

May 12, 1936.

J. L. BIACH

2,040,425

CONTROL MECHANISM

Filed July 31, 1931

2 Sheets-Sheet 1

Fig. 1.

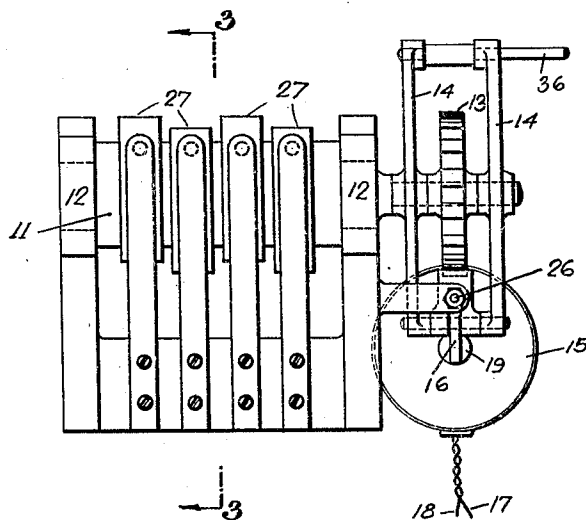
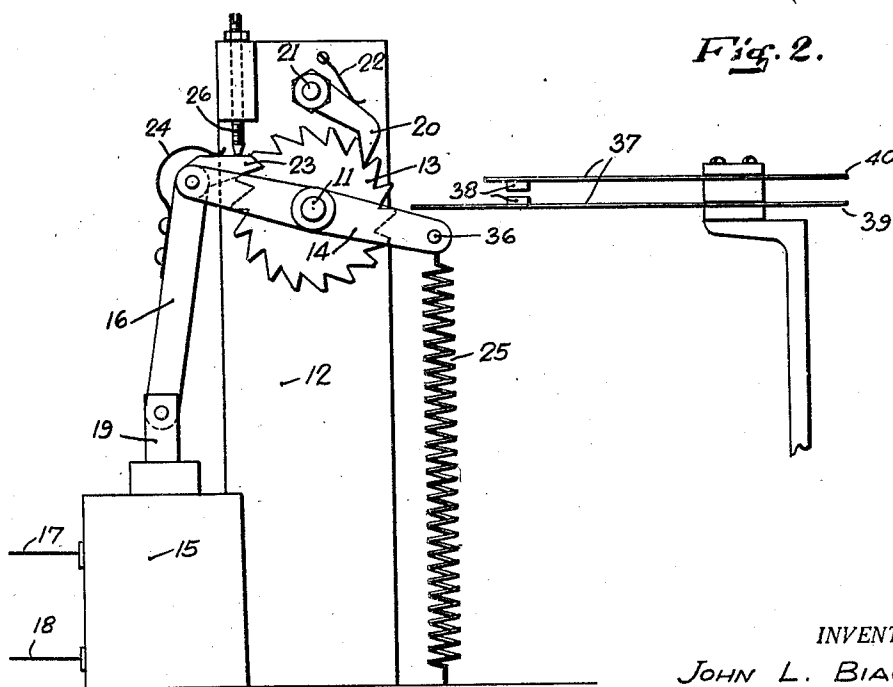


Fig. 2.



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2 Sheets-Sheet 2

Fig. 3.

