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C. E. SCHNELL ET AL

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CIRCUIT BREAKER RECLOSING RELAY

Filed Oct. 24, 1923

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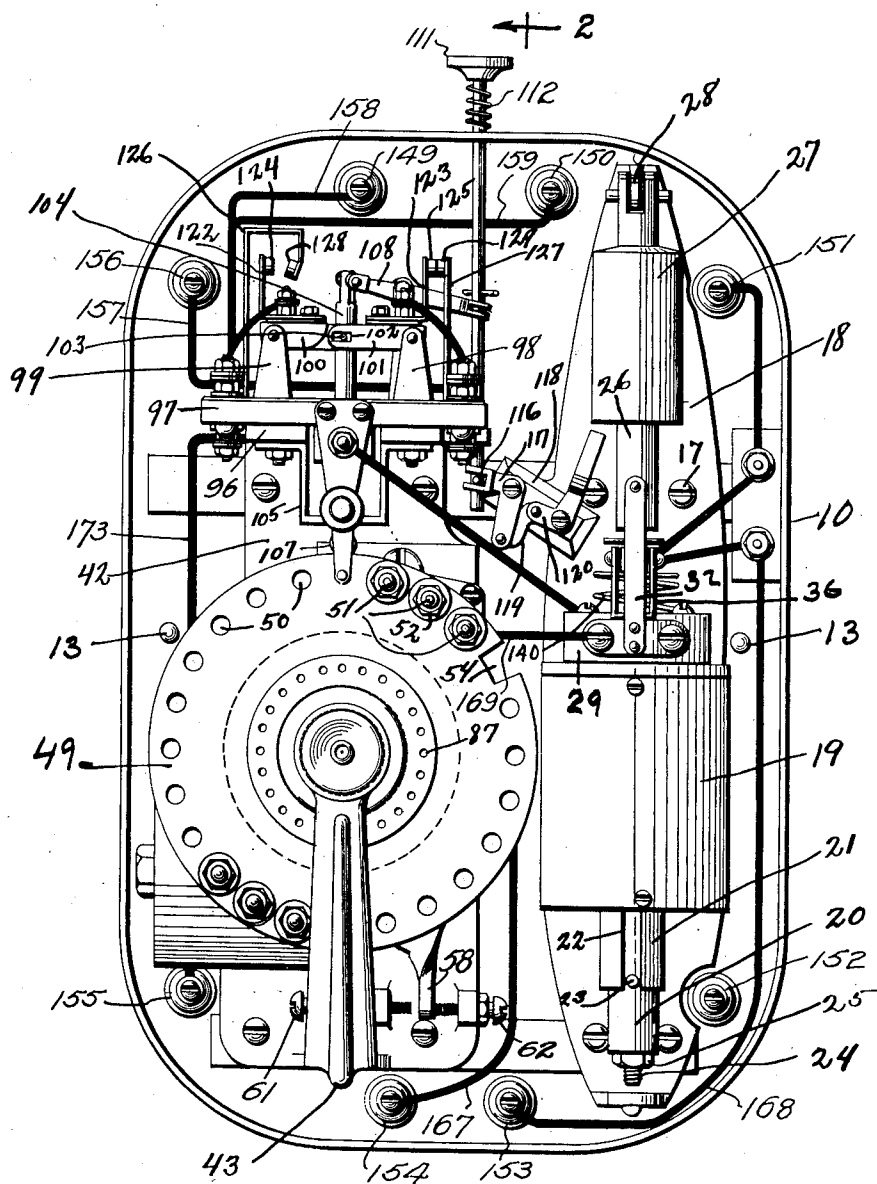


Fig 1.

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INVENTORS
CHARLES E. SCHNELL
ERNEST K. SADLER
BY
Frank Waterfield
ATTORNEY

