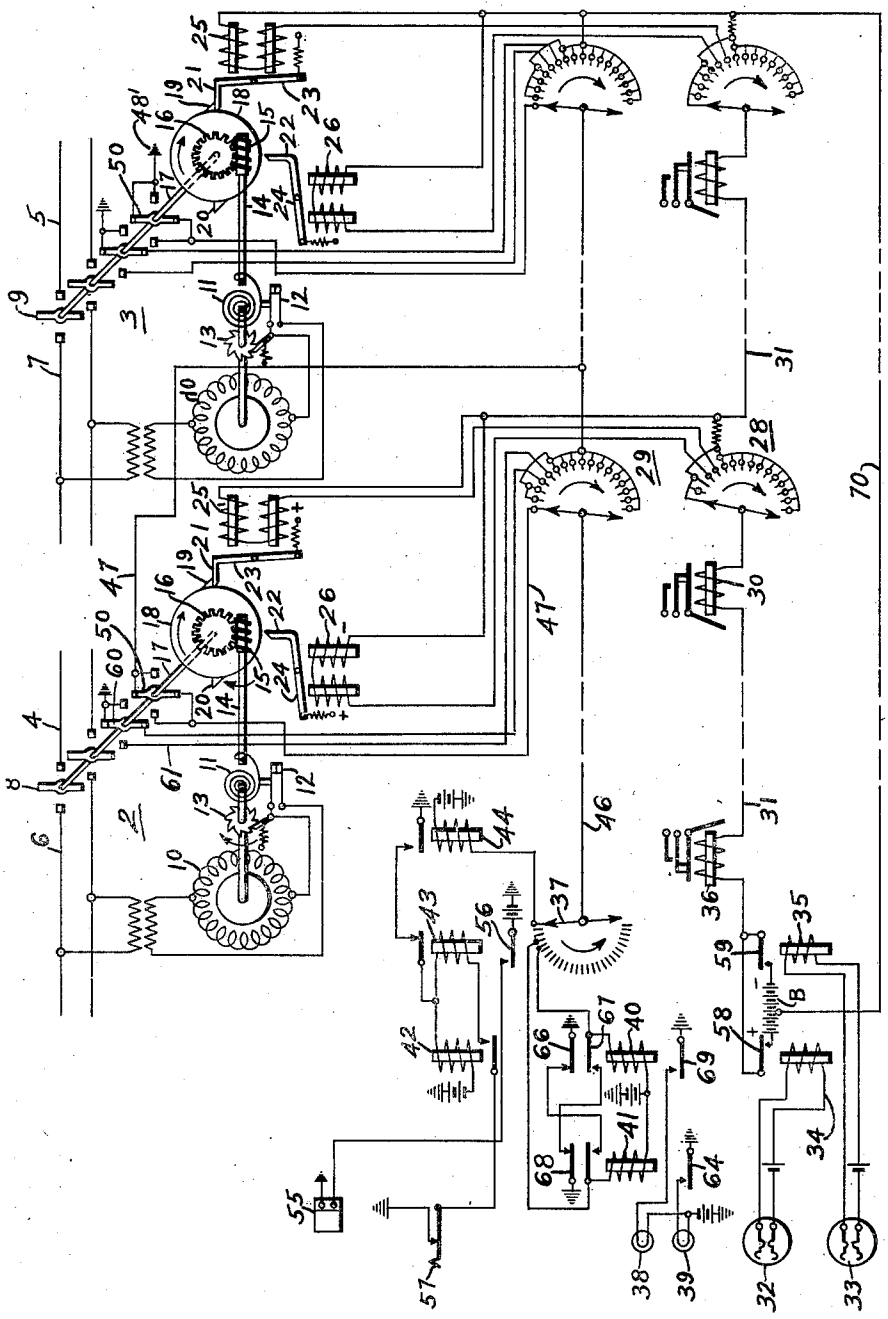
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SUPERVISORY CONTROL SYSTEM

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SUPERVISORY CONTROL SYSTEM

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My invention relates to signalling systems and, more particularly, to the remote control of apparatus units at sub-stations in which no local source of electrical energy is available for selectively operating such units.