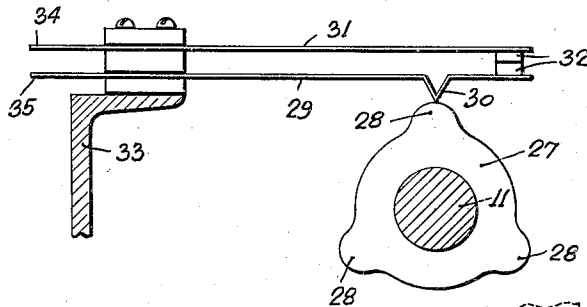
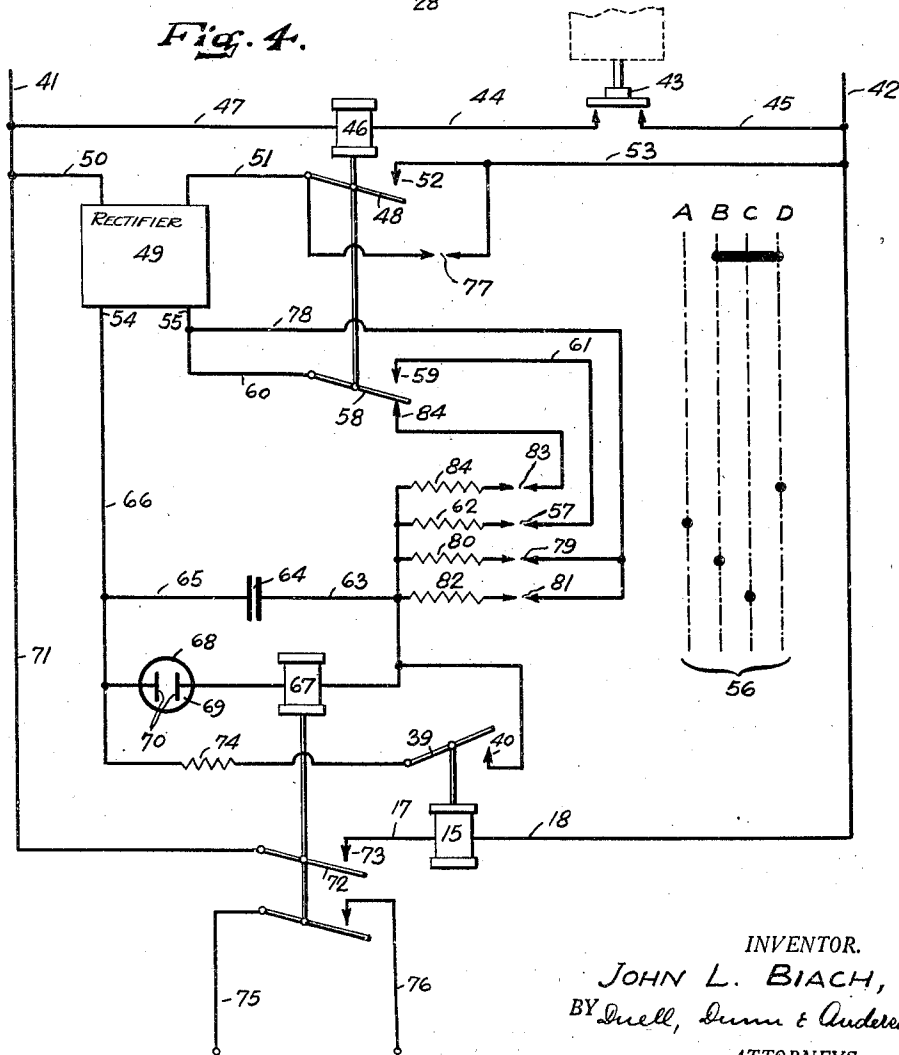


Fig. 4.



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UNITED STATES PATENT OFFICE

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CONTROL MECHANISM

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Application July 31, 1931, Serial No. 554,223

9 Claims. (Cl. 175—294)

This invention relates to reclosing mechanisms and more particularly to a mechanism for closing an oil circuit breaker after the breaker has been open due to a short circuit or similar cause.

Certain features of the present application are disclosed and claimed in a copending joint application Serial Number 446,454 of Charles D. Geer and myself, the joint application and the present application having a common assignee. No claims are made in the present application to such features, the claims herein being restricted to matter not disclosed in the joint application.

An object of this invention is to provide a mechanism which will reclose an oil circuit breaker at a predetermined time after the breaker is open.

A further object of the invention is to provide a reclosing mechanism which will reclose the oil circuit breaker one or more times if the short circuit persists.