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C. E. SCHNELL ET AL

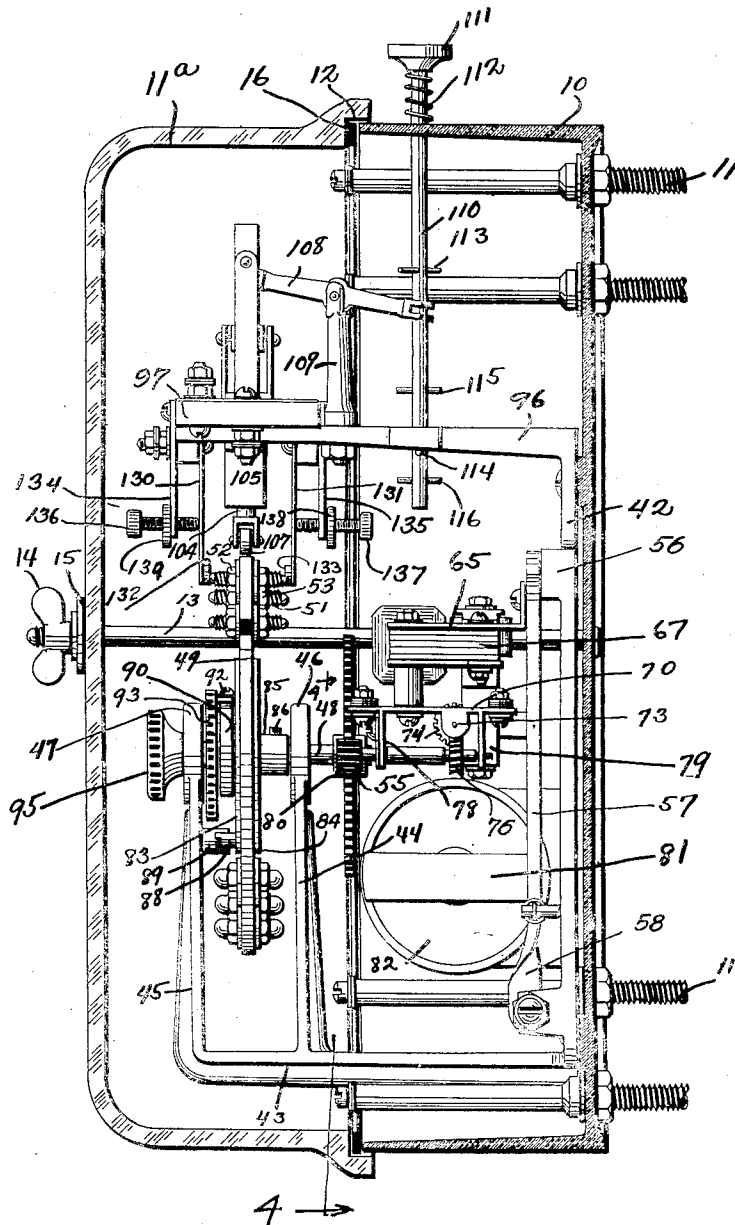
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Fig. 2.



INVENTORS
CHARLES E. SCHNELL
ERNEST K. SADLER
BY
Frank Waterfield
ATTORNEY

Dec. 8, 1931.

