Nov. 22, 1932. M. L. NELSON 1,888,329

REMOTE CONTROL SYSTEM

Filed Aug. 6, 1927

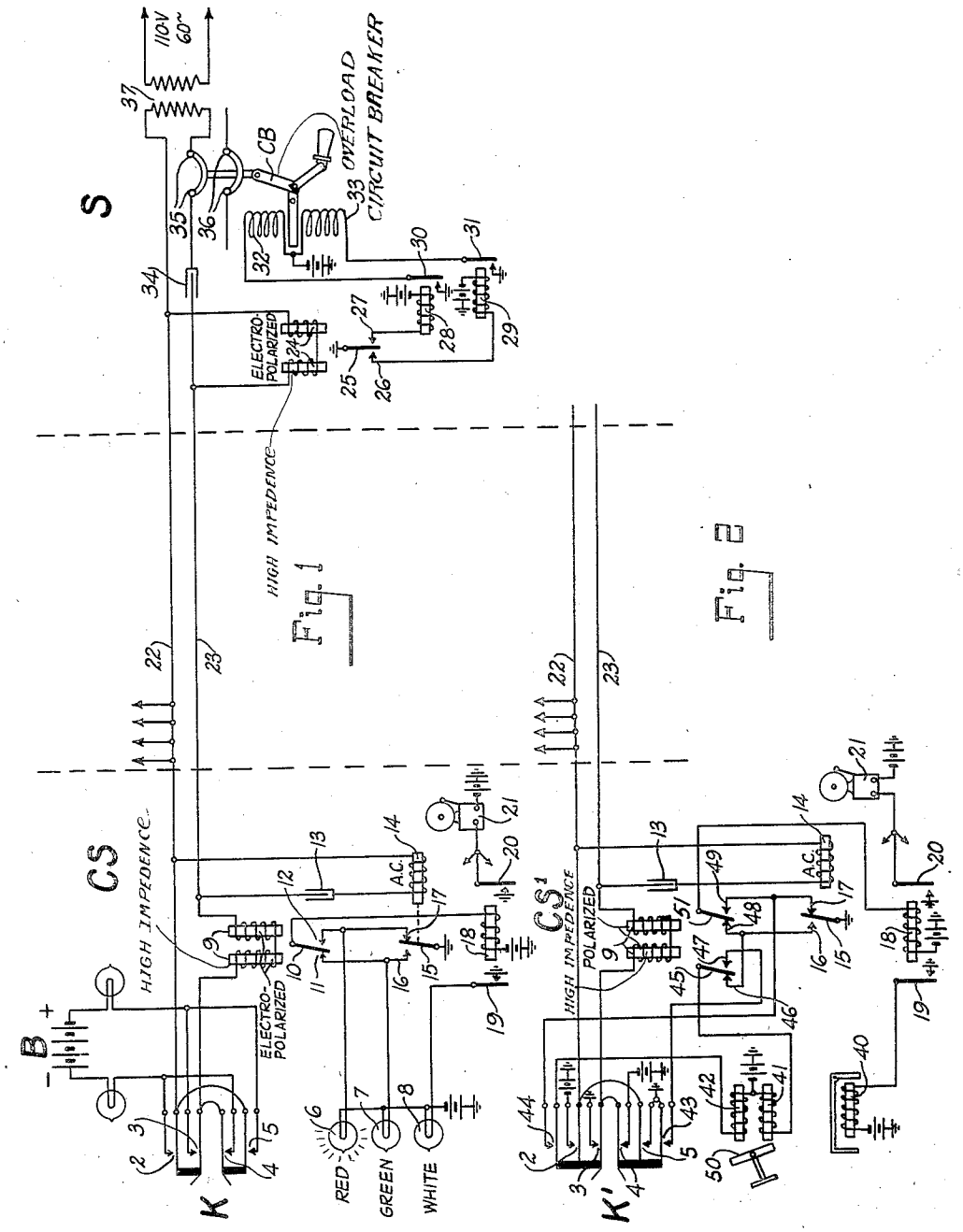


Fig. 1

Fig. 2

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Patented Nov. 22, 1932

1,888,329

UNITED STATES PATENT OFFICE

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REMOTE CONTROL SYSTEM

Application filed August 6, 1927. Serial No. 211,100.