A still further object of the invention is to provide a mechanism of the character described which will leave the circuit breaker open after it has tried to reclose it a certain number of times.

Another object of the invention is to provide an apparatus of the character described which will always provide a test period of a certain length of time before it returns to its normal condition.

An additional object is that of providing an apparatus of this character, the parts of which will be relatively few in number and each individually simple and rugged in construction, these parts operating over long periods of time with freedom from mechanical and electrical difficulties.

With these and other objects in mind, reference is had to the attached sheets of drawings illustrating a practical embodiment of the invention and in which:

Fig. 1 is a plan view of a portion of the apparatus;

Fig. 2 is a side elevation thereof;

Fig. 3 is a transverse sectional view taken along lines 3—3 and in the direction of the arrows of Fig. 1 and

Fig. 4 illustrates in a somewhat diagrammatic manner the action of the several elements of the apparatus and their relationship to each other.

Referring to Figs. 1 and 2, there is shown a shaft 11 mounted in bearings 12 so that it may rotate freely. Rigidly connected to shaft 11 is

a toothed wheel 13. Also mounted on shaft 11 is a rocker-arm 14. This rocker-arm is actuated by magnet 15 through a link 16. When magnet 15 is energized by applying a source of current to its leads 17 and 18, plunger 19 is attracted to rotate the rocker-arm 14 in a counter-clockwise direction. Rotation of wheel 13 is prevented by means of dead pawl 20 which is pivoted at 21 and forced into engagement with wheel 13 by spring 22. Rotatively mounted on the end of rocker-arm 14 is a live pawl 23 which is pressed into engagement with wheel 13 by means of spring 24. It will be noticed that as rocker-arm 14 is rotated counter-clockwise, live pawl 23 slips over the teeth of wheel 13. The amount of motion would be adjusted to be the distance subtended by one tooth. Thus pawl 23 will be brought into engagement with the next tooth, and when magnet 15 is deenergized, rocker-arm 14 is moved in a clockwise direction by spring 25. In returning to its rest position rocker-arm 14 through pawl 23 rotates wheel 13. An adjustable set screw 26 may limit the return motion of the rocker-arm 14. This operation can now be repeated and will be noted that wheel 13 and consequently shaft 11 will be rotated forward step by step. The magnet 15 together with the link mechanism and ratchet assembly may be considered a motor for rotating the camshaft.

Referring to Figs. 1 and 3, it will be noticed that the shaft 11 carries a series of cams 27. These cams are provided with projections 28. Bearing against the surface of the cam is a spring strip 29 having a V-shaped projection 30. Mounted above spring 29 is a spring strip 31 and mounted on each of the strips are contacts 32. The strips are insulated from each other and mounted conveniently as at 33. Connected to the springs are leads 34 and 35. It will thus be noted that as the cam is rotated step by step, contacts 32 will be brought into engagement with each other when the projection 28 of cam 27 moves under the projection 30. When the low portion of cam 27 moves under the projection 30 the contacts will be separated. In this way circuit between wires 34 and 35 is open or closed depending upon the position of cam 27. By making the projections 28 subtend the distance of one or more teeth of wheel 13, the period of closure of circuit between wires 34 and 35 can be regulated.

As will appear below, four distinct positions are required, according to the present embodiment of the invention. This would make it nec-

essary for the rocker-arm 14 to move the wheel 13 through an arc of 90 degrees. While this is feasible, it is more convenient if a shorter arc can be utilized. This can be done by having several, for example, three complete cycles per revolution. In this way a motion of only 30 degrees is necessary. It will be understood that the cam and toothed ratchet wheel shown are illustrative only. If a four position cycle repeated three times in one complete revolution of the cam-shaft is used as above indicated, a three projection cam as illustrated will be used with a 12 tooth ratchet wheel. On the other hand if for example a six position cycle repeated three times is used, an 18 tooth ratchet wheel as illustrated is provided.