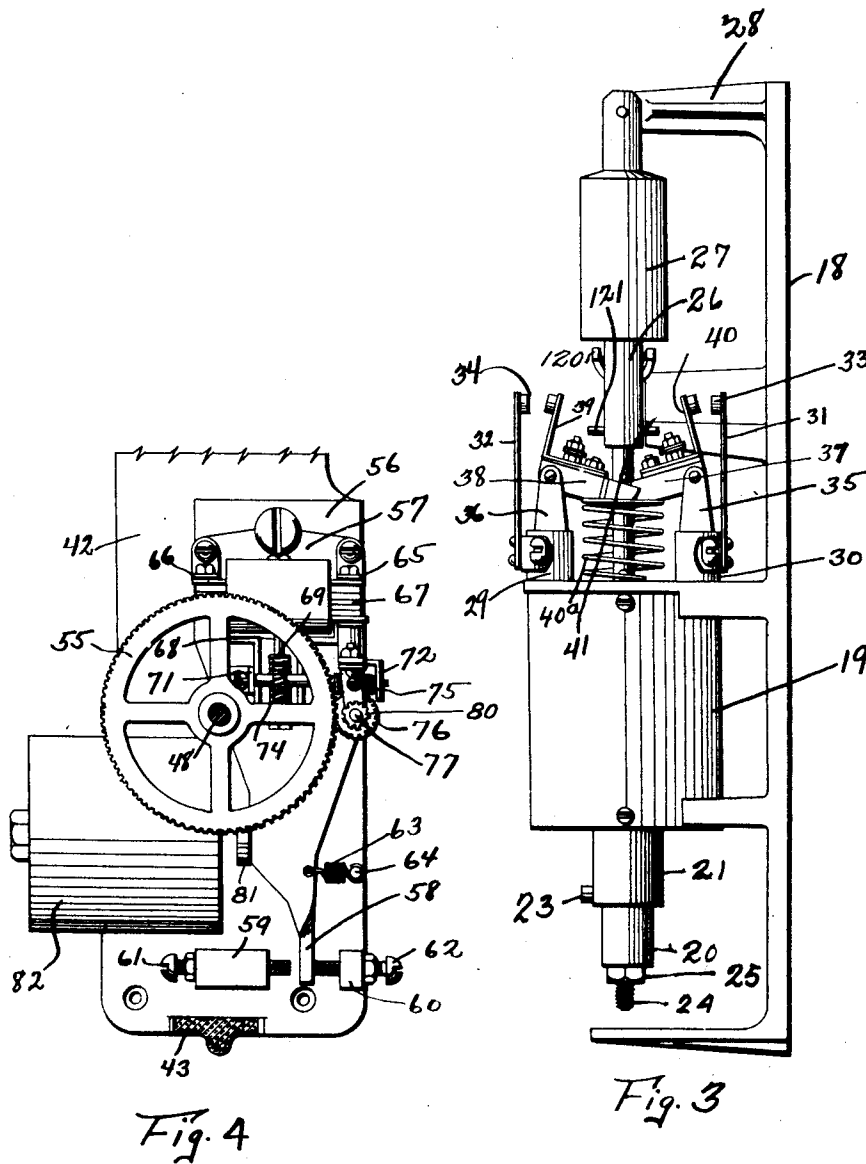
C. E. SCHNELL ET AL

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INVENTORS
CHARLES E. SCHNELL
ERNEST K. SADLER
BY
Frank Watfield
ATTORNEY

Dec. 8, 1931.

C. E. SCHNELL ET AL

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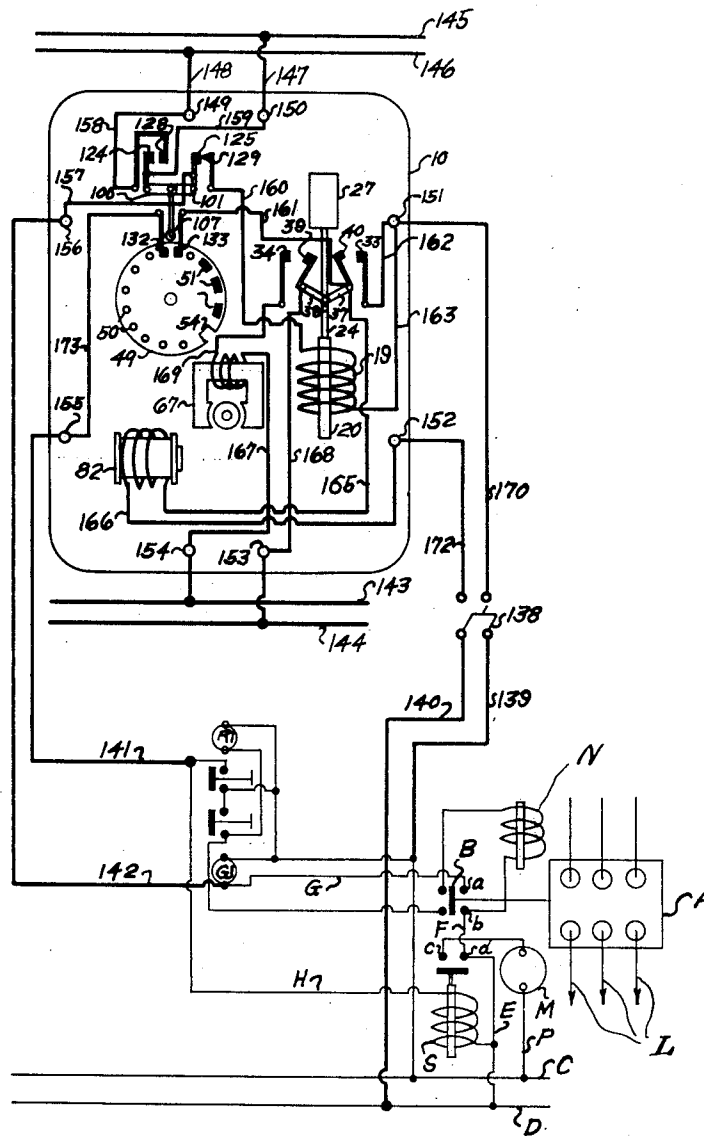


Fig. 5.

INVENTOR.
Charles E. Schnell
Ernest K. Badler
BY
F. C. Kuebler.
ATTORNEY.

UNITED STATES PATENT OFFICE

CHARLES E. SCHNELL AND ERNEST K. SADLER, OF FRESNO, CALIFORNIA

CIRCUIT BREAKER RECLOSING RELAY

Application filed October 24, 1923. Serial No. 670,467.

Our invention relates primarily to a relay for use in the control circuit of an oil circuit breaker or switch and it has for its object the provision of means set in motion by the opening of the circuit breaker or switch by reason of an overload, or other adverse conditions, for testing the circuit by automatically reclosing the circuit breaker or switch a predetermined number of times. In the event the adverse conditions causing the trouble have been removed the circuit breaker or switch will remain closed, and the relay will automatically reset itself to its starting position. Otherwise the same will be locked out. After the trouble on the line fed from the switch has been remedied the relay may be unlocked permitting the switch to be closed.

It is one of the objects of our invention to provide a device of the above character which may be easily and quickly installed or incorporated in a circuit already in operation without materially altering or interfering with the same.

A further object is to provide a device of the above character which will be simple and efficient in operation, automatic in action, and which when once installed will require but the minimum of attention.

