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REGISTERING MEANS FOR AUTOMATIC RECLOSING CIRCUIT BREAKER SYSTEMS

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Fig. 1.

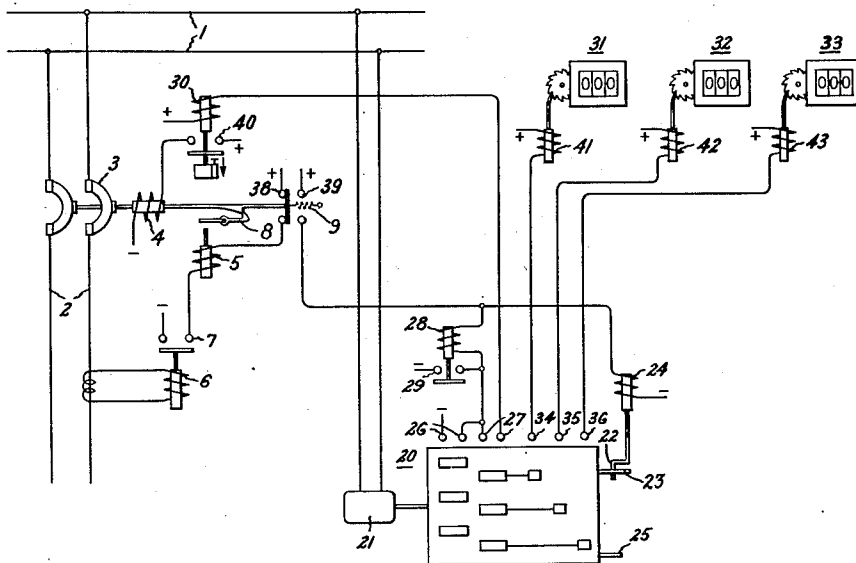
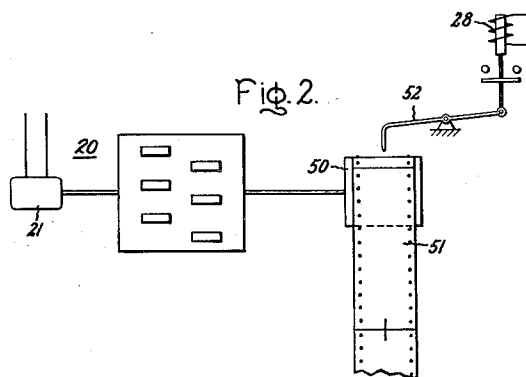


Fig. 2.



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UNITED STATES PATENT OFFICE

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REGISTERING MEANS FOR AUTOMATIC RECLOSING CIRCUIT BREAKER SYSTEMS

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7 Claims. (Cl. 235—92)

My invention relates to registering means for automatic reclosing circuit breaker systems and particularly for such systems in which means are provided for automatically reclosing a circuit breaker at different predetermined time intervals after the initial opening of the circuit breaker if it is open at the expirations of said time intervals.

One object of my invention is to provide an arrangement of apparatus whereby the number of reclosures, which occur at the expiration of each of the different predetermined time intervals during a given period of time, may be readily determined. Heretofore it has been the practice to count the total number of reclosures occurring within a given period of time, but no arrangement has been provided for segregating this total number of reclosures between what are commonly known as first, second, third, etc., reclosures so that the percentage of each type of reclosure occurring within a given period of time can be readily determined. Such information is desirable from an operating point of view in order to obtain data as to the kind of service rendered so that the necessary steps may be taken to further improve service when necessary.

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 incorporating one embodiment of my invention, and Fig. 2 of which diagrammatically illustrates an automatic reclosing circuit breaker system incorporating another embodiment of my invention, and the scope of my invention will be pointed out in the appended claims.