An object of my invention is to provide means for selectively operating a plurality of remotely disposed apparatus units.

Another object of my invention is to provide means for selectively operating remotely disposed apparatus units without the necessity of providing a local source of electrical energy at said remote points.

Another object of my invention is to provide means for selectively releasing stored mechanical energy at remote points to operate circuit breakers thereat.

Another object of my invention is to provide a constant source of mechanical energy for operating the units in a supervisory control system.

Another object of my invention is to provide means for operating a supervisory control system employing a storage battery at the office or main station only.

Another object of my invention is to provide means for maintaining a constant source of mechanical energy for operating a circuit breaker.

Other objects of my invention will appear in the specification which follows.

In modern distribution systems, apparatus units, such as circuit breakers, are often located in manholes or on poles remotely disposed from each other. The use of storage batteries in each of these locations for controlling such units by means of a supervisory control system is impractical, since storage batteries require a certain amount of attention. For this reason, it has been considered impossible selectively to control and supervise such circuit breakers from a central point.

Wherever circuit breakers located in manholes are to be operated to connect two main circuits, however, one of the circuits will normally be energized. I propose to employ the energy from such circuit for operating the associated circuit breaker.

In practicing my invention, I provide an arrangement for transforming some of the electrical energy into mechanical energy and storing it in that form so that it may be selectively released from the central office by a dispatcher for operating a circuit breaker located at the manhole.

The single figure of the drawing is a circuit diagram of a system disclosing a preferred embodiment of the selective circuits and apparatus employed in practicing my invention.

In general, my invention comprises a source of mechanical energy 11, located at a substation, adapted to be selectively released from a central or dispatching office for operating a selected circuit breaker.

Referring more particularly to the details of the mechanisms for controlling and supervising the apparatus at the substations 2 and 3, load circuits 4 and 5 are arranged to be connected to feeders 6 and 7 by means of circuit breakers 8 and 9, respectively. The feeder 6 supplies energy for rotating the motor 10 until the spring member 11 is sufficiently tensioned to open the circuit of the motor 10 at contacts 12.

A latching device 13, secured to the shaft of the motor 10, prevents the motor from rotating in the reverse direction to release the stored energy after the electrical circuit has been opened at 12. A shaft 14, secured to one end of said spring member 11, normally tends to rotate in the direction shown by the arrow because of the torque exerted on it by spring 11. The motor, its shaft, the spring and shaft 14 are all mounted in a manner well known to the art and need not, therefore, be shown.

A worm 15, integral with the shaft 14, meshes with a worm wheel 16 which is secured to the shaft 17 of the circuit breaker 8. A disc 18 is also secured to the shaft 17 of the circuit breaker 8 and is provided with projections 19 and 20 which are arranged to make contact with the latch members 21 and 22 of the armatures 23 and 24 of relays 25 and 26, respectively.

When the circuit breaker 8 occupies the position illustrated, the latch member 21 of the relay 25 maintains the circuit breaker in

its open position. Upon proper energization of the relay 25, the latch member 21 is withdrawn from latching engagement with the projection 19, and the circuit-breaker shaft 17 is rotated a quarter turn by the spring 11 until the projection 19 engages latch 22, and the circuit breaker is then closed. Similarly, upon the proper energization of the relay 26, the latch 22 is removed from the engagement with the projection 19, and the circuit breaker shaft 17 is rotated a quarter turn to the open position by means of the torque exerted by the spring 11 through the shaft 14 and worm 15. Normally, the armatures 23 and 24 are maintained in the disclosed position by means of springs, as shown.

The relays 25 and 26 are polarized so that they will not retract the latches 21 and 22 when energized by impulses of positive polarity. An impulse of negative polarity, however, will so energize either of these relays as to rotate its armature about its pivot point against the tension of the associated spring. These polar relays are standard and well known. As disclosed, their armatures are biased by means of a spring, although it is well known that the armatures of the relays may be electrically biased.