This invention relates in general to remote control systems, but more particularly to such remote control systems as are used by a despatcher to control from his office, circuit breakers and the like which are located in distant substations; and the principal object is the production of a new and improved system of this type to control and supervise a number of switching devices located comparatively short distances from the despatcher's office.

It is a further object to provide a system of this character wherein the equipment is simple and inexpensive, thereby reducing the cost of installation and maintenance and rendering the system more reliable and economical from an operating standpoint.

In order that the full utility of the invention may be grasped it may be pointed out that it has been proposed heretofore to control circuit breakers etc., from a central point by means of large selecting devices which have access to a large number of circuit breakers in a substation; these selecting devices being controlled from the despatcher's office over a single pair of wires. Where a small number of circuit breakers are scattered over an area only a short distance from the despatcher's office the inclusion of a selecting device would be much more expensive compared to the cost of cabling between the two. Accordingly it is a further object of this invention to eliminate these switching devices and provide a single operating wire for each device to be controlled, and a common return wire connected to all the devices in the system, the cost of these conductors being negligible compared to the selecting devices. The operation of the distant circuit breaker is controlled from the central office over the two wires by direct current while supervisory equipment is controlled from the distant device over these same wires by alternating current.

The invention is illustrated in the accompanying drawing, comprising Figs. 1 and 2 by means of the usual circuit diagrams, and embodies a sufficient amount of the apparatus to set forth the invention and enable a person skilled in the art to readily comprehend it.

Fig. 1 shows the control and supervisory equipment CS of a single device at the central station, connected by an operating wire 23, and a common wire 22 to a circuit breaker CB, to be controlled at the substation S. Fig. 2 is a modification of Fig. 1 in that the lamps at the central station which indicate the position of the apparatus at the substation, are replaced by visual indicators which serve the same purpose.

Referring now to Fig. 1 the apparatus at the central station consists of a non-locking key K by means of which either negative or positive direct current from the battery B may be impressed upon either of the leads 22 and 23. Associated with the key K are three lights, a red light 6 to indicate that the associated circuit breaker is closed, a green light 7 to indicate that the breaker is open, and a white light 8 which indicates when the breaker automatically changes position. An alternating current relay 14 controls the "open" and "closed" lamps 6 and 7, while a signal alarm relay 18 controls the "change of position" lamp 8 and an alarm 21. An electro-polarized relay 9, whose armature 10 is held in the last operated position by a latch or other well known means, controls the signal alarm relay 18.

Connecting the central station CS and the distant circuit breaker CB at the substation S are two wires 22 and 23, the conductor 23 being individual to each circuit breaker CB, between the central station CS and the substation S, while the conductor 22 is common to any number of circuit breakers in the system.

The equipment at the substation S consists of the usual type of electrically operated circuit breaker CB, carrying a pair of auxiliary contacts 35 in addition to the main contacts 36. This breaker is arranged so that should the line circuit controlled by contacts 36 develop on overload or accidentally carry a foreign high potential, the breaker will be automatically operated to open the contact 36. The usual method is to shunt a relay in the line circuit which is operated by the excess voltage to control a latch against which the circuit breaker armature is tensioned. This

has not been shown in the drawing as it is well known in the art how these circuit breakers are self operated. The operating coils 32 and 33 of the circuit breaker CB are controlled by two auxiliary relays 28 and 29, and these are in turn controlled by the electro-polarized relay 24 whose armature 25 always returns to normal position when the relay is deenergized. Alternating current connected to the transformer 37 is connected to the leads 22 and 23 when the circuit breaker CB is in closed position as shown in the drawing.

Before going into the detailed description of the operation of the system it may be stated that the battery B, at the central station CS, is preferably direct current of about 90 volts which may be obtained from an ordinary dry battery, to operate the electro-polarized relays 9 and 24, as the circuit is closed only during the time the circuit breaker CB is being opened and closed and only a small amount of current consumption takes place. The two lamps in circuit of the battery B are for protection only. The source of current connected to the lamps 6, 7, and 8, and other apparatus may be either alternating or direct current, of preferably 55 volts if direct current. It will be understood that if desired, the battery B may be dispensed with and some other direct current source, if available, connected in its place. At the substation S the source of current may also be of any kind desired, except that the source through the insulating transformer 37 must be alternating current of preferably about 110 volts, 60 cycles. It will be appreciated that the transformer 37 and the source of alternating current connected thereto, may be connected to the conductors 22 and 23 anywhere along these conductors, either at the central station CS or at the substation S as may be convenient. The auxiliary contacts 35 at the circuit breaker connects this source of alternating current to the line wires 22 and 23.

