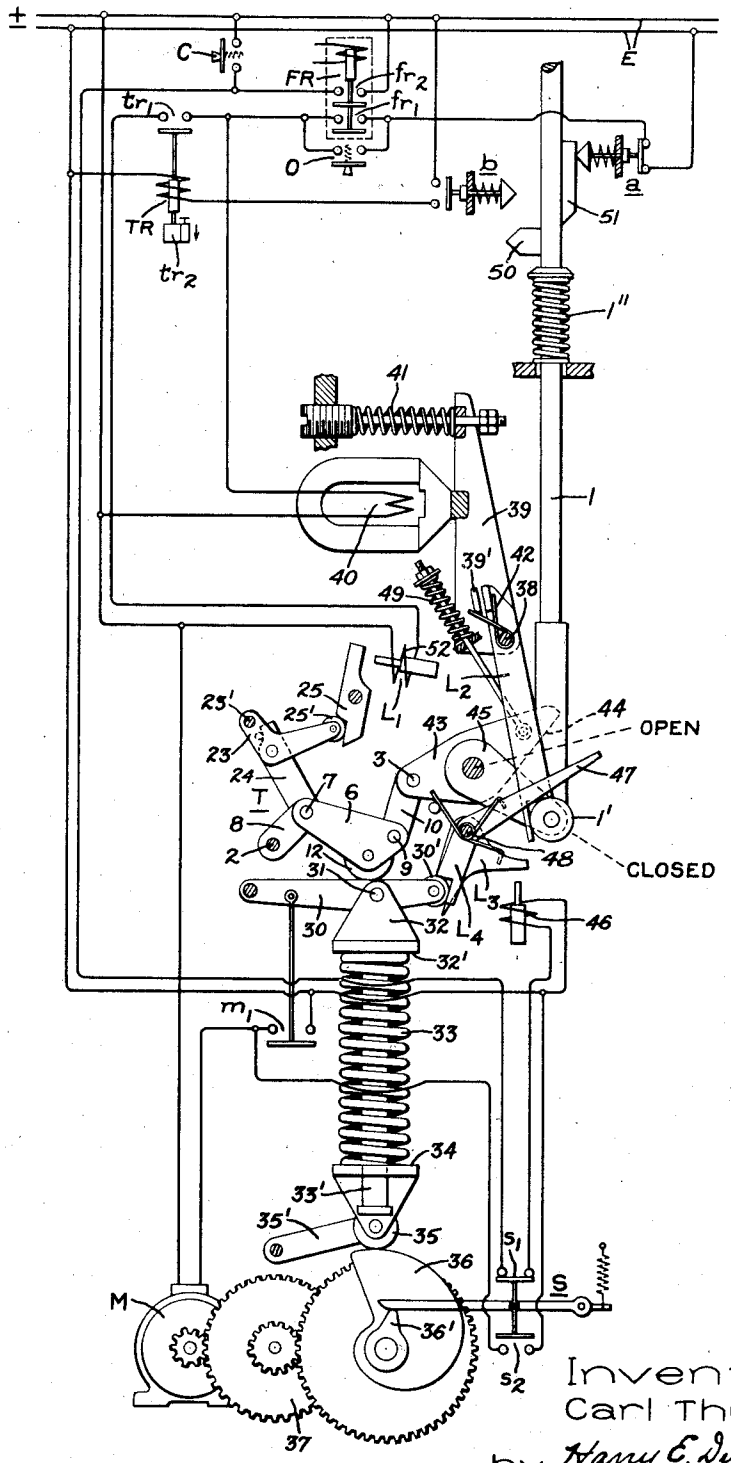
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HIGH SPEED CIRCUIT BREAKER RECLOSING MECHANISM

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HIGH SPEED CIRCUIT BREAKER RECLOSING MECHANISM

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My invention relates to high speed reclosing mechanisms, more particularly as applied to electric circuit breakers which are connected in high voltage networks of power transmission lines, and has for its principal object the provision of an improved high speed reclosing mechanism that is efficient, positive and very rapid in operation, and that is effective to apply the reclosing force instantly at a predetermined point in the opening stroke.