Selector switch 28 is of a type well known in the automatic telephone art and is operative in response to impulses received from the central station for selecting the particular circuit breaker which it is desired to operate. A switch 29 connects the supervisory line 46 to the selected unit for transmitting supervisory signals indicative of the condition of the selected circuit breaker. A stepping magnet 30 is responsive to impulses received over a conductor 31, for stepping the wipers of the switches 28 and 29.

At the dispatcher's office are located two dials 32 and 33 for controlling relays 34 and 35, respectively. The operation of the dial 32 by energizing relay 34 impresses impulses of positive polarity upon the conductor 31 and energizes the stepping magnets 36, 30, etc. connected to the conductor 31 for stepping their respective switches. The stepping magnet 36 controls the stepping of the wiper of the switch 37. The closing of the dial contacts 33, by energizing relay 35, impresses impulses of negative polarity upon the conductor 31 for energizing a selected polar relay such as that shown at 25 after it has been selected, so as to cause its armature to rotate about its pivot and remove the latch from engagement with the projection of the circuit-breaker shaft.

Signal lamps such as those shown at 38 and 39, individual to each of the circuit breakers, are provided for indicating the condition of each circuit breaker and are, in turn, controlled by the relays 40 and 41. The relays 42 to 44 operate in response to any change of a circuit breaker when the switches are all in their normal first position for providing the dispatcher with a warning of such a change.

In order to better understand the invention, a detailed description of the operations which take place will now be given.

Normally, the wipers of all the switches are on their first contacts. It will be assumed that the circuit breaker 8 is operated from its tripped to its closed position by any suitable automatic means, not shown. As a result of the rotation of the shaft 17 through a quarter turn, the contact arm 50 is rotated from its vertical to its horizontal position, to cause a temporary disengagement of the contacts associated with the switch arm 50. The normally closed circuit for the relay 44 from ground through battery, winding of relay 44, first contact and wiper of switch 37, conductor 46, the wiper and first contact of switch 29, conductor 47, through the contacts of the arm 50, and thence through the auxiliary apparatus of the remaining units, to ground at 48′, is momentarily interrupted.

Relay 44, when de-energized, closes its back contact to complete a circuit from ground, through battery, coil of relay 42, the upper back contact of relay 43 and the back contact of relay 44 to ground. The relay 42 completes an energizing circuit through its front contact and the normally closed contact of key 57 for relays 42 and 43 in series. Relay 43, however, is not energized until the short circuit is removed from its coil by the opening of the contact of relay 44 when the energizing circuit of the latter is restored by the engagement of the switch arm 50 with its horizontally disposed contacts.

Energization of the relay 43 completes an energizing circuit for the buzzer 55 through the armature 56, the dispatcher being thus informed that a change has taken place at a substation. The locking circuit for the relay 43 may be opened by the dispatcher at the key 57.

The dial 32 is now operated for closing and opening its contact once. The closing of the contact 32 completes an obvious energizing circuit for the relay 34, which, in turn, closes a circuit for the stepping magnets connected to conductor 31, from the midpoint of the battery B through the front contact and armature 58, through the winding of the stepping magnet 36, conductor 31, the winding of the stepping magnet 30, the wiper and first contact of switch 28, conductor 31 again and through the stepping magnets at the second and any other stations connected in said circuit and returning through the conductor 70. The energization of the stepping magnets prepares their respective associated pawls for rotating their switch members.

The impulse impressed on conductor 31, it should be noted, is of positive polarity. Upon the opening of the contact 32, the relay

34 is de-energized, and the circuits of all the stepping magnets are opened. The de-energization of the stepping magnets steps their respective wipers from their first to their second contacts. This operation is repeated until the switch wipers reach the contacts associated with the operated circuit breaker, at which positions the supervisory signal associated with that particular circuit breaker will change, thus advising the dispatcher that he has reached the particular circuit breaker which operated. At the same time, the signal change informs him of the circuit breaker's position at that time.