A detailed description of the operation of the system will now be given in connection with Fig. 1 wherein it will be noted that the circuit breaker CB has been operated and is in closed position. This completes a circuit from the source of alternating current through the transformer 37, the auxiliary contacts 35 of the circuit breaker, condenser 34, operating wire 23, condenser 13, A. C. relay 14, and back over the common wire 22 to the other side of the transformer 37. Owing to the high impedance of the electro-polarized relays 9 and 24, they are not affected by the alternating current flowing in this circuit and they will not operate. Relay 14, however, is energized and closes a circuit from ground on the armature 15 and its front contact 17, through the red lamp 6 to battery, thereby indicating to the operator at the central station CS that the circuit breaker CB is in closed position. If at this time with the apparatus in the condition just described, the circuit breaker should "open" or trip automatically, due to an overload or other cause, the alternating current circuit through the relay 14 would be opened at the auxiliary contacts 35 and the relay deenergized. The circuit of the red lamp 6 is therefore interrupted at the contact 17 of the relay 14 and the green lamp 7 is lit from the ground on armature 15 and back contact 16. The illumination of lamp 7 indicates that the circuit breaker is in open position. At the same time the circuit of the signal alarm relay 18 is closed from ground on armature 15 and its back contact 16, closed contact 11 and armature 10 of the polarized relay 9, to battery through relay 18. This relay energizes and at its armature 19 closes a circuit for the white change of position lamp 8, which lamp indicates that this particular circuit breaker in the system has changed its position, inasmuch as there may be any number of lamps either red or green associated with other breakers that may be lit at the time. Another effect of the energization of relay 18 is the placing of ground by armature 20 to the audible alarm or bell 21, which indicates to the despatcher that a circuit breaker has been operated in response to conditions at the substation beyond his control. This alarm 21 may be made common to any number of breakers in the system.

Should the despatcher decide to close the circuit breaker again he momentarily operates the key K in the upward or "closed" position. A circuit is thereby completed from positive battery B, contacts 3 of the key K, polarized relay 9, operating conductor 23, polarized relay 24, back over the common conductor 22, through contacts 2 of key K to negative battery B. The direction of current flow over this circuit is such that the polarized relay 9 does not operate as it is already in the position corresponding to such direction of current flow. The polarized relay 24 at the substation, however, operates and moves its armatures 25 to close its contact 26. A circuit is therefore completed from ground on armature 25, contact 26, to relay 29 to battery. Relay 29 closes its armature 31 to ground and energizes the operating or "in" winding 33 of the circuit breaker, thereby closing the circuit through auxiliary contacts 35 and also for the main contacts 36. The auxiliary contacts 35 close the circuit previously described for the A. C. relay 14 which upon energizing moves its armature 15 from contact 16 to 17, as a result of which the green lamp 7 will go out and the red lamp 6 will be lighted. At contact 16 the circuit of the relay 18 will be opened and when the relay deenergizes the audible alarm 21 will cease and the white change of position lamp 8 will go out.

Assuming now that instead of the circuit breaker being automatically tripped to open position the despatcher desires to trip it himself. He will therefore momentarily operate the key K to the lower or "open" position. Negative battery B is therefore closed through contacts 4 of the key K, polarized relay 9, operating wire 23, polarized relay 24, back over the common conductor 22 to contacts 5 to positive battery.

The direction of current flow in this circuit is such that both polarized relays, 9 and 24 are operated. Polarized relay 24 moves its armature 25 against its contact 27, thereby operating relay 28, which in turn at its armature 30, energizes the "out" winding 32 of the circuit breaker CB. The breaker is operated and the circuits through the contacts 35 and 36 interrupted. The opening of the circuit through the auxiliary contacts 35 allows the A. C. relay 14 to become deenergized, thus opening at its contact 17, the circuit of the red "in" lamp 6, and at its back contact 16, closing the circuit of the green "out" lamp. It will be remembered that the polarized relay 9 was also operated, and its armature 10 moved to close with its contact 12. The relay 18 is therefore not operated and the lamp 8 not lit due to the circuit for this relay not being completed through contact 11 as before, and no alarm will be sounded.