Other objects and advantages will appear hereinafter, and while we have shown and will describe the preferred form of our invention, we wish it to be specifically understood that we do not limit ourselves to such preferred form, but that various changes and adaptations may be made therein without departing from the spirit of our invention.

In the drawings accompanying and forming a part hereof:

Fig. 1 is a front elevation of our device as positioned for use, with the cover removed.

Fig. 2 is a section on the line 2—2 of Fig. 1, showing the cover.

Fig. 3 is a side elevation of a portion of our device removed from its case.

Fig. 4 is a section taken on the line 4—4 of Fig. 2, with parts omitted for clearness of illustration.

Fig. 5 is a wiring diagram of our device connected to one type of circuit breaker reclosing system.

The heavy lines showing our device and its connections to one form of an existing remote control circuit for an oil or air circuit breaker.

Referring to the drawings, our device comprises an outer pan-shaped base or casing 10 provided in the bottom thereof with terminal studs indicated generally by the numeral 11 by means of which the same is secured to a switchboard or other place of use. The outer or open end of casing 10 is closed by a detachable closure 11a, preferably of glass, which is provided with a recess 12 in its open end, of a size and configuration to receive the open end of casing 10, and is held positioned by studs 13 one end of each of which is rigidly mounted in the bottom wall of casing 10. The other end of each of the studs 13 projects through apertures near each side of closure 11a and is provided with a wing nut 14 and a washer 15. Suitable shock absorbing or insulating material 16 is mounted within recess 12, the purpose of which will be obvious.

Rigidly mounted upon the inner face of the bottom wall of base 10, by means of screws 17, is a bracket 18 in which is mounted, centrally thereof, a vertically extending solenoid 19 provided with a plunger 20. Solenoid 19 is iron bound and is provided on its lower end with a downwardly extending sleeve 21 in the sides of which is a vertically extending groove or slot 22 for the reception of a pin 23 on the lower end of the plunger 20 and serves to prevent rotation of the plunger 20 relative to solenoid 19. Plunger 20 is provided with a central longitudinal bore the lower end of which is threaded, and in this bore is mounted a rod 24 the lower end of which is threaded for operative engagement with the threaded end of plunger 20, a lock nut 25 on the lower end of rod 24 serving to lock the same in its adjusted position. This construction is provided to permit adjustment of the length of travel of plunger 20, as will be hereafter more fully explained.

The upper end of rod 24 is secured to the lower end of a plunger 26 of a retarding means in the form of a dash pot 27. Dash pot 27 is pivotally connected at its upper end to an arm 28 extending forwardly from the

upper end of bracket 18. Extending upwardly from the top of solenoid 19, at opposites thereof, are blocks 29 and 30 of insulating material, to which are secured the lower ends of fixed contact members 31 and 32, which contact members extend upwardly and have provided on their free ends contact points 33 and 34. Extending upwardly from the top of blocks 29 and 30 are brackets 35 and 36 which are preferably bifurcated and in these bifurcated ends are rockably mounted movable contact carrying members 37 and 38 in the upper faces of which are mounted movable contact points 39 and 40 insulated therefrom. The free ends of members 37 and 38 extend towards each other and pass on opposite sides of plunger rod 24, resting against a spring 40a positioned above the upper end of the solenoid 19. Rod 24 is provided with a horizontally extending pin 41 which is of a length sufficient to pass over the free ends of members 37 and 38 and move the same downwardly, as hereafter explained.

Mounted upon the rear wall of casing 10, at the side of bracket 18, is a bracket 42 provided at its lower end with a forwardly extending arm 43 which arm is in turn provided with two spaced upstanding arms 44 and 45 the upper ends of which terminate in bearings 46 and 47. Revolvably mounted in bearings 46 and 47 is a shaft 48 carrying a switch member in the form of a disc 49 of insulating material, this disc being provided around its outer edge with a plurality of equally spaced holes 50, in which holes are adapted to be removably mounted circuit closing studs 51. The studs 51 have their ends threaded for the reception of nuts 52 and 53 by means of which said studs are held positioned in holes 50. The projecting ends of studs 51 are provided with rounded contact points. Provided in the periphery of disc 49, in lieu of one of the holes 50, is a locking notch 54 by means of which said disc is locked against rotation, as hereinafter explained. Shaft 48 projects inwardly a short distance beyond bearing 46 and rigidly mounted upon this projecting end is a gear 55.

Projecting outwardly from bracket 42, near the upper end thereof, is a lug 56 upon the free end of which is pivotally mounted one end of a control plate 57. Plate 57 extends downwardly and is provided at its lower end with a right angled lip 58. Extending outwardly from bracket 42, at opposite sides of lip 58, are abutments 59 and 60 in which are operatively mounted adjusting screws 61 and 62, which screws, with lip 58, control the amount of oscillation of plate 57. Connected at one end to the outer edge of plate 57, a short distance above lip 58, is a coil spring 63 the other end of which is mounted upon a stud or pin 64 mounted in

bracket 42 and serves to hold lip 58 in contact with screw 62, thereby holding plate 57 in its inoperative position.