Referring to Fig. 1 of the drawing, 1 represents a supply circuit which is arranged to be connected to a load circuit 2 by a circuit breaker 3. In order to simplify the disclosure, I have shown single phase circuits, but it will be obvious to anyone skilled in the art that my invention is applicable also to direct current and polyphase circuits. The circuit breaker 3 may be of any suitable type, examples of which are well known in the art. In the particular embodiment shown in Fig. 1, circuit breaker 3 is of the well known latched-in type and is provided with a closing coil 4 which, when energized, effects the closing of the circuit breaker and with a trip coil 5 which, when energized, releases a latch 8 so that an opening spring 9 can move the circuit breaker to its open position. For effecting the opening of the circuit breaker 3, when it is closed and a fault

occurs on the load circuit 2, I provide suitable fault responsive means shown as an overcurrent relay 6 which is connected in any suitable manner so as to be energized in accordance with the magnitude of the current flowing through the circuit breaker 3. When the current through the circuit breaker 3 exceeds a predetermined value, the overcurrent relay 6 closes its contacts 7 and completes an energizing circuit for the trip coil 5 to effect the opening of the circuit breaker 3.

Any suitable automatic reclosing means, examples of which are well known in the art, may be provided for reclosing the circuit breaker 3 at different time intervals after the initial opening of the circuit breaker has been effected by the operation of the overcurrent relay 6. These time intervals may be adjusted so that they may have any desired predetermined values above zero. As shown in Fig. 1, the automatic reclosing means includes a timer 20 and a driving motor 21 therefor which is permanently connected to a suitable source of current, such as the supply circuit 1. The motor 21 is normally prevented from rotating by a stop 22 which engages a projection 23 on the rotatable element of the timer 20. The stop 22 is arranged to be moved out of engagement with the projection 23 by a release magnet 24, an energizing circuit for which is completed through auxiliary contacts on the circuit breaker 3 when it is open. The stop 22 is also arranged to engage another projection 25 on the rotatable element of the timer 20 if the release magnet 24 is energized when the timer has reached a predetermined position after having effected a predetermined number of reclosures of the circuit breaker 3. This position of the timer is called the lockout position and, when the timer is held in this position by the stop 22, further operation of the timer is prevented.

The timer 20 is also provided with two sets of contacts 26 and 27 which are arranged to be closed sequentially a plurality of times during one cycle of operation of the timer. The timer 20 is arranged so that only one of these two sets of contacts 26 and 27 is closed at any given time. Also the timer 20 is arranged so that the sequential operations of the contacts 26 and 27 are respectively effected after the timer has been in operation for different predetermined periods of time after the initial opening of the circuit breaker 3 has been effected by the overcurrent relay 6. When the contacts 26 are closed, a circuit is completed for a control relay 28 if the circuit breaker 3 is open at that time. The relay 28, by closing its contacts 29, completes a lock-

ing circuit for itself so that, when the contacts 26 of the timer are subsequently opened, the relay 28 remains energized as long as the circuit breaker 3 remains open. When the contacts 27 are subsequently closed, a circuit is completed through the contacts 29 of the energized relay 28 for the control relay 30 which, in turn, completes an energizing circuit for the closing coil 4.

In order that the number of reclosures respectively occurring at the expiration of the different predetermined time intervals may be readily determined, I provide in the embodiment of my invention shown in Fig. 1 a plurality of registers of any suitable type for respectively registering the number of reclosures occurring at the expiration of said predetermined time intervals and means for selectively operating these registers in accordance with the position of the timer each time a reclosure is effected thereby. Since, in the particular embodiment shown in Fig. 1, the timer 20 is arranged to effect reclosures at three different points in each cycle of operation thereof, I have shown three registers 31, 32 and 33 for respectively registering the number of first, second and third reclosures effected by the timer 20. Each register is shown as an electromagnetically operated counting device and may be of any suitable type, examples of which are well known in the art. The operating circuit for the register 31 is arranged to be completed through a contact 34 on the timer 20 when it is in a position to effect the first reclosure of the contacts 27 if at the same time the circuit breaker 3 is open. Similarly, the operating circuit for the register 32 is arranged to be completed through a contact 35 on the timer 20 when it is in a position to effect the second reclosure of the contacts 27, if at the same time the circuit breaker 3 is open and the operating circuit for the register 33 is arranged to be completed through a contact 36 on the timer when it is in a position to effect the third reclosure of the contacts 27, if at the same time the circuit breaker 3 is open.

