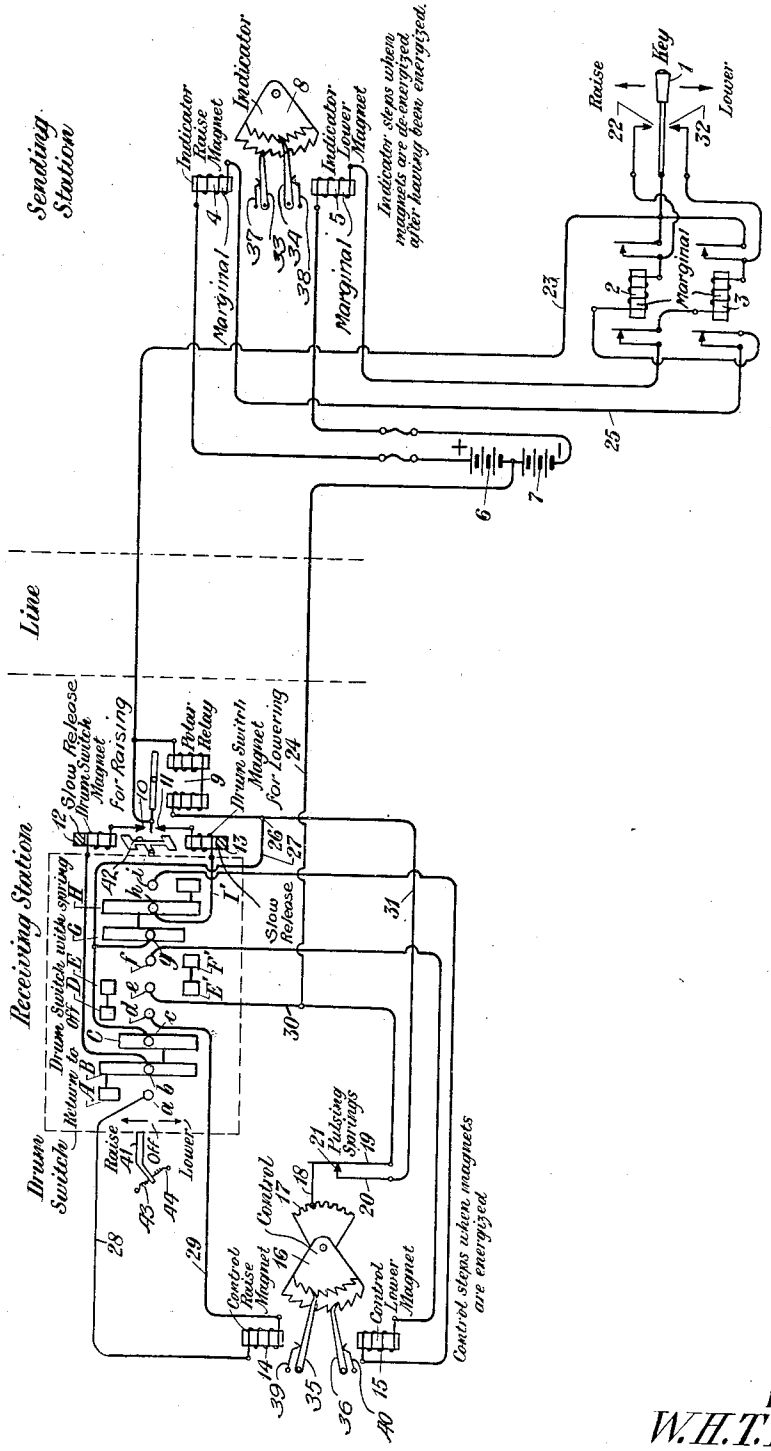
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REMOTE CONTROL SYSTEM

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INVENTOR
W. H. T. Holden

BY

ATTORNEY

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WILLIAM H. T. HOLDEN, OF BROOKLYN, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK

REMOTE-CONTROL SYSTEM

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This invention relates to remote control devices and particularly to a device of that type in which a signal is produced at the sending or control station upon the response of the controlled apparatus at the distant station to the transmission of an operating impulse from the control station.