Mounted upon the upper end of plate 57, by means of brackets 65 and 66, is a motor 67 on a shaft 68 of which is rigidly mounted a worm 69. Secured to the under side of motor 67 is a bracket 70 provided at each side thereof with downwardly depending bearings 71 and 72, and in these bearings are revolvably mounted the ends of a shaft 73. Rigidly mounted upon shaft 73, near bearing 71, and in operative engagement with worm 69 of shaft 68, is a worm wheel 74. Rigidly mounted upon shaft 73, near bearing 72, is a worm 75. Worm 75 meshes with a worm wheel 76 rigidly mounted upon a shaft 77 near one end thereof. Shaft 77 is revolvably mounted in bearings 78 and 79 depending downwardly from bracket 70, at right angles to bearings 71 and 72, and has rigidly mounted upon one end thereof a gear 80 which is adapted when plate 57 is oscillated into operative position to mesh with gear wheel 55 to rotate disc 49, thus forming a magnetically actuated clutch mechanism connecting the motor 67 and the disc 49. Extending outwardly from plate 57, near the lower end thereof, is an arm 81 which acts as a clapper for a magnet 82. Magnet 82 is iron bound and is mounted at one end upon a bracket extending outwardly from bracket 42. Disc 49 is preferably secured to shaft 48 by means of flanges 83 and 84 riveted thereto, and a hub 85, which hub is secured to said flanges in any suitable manner. Hub 85 is provided with a set screw 86 by means of which the position of said hub and its complement parts is secured upon shaft 48. The outermost flange 83 is provided near its outer edge with a plurality of internally threaded holes 87 any one of which is adapted to receive a stop pin 88 which is adapted to engage a similar pin 89 which is adapted to extend inwardly from the inner face of arm 45. Coiled around shaft 48, between flange 83 and the inner face of bearing 47, is a spiral spring 90 the inner end of which is attached to shaft 48 and the other end of which is mounted upon a pin 92 extending inwardly from an adjusting disc 93. Disc 93 is provided with an integral sleeve which projects through bearing 47 loosely and has its free end threaded for the reception of a lock nut 95 so that by tightening this lock nut the spring 90 may be held wound to any desired degree. Sleeve 94 is hollow and supports the outer end of shaft 48.

Extending outwardly from the upper end of bracket 42 is an arm 96 the free end of which is bifurcated. Mounted upon the upper face of arm 96, to extend across said bifurcated end, is a plate 97 of fibre or other suitable insulating material. Extending upwardly from the top of plate 97, at oppo-

site ends thereof, are brackets 98 and 99 which are preferably bifurcated and in these bifurcated ends are rockably mounted movable contact carrying members 100 and 101 in the free ends of which are provided slots 102 for the reception of a pin 103. Pin 103 is mounted near the upper end of a vertical lockout shaft 104. Depending downwardly from the under side of arm 96 is a substantially U-shaped bracket 105, the lower cross bar of which serves as a guide for the lower end of shaft 104. The lower end of shaft 104 is bifurcated and carries a roller 107 adapted to normally roll on the periphery of disc 49 and to drop into notch 54 to lock disc 49 against return to normal when this roller reaches this notch.

The upper end of shaft 104 is pivotally connected to one end of a lever 108 which lever is pivotally mounted intermediate its ends in the upper end of a standard 109 extending upwardly from arm 96. The other end of lever 108 is bifurcated to straddle a resetting shaft 110 the upper end of which projects through the top wall of casing 10 and terminates in a button or head 111. Coiled around shaft 110, between button 111 and casing 10, is a coil spring 112 which serves to hold shaft 110 in its uppermost position. Provided in shaft 110, just above the end of lever 108, is a pin 113 for a purpose to be hereafter explained. Pins 114 and 115 in shaft 110 provide means for limiting the up and down movement respectively of said shaft.

Provided in the lower end of shaft 110 is a pin 116 the ends of which project between the furcations of one ends of a bell crank 117. Crank 117 is pivotally mounted upon the free end of a projection 118 extending forwardly from bracket 18 and has the free end of its other longer arm pivotally connected to one end of a link 119. The other end of link 119 is pivotally connected to the short end of a bell crank 120, pivotally mounted on the end of projection 118. The other longer end of crank 120 is forked and straddles plunger 26 when in its operative position and engages a pin 121 in plunger 26 to prevent upward movement of plunger 26.