Referring to Figs. 1 and 2, it will be noted that the rocker-arm, in addition to controlling the action of the switches or contacts, which are cam operated, serves to cause a functioning of an additional pair of contacts. This may be achieved by, for example, having a pin 36 extending beyond the arm 14 and arranging in the path of travel of this pin a spring strip which forms a part of a strip pair mounting contact 38. Leads 39 and 40 are connected one to each of the strips 37 and it is obvious that as the arm 14 moves in a counter-clockwise direction the circuit will be closed, while when the arm moves in a clockwise direction the circuit will be opened.

The wiring diagram is shown in Fig. 4. A source of voltage supply is indicated at 41 and 42. The following description will be made on the assumption that the available voltage is alternating current. Of course the apparatus may be constructed for direct current equally well. 43 represents a switch which is mounted on the oil circuit breaker (indicated in dotted lines). This switch is arranged to close the circuit between wires 44 and 45 when the oil switch is in the open position. Assuming that an overload or similar trouble occurs on the line controlled by the oil circuit breaker, the breaker will open automatically and close switch 43. This will energize relay 46 through wires 47, 44, switch 43 and wire 45. This operates armature 48 and closes a circuit through rectifier 49 by means of wires 50 and 51, armature 48, contact 52, and wire 53. The rectifier 49 being energized, it furnishes direct current at its terminals 54 and 55. 56 represents the developed surface of the cams. The cams are notched successively from position A to B to C to D and then back to A. A is the resting or normal position and in this position contact 57 will be closed. When relay 46 operates it causes armature 58 to touch contact 59. This establishes a circuit from one terminal 56 through wire 60, armature 58, contact 59, wire 61, contact 57, resistance 62, wire 63, condenser 64, and wires 65 and 66 to the other terminal 54. It will thus be noticed that the direct current voltage of rectifier 49 is applied to the condenser 64 through the resistance 62. The condenser 65 will thus be charged at a rate determined by the rectifier voltage, resistance 62 and the capacity of condenser 64.

Shunting the condenser is a circuit consisting of relay 67 and a glow-tube 68. This glow-tube comprises a sealed bulb 69 into which the electrodes 70 extend. The bulb is filled with a suitable gas. The tube is characteristic that it is normally non-conducting, but when the voltage across its terminals reaches a certain predetermined value, the tube suddenly becomes con-

ducting and remains conducting until the voltage has dropped considerably below the critical ionizing voltage.

It will be appreciated that many values may be chosen, but by way of example the following values have been found suitable. The rectifier direct current output may be 412 volts. The condenser 64 may be a 5 m. f. condenser. It will be appreciated that the voltage across the terminals of condenser 64 will gradually build up according to the formula

$$E = E_0 \left(1 - e^{-\frac{t}{RC}} \right)$$

in which E represents the voltage across the condenser at any time t, E₀ the voltage impressed across the condenser charging circuit, R the resistance of the charging circuit in ohms, C the capacitance of the condenser in farads, and e the Napierian logarithmic base of value 2.718. The glow-tube may have a critical ionizing voltage of 260 volts. It will therefore be appreciated that the condenser voltage will reach the critical ionizing voltage of glow-tube 69 at a time in seconds which equals the value of resistance 62 divided by 200,000. For example, if resistance 62 is 200,000 ohms, the condenser will charge to the critical voltage in one second. If resistance 62 is 1 million ohms, the time required will be 5 seconds, etc.

When the glow-tube becomes conducting the energy stored in condenser 64 discharges through glow-tube 69 and relay 67, operating relay 67 momentarily. This closes a circuit through wire 71, armature 72, contact 73, wire 17, solenoid 15 and wire 18, operating solenoid 15. Solenoid 15 cocks the notching mechanism. Most of the energy stored in condenser 64 has been utilized in the momentary operation of relay 67. However, to make sure that no energy remains in condenser 64, solenoid 15 when completely energized closes circuit between wires 39 and 40 which shunts a low value resistance 74 across the condenser 64, completely discharging the condenser. Glow-tube 69 becomes non-conducting and relay 67 drops to its deenergized position. This breaks the energizing circuit of solenoid 15 which drops to its deenergized position. In doing so the notching mechanism moves the cams to position B. While relay 67 was energized it momentarily closes circuit between wires 75 and 76. This circuit may be used to operate the closing mechanism of the circuit breaker and thus the circuit breaker is reclosed.