The operation of the arrangement shown in Fig. 1 is as follows:

Under normal load conditions, the circuit breaker 3 remains closed, and the control devices are in the positions in which they are shown in the drawing. When an overload occurs, which is sufficient to cause the over-current relay 6 to close its contacts 7, a circuit is completed, through the auxiliary contacts 38 on the circuit breaker 3, for the trip coil 5 which, when energized, effects the opening of the circuit breaker 3. The closing of the auxiliary contacts 39 on the circuit breaker 3, when it opens, completes an energizing circuit for the release magnet 24 of the timer 20. The timer 20 then starts to rotate and a predetermined time thereafter closes its contacts 26 and completes an energizing circuit for the control relay 28 through the auxiliary contacts 39 on the circuit breaker 3. By closing its contacts 29, the relay 28 completes a locking circuit for itself so that the relay does not become deenergized when the timer 20 subsequently opens its contacts 26. When the timer 20 subsequently closes its contacts 27, a circuit is completed for the relay 30 through the contacts 29 of the relay 28. The closing of the contacts 40 of the relay 30 completes an energizing circuit for the closing coil 4 so that the circuit breaker 3 is reclosed. The closing of the contacts 27 also completes an energizing circuit for the operating coil 41 of the register 31 through the con-

tacts 29 of the relay 28 and the contacts 34 of the timer so that the first reclosure is registered on the register 31.

The opening of the auxiliary contacts 39 on the circuit breaker 3 when it closes effects the deenergization of the control relays 28 and 30, the closing coil 4 and the operating winding of register 31. If, after the first reclosure, the circuit breaker 3 is immediately opened by the overcurrent relay 6 closing its contacts 7, a second reclosure is effected by the timer 20 again sequentially closing its contacts 26 and 27 after it has continued in operation for another predetermined time interval. At the time this second reclosure is effected by the closing of the contacts 27 a circuit is completed for the operating winding 42 of the register 32 through the contacts 35 and 27 of the timer 20 and the contacts 29 of the relay 28 so that the second reclosure is registered on the register 32.

If, after the second reclosure, the circuit breaker 3 is again immediately opened, the timer 20 again effects, after a predetermined time interval, a third reclosure in the same manner as the first and second reclosures were effected. At the same time that the third reclosure is effected by the closing of the contacts 27, an energizing circuit is completed for the operating winding 43 of the register 33 through the contacts 36 and 27 of the timer 20 and the contacts 29 of the relay 28 so that the third reclosure is registered on the register 33.

If the circuit breaker 3 fails to remain closed after the third reclosure, the release magnet 24 is energized when the timer 20 reaches its lockout position. Therefore, the stop 22 engages the projection 25 on the timer and holds it in its lockout position under these conditions until the circuit of the release magnet 24 is interrupted in any suitable manner. This result may be accomplished by manually closing the circuit breaker 3 so that its auxiliary contacts 39 are opened.

If the circuit breaker 3 remains closed after any reclosure thereof the timer 20 is restored to its normal position but there is no operation of the registers when the timer 20, during its cycle of operation, subsequently moves through the remaining positions thereof in which it can effect additional reclosures since the operating circuits of the operating windings are open at the contacts 29 of the relay 28 when the time is in these positions. Therefore, it will be seen that the registers can be operated only when the timer effects a reclosure of the circuit breaker 3.

In the embodiment of my invention shown in Fig. 2, I have illustrated the motor 21 of the automatic reclosing circuit breaker system shown in Fig. 1 as also driving a drum 50 so that it makes one revolution for each revolution of the timer 20. As the drum 50 rotates, a strip 51 of paper, or other suitable material, on which a record may be made is caused to pass over the drum in any suitable manner, examples of which are well known in the art, so that a definite relation is maintained between the movements of the chart and the drum. Preferably the chart has predetermined index points marked thereon which bear a fixed relation to predetermined positions of the timer 20. During each cycle of operation of the timer, a definite predetermined length of the strip 51 is unwound. The control relay 28, when energized during the cycle of operation of the timer 20, is arranged to move a suitable recording device 52, such as a pen, pencil, stylus, etc., into engagement with the recording strip 51.