Mounted upon the upper faces of contact carrying members 100 and 101, insulated therefrom, are upwardly extending contacts 122 and 123 provided with contact points 124 and 125. Extending upwardly from plate 97, at each end thereof, are contacts 126 and 127 provided on their free ends with contact points 128 and 129 adapted to engage contact points 124 and 125. Depending downwardly from plate 97, on opposite sides of disc 49, are spring contacts 130 and 131 provided with contact points 132 and 133 adapted for engagement by studs 51, the contact points 132 and 133 cooperating with

the studs on the switch member to form a reclosing switch for a circuit breaker connected thereto in a manner to be hereinafter described. Extending downwardly from plate 97, at each end thereof, are arms 134 and 135 the lower ends of which are threaded, and in these threaded ends are adjustably mounted adjusting screws 136 and 137 by means of which the pressure of contact points 132 and 133 against studs 51 is regulated. Lock nuts 138 and 139 are provided to lock screws 136 and 137 in their adjusted positions.

For the purpose of clearness in the following description of the operation of our device, we shall refer to the contact points 33 and 40 as comprising a clutch-control switch, this terminology appearing also in the appended claims. Similarly, the contact points 34 and 39 are designated as a motor-control switch, while the contact points 124 and 128 are designated an alarm switch. So also, contact points 125 and 129 comprise a lockout switch and the solenoid 82 has been termed a clutch solenoid to differentiate this solenoid from the solenoid 19 which has been termed an energizing solenoid. So also, the studs 51 have been termed primary contacts, while the contact points 132 and 133 have been termed secondary contacts for the purpose of clearness and definiteness.

The terminal studs 11 serve a dual purpose of holding the relay of our invention to a switch board and of forming terminals 149 to 156 inclusive which connect the internal and external wiring of the relay.

Referring particularly to Fig. 5 we illustrate a wiring diagram of our device in conjunction with one type of circuit breaker reclosing system to which our relay may be connected. This choice of system is merely an arbitrary one, and it should be understood that we are not limited to the use of this type of reclosing system, this system being shown in light lines in Fig. 5.

Fig. 5 illustrates our invention as connected to a circuit breaker A having a closing mechanism M which is operated when the solenoid of an auxiliary relay S is energized. The energization of this auxiliary solenoid shunts a pair of contacts *c* and *d*, thus completing a circuit through the mechanism M and through leads E and P which are connected respectively to conductors C and D of a control bus. We prefer to energize this bus with direct current, but this choice is not essential to the utility of our invention.

One terminal of the auxiliary solenoid S is connected to lead E and to a conductor H which is in turn connected to the terminal stud 155 by a conductor 141. This terminal stud is also connected to the contact point 132 of the secondary contacts of the reclosing switch by a conductor 173. The contact point 133 of this switch is connected to the

movable contact 40 of the clutch control switch by a conductor 161, this movable contact being also connected to one terminal of the winding of the clutch solenoid 82 by a conductor 165. A conductor 166 connects the other terminal of the winding of the solenoid 82 to the terminal stud 152 which is in turn connected by conductors 172 and 140 to the bus conductor D through a switch 138. The switch 138 is of double-pole construction and is also included between conductors 139 and 170 which join the control bus conductor C to the terminal stud 151, this stud being connected to one terminal of the winding of the energizing solenoid 19 by a conductor 163 and to the stationary contact point 33 of the clutch-control switch by a conductor 162. A conductor 160 connects the other terminal of the winding of the solenoid 19 to the stationary contact point 129 of the lockout switch. The contact point 125 of the lockout switch is connected by a conductor 157 to the terminal stud 156 which is in turn connected to a conductor 142 leading to a terminal *a* of a pallet switch B. This pallet switch has another contact *b* which is connected to the contact *d*. The movable element of the pallet switch B is mechanically connected to the circuit breaker A so that this movable element shunts across the terminals *a* and *b* when the circuit breaker opens.

An alarm circuit is formed by conductors 145 and 146 which are respectively connected to terminal studs 150 and 149 by conductors 147 and 148, these terminal studs being in turn respectively connected to movable and stationary contact points 124 and 128 of the alarm switch by conductors 159 and 158. Thus, the alarm circuit is closed when the contact points of the alarm switch come into engagement.

The motor 67 is adapted to receive energy from a motor bus composed of conductors 144 and 143, respectively connected through terminal studs 153 and 154, and through conductors 168 and 167, to the movable contact point 39 of the motor-control switch and to one terminal of the motor 67. The other terminal of the motor is connected to the stationary contact point 34 of the motor-control switch by a conductor 169 so that when the contact points of the motor-control switch are in engagement, the motor 67 will be put into operation.

Upon the occurrence of an adverse condition on the circuit the circuit breaker A opens, due to the action of a tripping coil N, or other device, and the contacts *a* and *b* of the pallet switch are closed, thus completing a circuit through conductors E, G, 142 and 157, the current passing through the lockout switch (at this time closed) and through the winding of the solenoid 19 by way of the conductor 160, this current re-

turning to the control bus through conductors 163, 170 and 139. This energizes the solenoid 19 and moves the plunger 20 from its retracted position shown in Fig. 3 into an advanced position, thus simultaneously closing the motor control switch and the clutch-control switch.