Assuming now that the circuit breaker CB is automatically tripped "open", and that the despatcher desires to leave it open. As before this operation allows the A. C. relay 14 to fall back and through its armature 15 completes the circuit of the signal relay 18, thereby operating the alarm 21 and lighting the change of position lamp 8. In order to stop the audible alarm and extinguish the lamp 8 the despatcher momentarily operates the key in the downward or "open" position. The polarized relays 9 and 24 are operated as previously described, the relay 24 being without effect as the circuit breaker is already in "open" position, while the relay 9 opens its contact 11 and allows the signal relay 18 to deenergize and stop the alarm 21 and extinguish the lamp 8. The green lamp 7 remains lit to indicate that the circuit breaker is in "open" position.

Should the circuit breaker be manually operated at the substation, the proper supervision and alarm would be registered at the central station as before, when it was tripped automatically or by the dispatcher from the central office.

Any failure of the operating wire 23 while the circuit breaker is in "closed" position would register at the central station as an "open" breaker, but would immediately be apparent to the despatcher on account of his inability to reclose the breaker and stop the alarm signal.

In the modification shown in Fig. 2 the apparatus at the substation S is the same as that in Fig. 1 and has therefore not been again shown. At the control station CS1 an additional set of contacts, 45, 46 and 47 have been added to the polarized relay 9 and an extra set, 43 and 44, to each side of the key K'. The lamps 6, 7, and 8 of Fig. 1 have been replaced by indicators 41 and 42, and a visual signal 40. In this case the current for operating the various devices, has been taken from the same source of direct current battery. The extra contacts 43 and 44 on the key K are for the purpose of effecting a saving in current consumption, inasmuch as the visual signal indicators 41 and 42 need only be operated momentarily to move the signal armature 50 one way or the other, whereupon this armature will remain in the position last assumed when the current is cut off the relays.

In the operation of this modification, should the circuit breaker (not shown) go "open" the A. C. relay 14 will deenergize and at its armature 15 and back contact 16, close a circuit through contact 46 and armature 45 of polarized indicator 9 to the signal indicator 41. This indicator 41 upon energizing moves the armature 50 in the opposite direction from what it was in, and indicates to the despatcher that the circuit breaker has been "opened". Another effect of the deenergization of A. C. relay 14 is the placing of ground from armature 15, back contact 16, contact 48 and armature 51, to the signal alarm relay 18, which operates the audible alarm 21 from its armature 20 and the visual signal 40 from its armature 19. Visual signal 40 indicates to the despatcher the particular circuit breaker in the system, which has operated.

Should the despatcher decide to reclose the circuit breaker the key K' is operated in the upward or "closed" position momentarily. This operation energizes the polarized relay 24 as previously described, to shift its armatures, operate the circuit breaker, operate A. C. relay 14, and at the contacts 44 of the key K' the circuit of the signal relay 42 is closed which shifts the armature 50 in the other direction to indicate that the circuit breaker is in. In addition the alarm relay 18 is deenergized through contact 16 being opened, and the alarm 21 ceases. The visual signal 40 also falls back.

From the above operation and others not specifically pointed out, but which are readily apparent, it will be seen that the circuit and operation of the equipment in Fig. 2 is very much similar to that of Fig. 1 and no further explanation of Fig. 2 is therefore thought necessary.

It will be appreciated that the invention permits of any number of variations whereby any device at a distant point may be controlled and supervised from a central station over a single operating conductor and a common return conductor and it is not desired to

be limited to the precise structure shown in the drawing but only by the scope of the appended claims.

What is claimed is:

1. In a remote control system, a control station and a distant device interconnected by a pair of conductors, signals at said station, a source of direct current and a source of alternating current, a polarized relay responsive to direct current and a supervisory relay responsive to alternating current at said station, a second polarized relay responsive to direct current, means for operating said device, means at said station for connecting either pole of said direct current source to said conductors, said polarized relays selectively operated in accordance with the direction of current flow in said conductors, the first polarized relay operating said signals to indicate a desired change in position of said device and the second polarized relay operating said operating means to operate said device, and means operated by said device for connecting said alternating current source to said conductors, said supervisory relay operated responsive to the connection of said alternating source to operate said signals to indicate that the device has operated and to indicate the position to which said device has been operated.