In electric distribution systems where continuity of service is a very important factor, means have been provided for quickly reclosing an electric circuit breaker one or more times after automatic opening in response to a fault on the assumption that a very large percentage of faults, such as surges due to lightning, for example, are of a temporary nature. From the standpoint of service continuity, the ideal condition is that the breaker be reclosed instantly after the breaker has cleared the fault. Accordingly, where standard opening and closing mechanisms are employed, reclosure does not actually start until the full opening stroke has been completed.

The function of a circuit breaker is not only to open a circuit and clear faults, but also to maintain the circuit clear under adverse voltage conditions. That is, the length of stroke of the circuit breaker must be sufficient to prevent restriking of the arc in case the line voltage is several times that of normal. As contrasted with this isolating function of the breaker, it should be borne in mind that a well designed breaker can actually clear a fault within a few inches of opening stroke.

There is disclosed in my application, Serial No. 85,789, filed June 17, 1936, for High speed reclosing mechanisms, a reclosing mechanism wherein a pair of separately energized motor mechanisms are interrelated for the purpose of obtaining rapid reclosure. There is also disclosed in my application, Serial No. 192,782, filed February 26, 1938, for "High speed reclosing mechanism," a reclosing mechanism of this character wherein spring energy is instantly available for reclosing.

In accordance with the present invention, a trip-free linkage operatively interconnects the circuit breaker and a source of stored energy, such as a charged spring for example, that is in turn controlled by a plurality of selectively operated latching devices.

My invention will be more fully set forth in the following description referring to the accompanying drawing, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

Referring to the drawing, the single figure thereof is a partly diagrammatic layout of a high speed circuit breaker reclosing mechanism of the charged spring type embodying the present invention.

The automatic reclosing system shown comprises essentially a source of motive power M, such as a motor, a thrust transmitting linkage T, and circuit breaker operating means such as the rod 1. The circuit breaker operating rod 1 is moved to the closed circuit position shown by means of the motor M and the linkage T (which is latched in thrust-transmitting position), and is held in such position by latching means against the bias of the usual circuit breaker opening springs 1''.

Referring more specifically to the operating linkage T the arrangement is fundamentally similar to that disclosed and claimed in my Patent 1,827,626, granted October 13, 1931, for Switch operating mechanism, although it is obviously not limited to this specific form of linkage. As illustrated, the linkage is connected at one end to a fixed pivot 2 and at the other end at 3 to a rocking lever 43 for operating the breaker rod 1. The linkage comprises an intermediate floating lever 6 that is connected at 7 to a guide link 8 and at 9 to the lever 43 through a connecting link 10. The floating lever 6 can be rotated counterclockwise by an energy storing device, such as a charged spring, about the pivot 7, which is normally held stationary by a latching device L_1.

In accordance with the above patent, the latching device L_1 comprises a toggle linkage 23—24, the link 23 having a fixed pivot at 23' and the link 24 being connected to the pivot pin 7. The toggle in the restraining position shown is underset and held in such position by a solenoid controlled latch 25 that engages a roller 25' carried by the link 23.

In the present instance the floating lever 6 is operated by means of a pivoted lever 30 that is connected at pin 31 to a spring carriage 32. The spring carriage for the operating spring 33 comprises in addition to the upper spring seat 32', a lower spring seat 34 provided with a roller 35 for co-action with a cam 36. The upper spring seat 32' is rigidly connected to a guide rod 33' that is slidably mounted in the lower spring seat 34. Accordingly, it will be noted that when the upper spring seat 32' is held stationary, rotation

of the cam **36** is effective to raise the lower seat **34** thereby to charge the spring. The cam **36** is adapted to be operated by the motor M through a suitable gear train **37**. The lower end of the spring carriage is positioned by a pivoted guide link **35'**.

In the closed circuit position shown the linkage T is latched at L_1 so that the floating lever **6** can be operated about the normally stationary pivot **7**. The breaker rod **1** is held in the closed position independently of the linkage T against the bias of an opening spring **1''** by a latch L_2 arranged to engage a roller **1'** carried by the rod **1**. The latch L2 is pivotally mounted at **38**, as is also the armature **39** of a high speed tripping magnet **40**. The armature **39** is biased at **41** clockwise toward the open magnetic circuit position to facilitate high speed tripping. The latch L_2 is also biased by a spring **42** co-acting with the armature **39** toward the latched position shown. For releasing the latch L_2 when the coil of the tripping magnet **40** is energized, the armature **39** is provided with a lug **39'** disposed in alinement with the latch. The breaker operating rod **1** is connected to the linkage T by means of a rocking lever **43** that is provided with a cam surface **44** arranged to engage the roller **1'** for depressing the rod **1** to close the breaker. The lower end of the rod is connected to a guide link **45** as shown.