The closing of the motor-control switch completes a circuit from the motor bus through the conductors 168, 169, and 167, thus energizing the motor 67. Simultaneously, the closing of the clutch-control switch completes a circuit through conductors 139, 170, 162 and 165, the current then passing through the winding of the clutch solenoid 82 and returning through conductors 166, 172 and 140 to the control bus.

This energization of the clutch solenoid 82 moves the control plate 57 until the lip 58 engages the adjusting screw 61, this movement taking place against the action of the spring 63. The adjusting screw 61 is so adjusted that the gear 80 at this time comes into operative engagement with the gear wheel 55. The clutch means formed by the gear 80 and gear wheel 55 will remain in position to operatively connect the motor 67 and the disc 49 as long as current is flowing through the solenoid 82, this current being only interrupted when the clutch-control switch is opened.

When the disc 49 is rotated a distance sufficient to bring the first stud 51 into engagement with the contact points 132 and 133, current passes through conductors 139, 170 and 162, this current reaching the contact point 133 through conductor 161 and the motor-control switch. The stud 51 carries the current to the contact point 132 whence it returns to the control bus through conductors 173, 141 and H, passing through the auxiliary solenoid S on its way. This energizes the solenoid S and causes the contacts *c* and *d* to be bridged, thus sending current through the reclosing mechanism M and reclosing the contacts of the circuit breaker A.

If the adverse condition has been removed from the circuit in which the circuit breaker A is connected, the relay of our invention will shut down after a predetermined time interval, due to the pallet switch B opening the circuit between the contacts *a* and *b*. When this circuit is opened, no current will flow through the energizing solenoid 19, and the plunger 20 thereof will tend to drop downward into a retracted position. This downward movement is retarded by the dash pot 27 so that the clutch-control switch and motor-control switch are not opened immediately but are held in closed position by the spring 140 until the pin 41 lowers into engagement with the contact-carrying members 37 and 38. This simultaneously opens the clutch-control switch and motor-control switch and thus de-energizes the clutch sole-

noid 82 and the motor 67. The spring 63 thus draws the control plate 57 into such a position that the clutch means is disengaged. This releases the gear wheel 55 and allows the spiral spring 90 to return the disc 49 to its former position at which time the stop pin 88 engages the stop pin 89.

Should the adverse condition remain on the circuit after the breaker has been once reclosed, the tripping coil N, or an equivalent means, will immediately open the circuit breaker A, thus again completing a circuit through the solenoid 19 which again moves the plunger 20 into advanced position. The dash pot 27 is so regulated that the plunger 20 does not open the motor and clutch-control switches until after the breaker A has had time to again open if the adverse condition remains on the circuit. The clutch solenoid 82 and motor 67 are thus not de-energized, but continuously cooperate to turn the disc 49 until the second stud 51 bridges the contact points 132 and 133. At this instant, the reclosing mechanism M is again energized and again recloses the circuit breaker A.

In the event that the adverse condition on the circuit is a permanent one, it is desirable to lock the relay in inoperative position relative to the circuit breaker A after the occurrence of a predetermined number of reclosings, depending upon the number of studs 51 placed in the disc 40. This is accomplished when the disc 49 is rotated to such an extent that the roller 107 drops into the notch 54, thus separating the contact points 125 and 129 of the lockout switch and moving into engagement the contact points 124 and 128 of the alarm switch. This opening of the lockout switch de-energizes the solenoid 19, while the closing of the alarm switch completes a circuit through the conductors 145 and 146 and through the visible or audible signal connected thereto. The de-energization of the solenoid 19 of course de-energizes the motor 67 and clutch solenoid 82.

Before the relay can again be placed in operative relation relative to the circuit breaker A after a lockout has taken place, the operator must depress the button 111. This raises the roller 107, opens the alarm switch, and closes the lockout switch. Simultaneously, the movement of the button 111 causes the bifurcated end of the bell crank 120 to engage the pin 121, thus preventing any upward movement of the plunger 20. This is necessary when it is understood that the spiral spring 90 returns the disc 49 to its original position as soon as the roller 106 is lifted from the notch 54. As the terminal studs successively pass the contact points 132 and 133, a circuit is successively completed through the reclosing switch. The solenoid 19 is also at this time energized if the circuit breaker A has remained open, thus tending to force the plunger 20 into advanced posi-

tion. The bifurcated end of the bell crank 120 prevents this movement of the plunger and thus prevents a closing of the clutch-control switch and motor-control switch, thus preventing the reclosing of the circuit breaker A during the reverse movement of the disc 49.

