic reclosing circuit breaker system, two electric circuits arranged to be energized independently of each other, a circuit breaker for connecting said circuits together, means for effecting the opening of said circuit breaker a reclosing relay for controlling the reclosing of said circuit breaker having a winding arranged to be connected when the circuit breaker is open so that it is energized in accordance with the difference between the voltages of said circuits, and another relay connected so as to be responsive to the difference between the voltages of said circuits and operative in response to a predetermined voltage which is higher than the normal voltage of either circuit to disconnect said reclosing relay winding so that it is unresponsive to the voltage difference between said circuits.

6. In an automatic reclosing circuit breaker system, two electric circuits arranged to be energized independently of each other, a circuit breaker for connecting said circuits together, means for effecting the opening of said circuit breaker, current limiting means arranged to be connected in series between said circuits when said circuit breaker is open, a reclosing relay for controlling the reclosing of said circuit breaker having a winding connected in parallel with said current limiting means, and a relay connected in parallel with said current limiting means and arranged when the voltage impressed thereon exceeds a predetermined value to disconnect said current limiting means and said reclosing relay from in series between said circuits.

7. In an automatic reclosing circuit breaker system, two direct current electric circuits arranged to be energized independently of each other, a circuit breaker for connecting said circuits together, means for effecting the opening of said circuit breaker, means controlled by the voltage across one of said circuits for effecting the reclosing of said circuit breaker whenever the load on said one of said circuits is less than a predetermined amount and the other circuit is energized, and means for removing said voltage controlled means from the control of said voltage when said circuits are energized so that they have opposite polarities.

8. In an automatic reclosing circuit breaker system, two electric circuits arranged to be energized independently of each other, a circuit breaker for connecting said circuits together, means for effecting the opening of said circuit breaker, means controlled by the voltages across said circuits for effecting the reclosing of said circuit breaker, and a relay connected so as to be energized in accordance with the voltage across the main terminals of the circuit breaker when it is open and arranged when the voltage impressed thereon exceeds a predetermined value to render said voltage controlled means inoperative to effect the closing of said circuit breaker.

In witness whereof, I have hereunto set my hand this 27th day of April, 1926.

ARVID E. ANDERSON.