Another latching device for controlling the spring **33** will now be described. The lever **30**, which is connected to the spring carriage at **31** is provided with a latching roller **30'** that may be engaged by two separately actuated latches L_3 and L_4. The latch L_3 is adapted to be electrically operated by means of a tripping solenoid **46**, and the latch L_4 is adapted to be mechanically actuated by means of its extension **47** and the coacting roller **1'**. The latches L_3 and L_4 can be co-pivotally mounted at **48** and are both spring biased as shown toward the latching position with respect to the roller **30'**. It will therefore be apparent that the spring **33** cannot be released to discharge its energy unless both latches L_3 and L_4 are actuated.

The cycle of operation is as follows. Let it be assumed that the spring **33** is charged as shown and the breaker is open, that is, with the lower end of the rod **1** in the dotted line position indicated. The closing operation by spring energy now can be initiated by closing the switch C thereby to energize from the source of control voltage E the tripping solenoid **46** of the latch L_3. This tripping circuit also includes auxiliary switch contacts s_1 of the cam switch S so that tripping can be accomplished only if the spring **33** is charged with the cam **36** in the position illustrated.

Since the breaker in moving to the open position necessarily releases the latch L_4 by reason of engagement of latch extension **47** by the roller **1'**, the latch L_4 is already tripped and operation of the latch L_3 causes release of the lever **30** and therefore the spring **33**. The spring energy causes in turn counterclockwise rotation of the lever **30**, floating lever **6**, the roller **12** being in abutting relation to the lever **30**, and clockwise rotation of lever **43** to close the breaker through the cam surface **44** and roller **1'**. During this operation a spring **49** interconnecting the armature **39** and the lever **43** as shown is stressed for resetting said armature with respect to the magnet **40**. As previously indicated the latch L_2 under bias of its spring **42** snaps over the roller **1'** to hold the breaker in the closed position independently of the operating mechanism.

At the end of the breaker closing stroke an auxiliary motor switch m_1 is closed by the lever **30** thereby energizing the motor so that the cam **36** is rotated clockwise, first causing the roller **35** to drop to the low point of the cam to reset the linkage T as well as latches L_3 and L_4 and then recharging the spring **33**. As the roller **35** drops to the low point of the cam the linkage T is stretched so as to reset all latches prior to the spring charging operation. As the cam continues to rotate clockwise from its low point the spring seat **32** is held stationary by the latches and the spring seat **34** moves upward to compress and recharge the spring.

As the mechanism resets in response to initial rotation of the cam the switch m_1 opens and a second auxiliary switch s_2 closes after predetermined rotation of the cam. To this end an auxiliary cam **36'** controls the pivoted switch arm of switch S so that switch s_2 closes when the low point of the cam is reached. The motor M therefore remains energized and continues to recharge the spring until the high point of the cam is again reached. At this point the switch s_2 cuts out the motor as shown, and switch s_1 which is in the circuit of tripping solenoid **46** is closed.

In trip-free operation it will be noted that all latches are tripped. That is, in closing the breaker, the auxiliary switch *b* is momentarily closed by a cam **50** carried by the rod **1** to energize the transfer relay TR and thereby connect the coil **52** of the tripping latch L_1 in the circuit. The tripping circuit so established is through the auxiliary switch *a*, which, as in the previous case is closed by cam **51** on the breaker rod when the breaker is closed and is open when the breaker is open, contacts fr_1 of the fault relay FR, contacts tr_1 of transfer relay TR and the tripping solenoid **52** of the latch L_1. It will be noted that when the fault relay FR is energized the latch L_3 also is always operated by reason of contacts fr_2 which shunt the switch C. Also the circuit for maintaining trip-free protection during reclosing is held for a brief time at the contacts tr_1 by a dashpot tr_2 to insure that the breaker is fully closed before tripping control is again transferred to latch L_2.