This operation will occur in the present illustration when the switch wipers reach their fifth contact, the switch arm 60 being connected by conductor 61 to the fifth contact of switch bank 29. The circuit breaker, having previously been in an open position, the relay 41 has been energized and locked in a manner which is to be described hereinafter, with the result that the lamp 39 was illuminated by reason of the closing of its circuit at armature 64. The illumination of the lamp 39 indicates that the circuit breaker is open.

When the switch members reach their fifth contacts, however, a circuit is completed from ground over the contact 60, conductor 61, the fifth contact of the switch 29, its wiper, conductor 46, the wiper and fifth contact of switch 37 through the winding of relay 40 and battery to ground. The energization of the relay 40 opens the locking circuit of the relay 41 at its armature 66 and completes a locking circuit for itself at armature 67, through armature 68 of the relay 41, and closes the circuit of the lamp 38 at armature 69. At the same time, the de-energization of the relay 41 opens the circuit of the lamp 39, and the dispatcher is thus informed of the changed condition of the circuit breaker.

It will now be assumed that the dispatcher desires to open the circuit breaker. With the wipers on their fifth contact, it is only necessary to transmit a sufficient number of stepping impulses to bring the wipers to the fourth switch contact.

The dispatcher will then close the contact 33 and thereby impress a negative impulse on the conductor 31, over a circuit from the return conductor through the midpoint of battery B, the front contact and armature 59, through the winding of the stepping magnets 36 and 30, the conductor 31, the wiper and fourth contact of switch 28 and through the relay 26, the conductor 31 and so on to return conductor 70. The stepping magnets in the circuits will all be energized, and polar relay 26 will operate its armature 24 to remove the latch member 22 from the path of the projection 19.

The spring 11 will then rotate the shaft 17 of the circuit breaker 8, through worm 15, one-quarter of a turn thereby disconnecting the power conductors 4 from the feeder 6. At the same time, a circuit will be completed, as traced before, from ground through the switch arm 60 for operating the relay 41 which, in turn, will complete its own locking circuit, open the circuit of the relay 40, at armature 68, and illuminate the lamp 39, thus indicating that the circuit breaker has been properly moved to an open position.

Attention is called, at this time, to the circuit arrangement which makes possible the series operation of neutral and polar relays for selecting circuit breakers at various points in the system. All of the contacts of the switch bank 28, except the fourth and fifth contacts, are tied together and connected to the conductor 31 which connects this station to the next station 3. Similarly, at the station 3, all the contacts of the control switch bank, except the sixth and seventh contacts, are connected together in series with the conductor which is connected to the next station and thus continues to the last station which finally connects to the return conductor 70.

By this arrangement, all of the stepping magnets are energized in series over the conductors 31 which connect the various stations. When the switch wipers are in a selected position, a circuit is completed from the switch wiper contact through the winding of a polar relay at the selected station and in series with the control conductor 31. This is true, for example, in the case of station 2 when the switch wiper is on either its fourth or its fifth contact. With the switch wiper on the fourth contact, the circuit for the stepping magnet is completed through the winding of the polar relay 26 in series with the line. With the switch wiper on the fifth contact, the stepping magnets are all connected in series with the polar relay 25.

With the wipers on contact 4 or contact 5, the circuit does not include the polar relays at the other stations. With the switch wipers, however, on other contacts, such as the sixth or seventh, polar relays in other stations are connected in series with the stepping magnet.

The selection of the desired apparatus unit is accomplished by impulses of positive polarity which are impressed upon the conductor 31 to energize the stepping magnets. The particular polar relay connected in the circuit at this time is not affected by impulses of positive polarity, by reason of the biasing spring 27 which normally moves the armature to the position to which positive impulses would tend to actuate it. If, however, the dispatcher desires to operate a circuit breaker, he impresses a series of positive impulses upon the line, energizing and de-energizing all of the stepping magnets until the switch wipers have reached the position at which the polar relay of the particular circuit

breaker he desires to operate, is connected in the series circuit.

At this point, by operating the key 33, the dispatcher impresses an impulse of negative polarity on the conductor 31, and the polar relay connected in the circuit is energized to operate its armature and retract the latch from the circuit-breaker operating mechanism.