In position B contact 77 is closed maintaining the energizing circuit of rectifier 49. It will be appreciated that this contact is closed in positions B, C and D. This may be achieved by having the switch therefor cooperate with one of the cams positioned upon the shaft 11, or by mounting an additional cam upon the shaft. Thus, whether or not relay 46 is energized or deenergized, the mechanism continues to function.

Assuming the overload or short circuit to persist on the line, the circuit breaker will again open. In position B there is provided a charging circuit from terminal 55 through wire 78, contact 79, resistance 80, wire 63, condenser 64, and wires 65 and 66 to terminal 54. The condenser will thus be charged at a rate depending upon the value of resistance 80. As soon as the condenser 64 has been charged to the critical voltage of tube 69, it flashes over and the notching arrangement described above occurs again, reclosing the oil circuit breaker a second time. The cams are now

in position C. The new charging circuit thus provided goes through contact 81 and resistance 82 instead of contact 79 and resistance 80. At a time determined by resistance 82 the notching operation will again repeat, reclosing the circuit breaker another time and notching the cams to position D. Assuming that the circuit breaker again opens, it will be noticed that in position D the only contact closed in the charging circuit for the condenser is contact 83. Due to the fact that relay 46 is energized, armature 58 will not be touching contact 84, and thus no charging circuit for condenser 64 will exist. Thus no further notching operation takes place. The oil circuit breaker remains open and has to be reclosed by hand, presumably after the trouble has been remedied. After it has been put in by hand, switch 43 will open and relay 46 becomes deenergized. This establishes the charging circuit through contact 84 and contact 83 and resistance 84. After a time determined by resistance 84 the notching operation again occurs and the cams return to position A, the rectifier becomes deenergized and the apparatus returns to normal.

It will thus be noted that there is provided an apparatus which recloses the circuit breaker three times, but after the third time leaves the breaker open until the trouble has been remedied. However, after the circuit breaker has been closed by hand the machine times a protective period (as determined by the resistance 84), before it returns to the normal rest position. If the trouble is only a temporary one and the breaker remains in after the first, second or third reclosing, then the apparatus, after going through its cycle and providing the protective period, returns to normal. As a rule this protective period is two minutes or more and thus, if the breaker remains in for a period of two minutes or more it may be assumed that the trouble has passed.

It will be appreciated that the apparatus may be arranged for only two reclosings by omitting position C on the cams. Similarly, additional reclosings may be provided by additional cam positions. If for any reason it is desired that the circuit breaker should be intentionally opened, means may be provided to disconnect the reclosing mechanism from the circuit so that repairs or tests may be accomplished without interference or annoyance. It will also be apparent that any number of changes in construction and rearrangement of the parts might be resorted to without departing from the spirit of the invention as defined by the claims.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A control mechanism for association with circuit breakers, said mechanism including means controlling a closing of the circuit breaker, means for actuating said controlling means a plurality of times, means connected to said apparatus for initiating the operation of said controlling means in response to an initial opening of said circuit breaker, said mechanism in response to such initial opening operating cyclically to provide such plurality of control actuations, means responsive to an opening of the circuit breaker after such plurality of closing actuations to render said mechanism ineffective to provide further closing actuations; and means forming a part of said mechanism for restoring the same to its initial condition responsive to said circuit breaker being manually closed and remaining closed for a predetermined period to operate through a second cycle responsive to a further actuation of the

circuit breaker with which said mechanism is associated.