The time interval between successive energizations of the auxiliary solenoid S, and thus between successive reclosings of the circuit breaker A, is adjustable by varying the spacing of the studs 51 in the holes 50. Thus, by separating these studs a greater distance, the time interval between reclosings is increased. Similarly, the desired number of reclosings before lockout may be regulated by the number of studs 51. The time interval between the first opening of the breaker A and lockout may be regulated by changing the position of the pin 88 in the holes 87, thus regulating the position to which the disc 49 may be returned under the action of the spiral spring 90 and consequently the distance this disc must travel before the roller 107 drops into notch 54.

It should be clear that our invention is applicable not only to the particular circuit shown, but is applicable also to any system requiring one or more energizations of an operating circuit due to one or more energizations of a control circuit. The control circuit in the present illustration includes the solenoid 19 and the pallet switch B, with the lockout switch as an auxiliary accessory. Similarly, the operating circuit includes the reclosing switch with its studs 51 and contact points 132 and 133 or an equivalent switch.

In certain of the appended claims we have termed the motor 67 a constant speed motor, but this term should not be interpreted to include only such types of motors as maintain unvarying speeds with different loads, such as a synchronous motor. The term is used in these claims to differentiate our invention from certain other devices employing magnetically operated pawls to effect the intermittent movement of a switch member. Thus, our motor is one which imparts to the disc 49 a continuous movement during the time of operation thereof rather than an intermittent movement.

It will be seen that the circuit breaker is of the conventional type, being provided with a closing means M which is adapted when energized to close the breaker, and a conventional tripping means, including the relay S. The circuit breaker also includes the pallet switch B, all of these instrumentalities being found in the conventional type of electrically operated circuit breaker. The energizing solenoid and its associated wiring may be conveniently termed "energizing means" for purposes of identification. The rotating disk 49 with its associated parts is of course

a sequence controlling means, the sequence of operations of the device being controlled by the positions of the members 51. Other instrumentalities well known in the art for performing the same functions can of course be substituted for all of the above instrumentalities.

Having described our invention, what we claim is:

1. A reclosing mechanism for use with a circuit breaker having main contacts, a tripping coil, a closing coil, and a pallet switch, comprising: a sequence controlling means; an energizing means including a coil so connected as to be energized while said pallet switch is closed due to said circuit breaker being open, and when so energized to throw said energizing means into its active position; means by which said energizing means causes said sequence controlling means to move at a definite rate from a primary position toward a secondary position at a definite rate during the time said energizing means is in its active position; means by which said sequence controlling means may repeatedly close said circuit breaker by energizing its closing coil at definite positions of said sequence controlling means between said primary and secondary positions; a dash-pot so embodied in said energizing means as to hold said energizing means in its active position (with the coil of said energizing means deenergized) for a sufficient period to allow said circuit breaker to be closed and immediately open under overload; and a locking member for mechanically locking said sequence controlling means in its extreme secondary position whenever it reaches that position.
2. A reclosing mechanism for use with a circuit breaker having main contacts, a tripping coil, a closing coil, and a pallet switch, comprising: a sequence controlling means; an energizing means including a coil so connected as to be energized while said pallet switch is closed due to said circuit breaker being open, and when so energized to throw said energizing means into its active position; means by which said energizing means causes said sequence controlling means to move at a definite rate from a primary position toward a secondary position at a definite rate during the time said energizing means is in its active position; means by which said sequence controlling means may repeatedly close said circuit breaker by energizing its closing coil at definite positions of said sequence controlling means between said primary and secondary positions; a dash-pot so embodied in said energizing means as to hold said energizing means in its active position (with the coil of said energizing means deenergized) for a sufficient period to allow said circuit breaker to be closed and immediately open under overload; a locking mem-

ber for mechanically locking said sequence controlling means in its extreme secondary position whenever it reaches that position; and means by which an operator may release said sequence controlling means from said secondary position.

3. A reclosing mechanism for use with a circuit breaker having main contacts, a tripping coil, a closing coil, and a pallet switch, comprising: a sequence controlling means; an energizing means including a coil so connected as to be energized while said pallet switch is closed due to said circuit breaker being open, and when so energized to throw said energizing means into its active position; means by which said energizing means causes said sequence controlling means to move at a definite rate from a primary position toward a secondary position at a definite rate during the time said energizing means is in its active position; means by which said sequence controlling means may repeatedly close said circuit breaker by energizing its closing coil at definite positions of said sequence controlling means between said primary and secondary positions; a dash-pot so embodied in said energizing means as to hold said energizing means in its active position (with the coil of said energizing means deenergized) for a sufficient period to allow said circuit breaker to be closed and immediately open under overload; a locking member for mechanically locking said sequence controlling means in its extreme secondary position whenever it reaches that position; a lockout switch actuated whenever said sequence controlling means reaches its final position for opening the circuit through the coil of said energizing means; and means by which an operator may release said sequence controlling means from said secondary position.

In witness that we claim the foregoing we have hereunto subscribed our names this 16th day of August, 1923.

CHARLES E. SCHNELL.
ERNEST K. SADLER.