Since the relay 28 is energized only when a reclosure is being effected, it is evident that a record is made on the strip 51 only when the circuit breaker 3 is reclosed. By observing the relative spacings of the records made on the strip 51 with reference to the index points, it is possible to determine whether the circuit breaker is reclosed one, two or three times during each cycle of operation of the timer 20. Also it is apparent that the number of different kinds of reclosures, which occur during a given period of time, can be readily determined from the records made on the strip 51.

While I have, in accordance with 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, fault responsive means for opening said circuit breaker, means for automatically reclosing said circuit breaker at the expiration of different time intervals counting from the initial opening of said circuit breaker effected by said fault responsive means, and means for registering each reclosure of said circuit breaker in such a manner that the number of reclosures respectively occurring at the expiration of said time intervals can be determined from the registrations including timing means having a predetermined cycle of operation, means controlled by said fault responsive means for initiating the operation of said timing means, and means controlled by said timing means for registering each reclosure in accordance with the point in said cycle of operation at which the reclosure occurs.

2. In combination, an electric circuit, a circuit breaker in said circuit, a timing device having a predetermined cycle of operation, fault responsive means for opening said circuit breaker, and for initiating the timing operation of said timing device, means controlled by said timing device at each of a plurality of points in said cycle of operation for reclosing said circuit breaker said timing device for registering each reclosure in accordance with the point in said cycle of operation at which the reclosure occurred.

3. In combination, an electric circuit, a circuit breaker in said circuit, a timing device, fault responsive means for opening said circuit breaker, and for initiating the timing operation of said timing device, means controlled by said timing device in each of a plurality of positions thereof for reclosing said circuit breaker, registers for respectively registering the number of reclosures occurring in each of said positions of said device,

and means for selectively operating said registers in accordance with the position of said timing device each time said timing device effects a reclosure.

4. In combination, an electric circuit, a circuit breaker in said circuit, a timing device, fault responsive means for opening said circuit breaker and for initiating the timing operation of said timing device, means controlled by said timing device in each of a plurality of positions thereof for reclosing said circuit breaker, electromagnetically operated counters for respectively counting the number of reclosures occurring in each of said positions of said device, an operating circuit for each counter, and means controlled by said timing device for selectively completing the operating circuit of the proper counter each time said timing device effects a reclosure in each of said positions.

5. In combination, an electric circuit, a circuit breaker in said circuit, a timing device, fault responsive means for opening said circuit breaker and for initiating the timing operation of said timing device, means controlled by said timing device for reclosing said circuit breaker after said timing device has been in operation for different predetermined intervals of time, and means jointly controlled by said timing device and said circuit breaker for registering each reclosure in accordance with the time interval elapsing before each reclosure effected by said timing device.

6. In combination, an electric circuit, a circuit breaker in said circuit, a normally idle timer, means for moving said timer through a predetermined cycle of operation, fault responsive means for opening said circuit breaker and for initiating the operation of said timer moving means, means controlled by said timer for reclosing said circuit breaker at predetermined points in its cycle of operation, and means jointly controlled by said circuit breaker and said timer for registering each reclosure in accordance with the point in the cycle of operation of said timer at which the reclosure is effected.

7. In combination, an electric circuit, a circuit breaker in said circuit, a normally idle timer, means for moving said timer through a predetermined cycle of operation, fault responsive means for opening said circuit breaker and for initiating the operation of said timer moving means, means controlled by said timer for reclosing said circuit breaker at predetermined points in its cycle of operation, electromagnetically operated counters for respectively counting the number of reclosures occurring at each of said predetermined points, an operating circuit for each counter, and means jointly controlled by said circuit breaker and said timer for selectively completing each operating circuit when said circuit breaker is open and said timer is at the respective point in the cycle of operation.

ARVID E. ANDERSON.

CERTIFICATE OF CORRECTION.

Patent No. 2,340,635.

February 1, 1944.

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It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, line 51, for "time" read --timer--; page 3, first column, line 51, claim 3, after "breaker" insert --, and means controlled by--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 18th day of April, A. D. 1944.

Leslie Frazer

(Seal)

Acting Commissioner of Patents.