In the automatic reclosing cycle, the fault relay FR actuates both the latches L_3 and L_2, the latter latch being operated through the high speed tripping magnet at **40**. Energization of the tripping coil of magnet **40** is effective to release the spring **41** which rotates the armature **39** clockwise and releases the latch L_2 as previously described. The latch L_4 can obviously be adjustable with respect to the roller **1'** so that after predetermined opening movement of the breaker rod **1** the latch will be released to allow the spring **33** immediately to reclose the breaker in the manner above described.

Where the opening operation under manual control is desired an opening switch O is provided in parallel with the lower contacts fr_1 of the fault relay. The tripping circuit is then established through the auxiliary switch *a*, switch O and the tripping magnet **40** to release the breaker operating rod directly at the roller **1'**. The breaker is now at the beginning of the cycle above described.

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

1. An automatic circuit breaker reclosing sys-

tem comprising a source of motive power, trip-free structure operatively interconnecting said source of power and circuit breaker for closing said circuit breaker, latching means for holding said circuit breaker in closed circuit position independently of said trip-free structure, fault responsive means for releasing said latching means, and means controlling said source of motive power for initiating reclosure of said circuit breaker in accordance with predetermined opening movement thereof.

2. An automatic circuit breaker reclosing system comprising a source of motive power, a trip-free linkage operatively interconnecting said source of power and circuit breaker for closing said circuit breaker, a latch directly controlling said trip-free linkage, and a second latch directly related to said circuit breaker for holding said circuit breaker in closed circuit position independently of said trip-free linkage.

3. An automatic circuit breaker reclosing system comprising a source of motive power, a trip-free linkage operatively interconnecting said source of power and circuit breaker for closing said circuit breaker, said linkage including a member disengageably related to said circuit breaker for closing said circuit breaker, a latch for holding said circuit breaker in closed circuit position independently of said trip-free linkage, and means responsive to tripping of said latch and opening of said circuit breaker for causing reclosure of said circuit breaker by said motive means.

4. An automatic circuit breaker reclosing system comprising a closing spring, trip-free structure operatively interconnecting said spring and circuit breaker, and latching means for controlling the release of spring energy including means responsive to initial circuit opening movement of said breaker and means responsive to a fault condition in said circuit.

5. An automatic circuit breaker reclosing system comprising a closing spring, trip-free structure operatively interconnecting said spring and circuit breaker, a latch for holding said circuit breaker in closed circuit position independently of said trip-free structure, a second latch for holding said spring in charged condition, said second latch being actuated in accordance with predetermined opening movement of said circuit breaker, and a third latch also holding said spring in charged condition, said third latch being responsive to a fault condition in said circuit whereby release of said first and third latches in response to a fault condition causes release of the spring energy to reclose said circuit breaker prior to complete opening movement thereof.

6. An automatic circuit breaker reclosing system comprising a circuit breaker, a source of motive power including a motor and a spring arranged to be charged by said motor, a trip-free linkage operatively interconnecting said spring and circuit breaker, latching means for holding said circuit breaker closed independently of said linkage, other latching means for holding said spring in charged condition, means responsive to manual control for releasing said first-named latching means to open said circuit breaker, fault responsive means for releasing said first-named latching means and also said other latching means for causing said spring to reclose said circuit breaker after predetermined opening movement of said circuit breaker, and means responsive to said reclosing operation for causing energization of said motor to reset said linkage and recharge said spring.

7. An automatic circuit breaker reclosing system comprising a circuit breaker, a source of motive power including a motor and a spring arranged to be charged by said motor, a trip-free linkage operatively interconnecting said spring and circuit breaker, latching means for holding said circuit breaker closed, other latching means including two selectively operable latches for holding said spring in charged condition, tripping of both said latches being essential to release said spring, fault responsive means operable to cause tripping of said first-named latching means and also one of said spring latches, and means related to said circuit breaker for causing tripping of said second spring latch after predetermined opening movement of said circuit breaker for releasing said spring thereby to reclose said circuit breaker.

8. An automatic circuit breaker reclosing system comprising a circuit breaker, a source of motive power including a motor and a spring arranged to be charged by said motor, a trip-free linkage operatively interconnecting said spring and circuit breaker, latching means for holding said circuit breaker closed, a latch for holding said spring in charged condition, fault responsive means operable to cause tripping of said first-named latching means to open said circuit breaker, and means mechanically related to said circuit breaker for directly causing tripping of said spring latch in accordance with predetermined opening movement of said circuit breaker.

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