2. In a remote control system, a control station and a distant station, a device at the distant station having an open position and a closed position, a pair of lamps at the control station, one of said lamps being lighted and the other lamp being extinguished for indicating the position occupied by said device, a change lamp at said control station, a relay at said control station, a relay at the distant station, a source of direct current at the control station, means at the control station for connecting one potential or another potential of said source to said relays, said relays selectively operated in accordance with the connected potential, a circuit for said change lamp completed responsive to the selective operation of said first relay for lighting said change lamp to indicate that a change in position of said device is desired, means operated responsive to the selective operation of said second relay for operating said device from its occupied position to its alternate position, and means operated responsive to the said operation of said devise for extinguishing said change lamp and said lighted lamp and for lighting said other extinguished lamp.

3. In a remote control system, a control station and a distant station, a pair of conductors connecting the two stations, a device at the distant station having open and closed positions, signalling means at the control station, a source of current at said control station, means at the control station for selectively applying said source to said conductors to establish flow of current in different directions in said conductors, a pair of relays one at the control station and one at the distant station connected to said conductors, said relays selectively operated in accordance with the direction of current flow in said conductors, means responsive to the selective operation of the relay at the distant station for opening and closing said device, means responsive to the selective operation of the relay at the control station for operating the signalling means to indicate that a change in position of said device is desired, another source of current of a different character at the distant station, means for connecting or disconnecting said other source to or from said conductors dependent upon the position occupied by said device, another relay connected to said conductors operated responsive to the connection or disconnection of said other source to the conductors by the operation of said device, and circuits completed by the operation of said other relay for operating said signalling means to indicate that the device has been operated.

4. In a remote control system, a control station and a distant station, a pair of conductors connecting the two stations, a device at the distant station having an open position and a closed position, supervisory means at the control station, a pair of relays one at the control station and one at the distant station, means at the control station for selectively operating said relays, means responsive to the selective operation of the relay at the control station for operating said supervisory means to indicate that a change in position of said device is desired, means responsive to the selective operation of said relay at the distant station for operating said device to its open or closed position, a source of alternating current at the distant station, means for connecting or disconnecting said alternating source to or from said conductors dependent upon the position occupied by said device, another relay operated responsive to the connection or disconnection of said source to the conductors by the operation of said device, and circuits completed by said last relay for operating said supervisory means to indicate that the device has been operated and to indicate the position to which said device has been operated.

5. In a remote control system, a control station and a distant device interconnected by a pair of conductors, said device having an open position and a closed position, a signal at said station, a relay at said station, a second relay at said device, a source of direct current at the control station and a source of alternating current at the device, said relays serially connected to said conductors and responsive to the current flow from said station, means for selectively connecting either pole of said source at the control station to

said conductors, said relays selectively operated in accordance with the direction of current flow, means operated by the first relay for operating said signal to indicate that a change in position of said device is desired, means operated by the second relay for operating said device from one position to its other position, additional signals at the station normally indicating the position occupied by said device, means for connecting said alternating source to said conductors or for disconnecting said alternating source from said conductors dependent upon the position occupied by said device, and means operated responsive to the connection or disconnection of said source from said conductors by the operation of said device for releasing said first signal to indicate that the device has operated and for operating said additional signals to indicate the new position to which said device has been operated.

6. In a remote control system, a control station and a distant station, a device having an open and a closed position at said distant station, a first signal and other signals at said control station, a polarized relay at said control station, a supervisory relay at said control station, a polarized relay at said distant station, a direct current source at said control station, means for connecting either pole of said source to said polarized relays, said polarized relays selectively operated in accordance with the direction of current flow, means operated by said first polarized relay for operating said first signal to indicate that a change in position of said device is desired, means operated by the second polarized relay for operating said device from one position to its other position, an alternating current source at said distant station, said supervisory relay operated by said alternating source responsive to the operation of said device, and circuits completed by said supervisory relay for operating said first signal to indicate that the device has operated and for operating said other signals to indicate the position to which said device has been operated.

7. In a remote control system, a line connecting a control station with a distant device, a change of position lamp at said control station individual to said device, a source of current at said control station, means at the control station for connecting said source to said line, means at the distant device responsive to said connection for operating said device to change its position, means at the control station responsive to said connection for operating said lamp to indicate that said source has been connected to said line to operate said device, a source of current of different character at the distant device, means at the distant device responsive to the said operation of said device for connecting said different source of current to said line, and means at the control station operated responsive to the connection of said different source to said line for extinguishing said lamp to indicate that the device has changed its position.

In witness whereof, I hereunto subscribe my name this 3d day of August, A. D. 1927.

MARTIN L. NELSON.