Each circuit breaker has associated with it a spring 11, such as that shown in connection with circuit breaker 8, which normally produces a torque on the shaft 14. The spring 11 is maintained at a fixed constant torque value by the motor 10 which rotates to tighten the spring until the diameter of the spring decreases sufficiently to open the motor circuit at contacts 12. When the latch member is withdrawn by the energization of the polar relay, the circuit breaker rotates a quarter turn until stopped by the latch of the second polar-relay armature associated with the circuit breaker. Thus, to operate the circuit breaker 8, the dispatcher first impresses five positive impulses upon the conductor 31 which steps the switch wipers to their fifth position, connecting polar relay 25 in series with the remaining stepping magnets. He, thereupon, impresses an impulse of negative polarity on the circuit which operates the polar relay to remove the latch 21 from the projection 19 and permits the circuit breaker mechanism to rotate until the extension 19 comes in contact with the latch 22, thereby bringing the circuit breaker to a stop position, with the circuit breaker closed.

All the circuit breakers have as accessories, additional connectors, such as 60, for transmitting supervisory signals, and the connectors, such as 50, for transmitting indications with the set at rest, whereby the dispatcher is informed of a change. Although only two substations are disclosed, it is obvious that any practical number may be connected in series in this circuit, dependent only upon the number of contacts of the switch banks which, of course, may be increased to 50 or more.

In a system of this character, it is desirable to provide a simple arrangement for warning the dispatcher when a change of any circuit breaker has occurred. I have disclosed a novel arrangement of utmost simplicity for indicating any change of a circuit breaker. By my arrangement, the supervisory circuit is normally closed, but a change anywhere along the line will momentarily open the circuit, and a second change anywhere along the line will repeat this momentary opening of the supervisory circuit.

Although I have disclosed this feature in connection with the transmission of an indication of a change, it is obvious that it has many other applications.

I have disclosed the preferred embodiment of my invention for remotely operating circuit breakers at points where no local source of electrical energy is available for performing the desired operations. It is obvious, as just stated, that it has many other applications and I limit myself only insofar as is set forth in the appended claims.

I claim as my invention:

1. A system for selectively controlling a plurality of apparatus units located at different stations comprising groups of negatively polarized latching relays located at different apparatus stations, a distributor having a plurality of contact members and a stepping magnet at each apparatus station, a single control circuit connecting the stepping magnets of all the distributors in series-circuit relation to the control station, said control circuit extending through the distributor contacts and through the latching relays when the distributors are in a position to select any one of their associated latching relays and through the distributor contacts only when they are not in a selecting position, means at the control station for sending current impulses of positive polarity over the control circuit to operate the stepping magnets and thereby cause a desired distributor to select a latching relay, means at said control station operable to send a current impulse of negative polarity over the control circuit to operate the selected latching relay, means associated with each unit for biasing the unit for movement from position to position, and means controlled by the respective polarized latching relays for controlling the operation of the biasing means.

2. In a supervisory control system having a dispatcher's office and a plurality of stations, apparatus units in said stations respectively capable of assuming different positions, spring motors continually biasing the apparatus units for movement from position to position, a control circuit connecting the dispatcher's station with the different stations, means for selectively controlling the movements of the units to the different positions comprising a plurality of polarized latching relays associated with each biasing means to cause intermittent movements of the apparatus units, a selector at each station, means at each station included in the control circuit and operated by impulses therein for controlling the operation of the corresponding selector, means whereby the selectors in operation selectively and individually connect the polarized relays to the control circuit, means at the dispatcher's office for transmitting current impulses of such polarity over the control circuit to cause the operation of the selectors only to select a desired polarized relay and connect it to the control circuit, and additional means at

the dispatcher's office for transmitting a single impulse of opposite polarity over the control circuit for effecting the operation of the selected polarized latching device.

In testimony whereof, I have hereunto subscribed my name this 12th day of July, 1928.

ROY J. WENSLEY.