2. A control mechanism for association with circuit breakers, said mechanism including a switch which when closed causes a closing of the circuit breaker, a motor, a second switch actuated by an initial opening of the circuit breaker with which said mechanism is associated and connected to said motor to initiate the operation thereof, an electromagnet connected to said first named switch to control the actuation thereof, a flash tube in series with said electromagnet, a condenser in shunt with said tube and electromagnet, a plurality of resistances connected to said condenser, and means operated by said motor to sequentially connect said resistances to a source of electrical current supply whereby during such motor operation said electromagnet will be periodically energized to actuate said first named switch a predetermined number of times.

3. A control mechanism for association with circuit breakers, said mechanism including a switch which when closed causes a closing of the circuit breaker, a motor, a second switch actuated by an initial opening of the circuit breaker with which said mechanism is associated and connected to said motor to initiate the operation thereof, an electromagnet connected to said first named switch to control the actuation thereof, a flash tube in series with said electromagnet, a condenser in shunt with said tube and electromagnet, a plurality of resistances connected to said condenser, means operated by said motor to sequentially connect said resistances to a source of electrical current supply whereby during such motor operation said electromagnet will be periodically energized to actuate said first named switch, and means connected to said electromagnet to short circuit said condenser each time said electromagnet is energized.

4. A control mechanism for use in association with a circuit breaker, said mechanism including means responsive to an opening of the breaker to provide an impulse for automatically reclosing the same, means functioning after a predetermined number of such reclosing impulses in response to a further opening of the circuit breaker to render said mechanism inoperative to automatically reclose said circuit breaker, and means forming a part of said mechanism to restore the same to its initial condition only after the expiration of an interval of time after said circuit breaker has been manually re-closed.

5. A control mechanism for association with a circuit breaker and including a shaft, a motor connected to said shaft to intermittently move the same, cams mounted upon said shaft, switches sequentially actuated by said cams, means responsive to the actuation of said switches to control the time period elapsing before the next intermittent movement and to give an impulse for reclosing the circuit breaker upon the latter opening, and means responsive to an initial opening of the circuit breaker for initiating operation of the motor.

6. A control mechanism for association with a circuit breaker, said mechanism including a motor, a shaft connected to said motor to be intermittently moved thereby, cams secured to said shaft, switches sequentially actuated by said cams, means connected to said switches and controlling the interval of time elapsing between one movement of the shaft and a succeeding movement thereof, means also connected to said switches for giving an impulse for reclosing the

circuit breaker, and means connected to said motor to initiate an operation thereof in response to an initial opening of said circuit breaker.

- 5 circuit breakers, said mechanism including a means controlling a closing of the circuit breaker, operating means for operating said controlling means a plurality of times, means connected to said circuit breaker for initiating the cycle of operations of said controlling means in response to an initial opening of said circuit breaker, and timing means including a condenser and means for varying the charge on said condenser and means operable upon the charge on said condenser reaching a predetermined value cooperable for predetermining the time interval between such actuations, a plurality of control circuits for governing said timing means to time different intervals, and selective means operated by said operating means upon each operation of said controlling means to connect another one of said control circuits to said timing means to provide an appropriate time interval.

8. A control mechanism for association with a circuit breaker and including a shaft, a motor connected to said shaft to intermittently move the same, cams mounted upon said shaft, switches

sequentially actuated by said cams as said shaft moves, means operable a predetermined time after the actuation of each of a plurality of said switches to reclose the circuit breaker upon the latter opening and to actuate said motor to move said shaft to actuate the next of said switches, and means responsive to an initial opening of the circuit breaker for initiating operation of the motor to actuate the first of said switches.

9. A control mechanism for use in association with a circuit breaker, said mechanism including means responsive to an opening of the breaker to provide a series of impulses for automatically reclosing the same separated by predetermined time periods, said means including a condenser, means for charging said condenser, a flash tube and a relay in series across said condenser and operable when said condenser reaches a predetermined charge to give the impulse for reclosing said circuit breaker, a plurality of control circuits to govern the charging time of said condenser and thus to govern said time periods, and means operated by said relay to disconnect one control circuit and connect another when said relay operates to give the reclosing impulse.

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