In the operation of remote control systems it is desirable that the operator at the controlling station shall know that the controlled apparatus at the distant station has properly operated in accordance with the transmission of an impulse or a series of impulses from the controlling station. It is one of the objects of this invention to provide a method and means for indicating at the controlling station the operation of the controlled apparatus at the distant station.

Another object of this invention is to provide means for insuring synchronism between the controlled station and the indicating apparatus at the controlling station.

Other objects of this invention will be apparent from the following description when read in connection with the attached drawing, showing schematically a simple form of embodiment of the invention.

In the drawing, the key 1 at the controlling station is intended to control the operation of the apparatus at the distant receiving station. The relays 2 and 3 serve to prevent the apparatus at both stations from getting out of synchronism and also to prevent a short circuit in the event that the control key 1 is thrown rapidly from one position to the other before a releasing impulse has been sent back from the distant station. Relays 2 and 3 are marginal in the sense that each operates prior to the energization of its corresponding magnet 4 or 5 of the indicating device in order to prevent the indicating device from getting out of synchronism with the controlled device at the distant end. The magnets 4 and 5, which derive their power from the batteries 6 and 7, serve to raise or lower the indicator 8 in response to the operation of the controlled apparatus at the distant station. When, for example, the magnet 4 is energized to such extent as to overcome the pressure of the spring 37 upon the armature 33, which cooperates with one group of notches of the indicator 8, the armature 33 will be raised and will be caused to engage the notch just above the one with which it is shown in co-action in the drawing. As soon as the magnet 4 is deenergized the pressure of the spring 37 will cause the armature to move downward, and this in turn will cause movement of the indicator in a counter-clockwise direction. The magnet 5 cooperates with its armature 34 in the same manner and effects the movement of the indicator 8 in a clockwise direction. The tongue of the polar relay 9 moves between the contacts 10 and 11. Contact 10 is connected with the winding of the magnet 12, to move the drum switch in one direction, by the attraction of the armature 42 by the magnet 12, which armature is rigidly connected with the shaft 41 of the drum-switch, and in like manner contact 11 controls magnet 13, to move the drum-switch in the opposite direction. Both magnets are of the slow-release type. The drum-switch is provided with springs 43 and 44 connected with an arm of the shaft 41, which springs, when the magnets are deenergized, restore the switch to what may be termed its normal mid-position. A plurality of wipers or brushes, designated *a* to *i* inclusive, are so adjusted as to engage the correspondingly positioned segments of the drum-switch. The magnets 14 and 15 which are controlled by the drum-switch, have armatures 35 and 36 with which the springs 39 and 40 respectively cooperate, and are intended to raise or lower respectively, the controlling device 16, which operates the apparatus to be controlled at the receiving station. The device 16 has connected therewith a toothed segment 17, with which a roller 18 engages. This roller is connected with a spring 19 which engages another spring 20 at the contact 21; whenever this contact is opened the indicating device at the sending station is operated.

The manner in which this system operates in order to attain the object of this invention is as follows: Let it be assumed that it is desired to raise the controlled device 16 or, in other words, to rotate its shaft in a clockwise direction. The key 1 at the sending station is moved upward, closing its con-

tact 22. A circuit is thereby established extending from contact 22, over conductor 23, winding of polar relay 9, conductor 31, contact 21 of springs 20 and 19, conductors 30 and 24, battery 6, winding of indicator magnet 4, conductor 25, left-hand contact of relay 3, winding of relay 2, to contact 22. The polar relay 9 will be energized, and its tongue will be moved upwards, closing its contact 10. Although the circuit through the indicator magnet 4 is closed, the current is insufficient to operate it. However, as soon as contact 10 is closed a circuit in parallel with the polar relay 9 will be established from contact 10, through the winding of magnet 12, brush *b*, segments B and C, brush *c*, conductor 31, contact 21, conductors 30 and 24. This shunt path will increase the current from the battery 6, through the winding of the indicator magnet 4, which will cause the indicator magnet to lift its armature 33 into co-action with the notch just above the one with which it is shown in co-action in the drawing. This, however, will not move the indicator 8, because its operation depends upon the interruption of this current. The energization of the drum-switch magnet 12 moves the drum in the direction which will bring the brushes in contact with the upper segments A, B designated "raise" and break contact between the brush *c* and the segment C. Since segment A is conductively connected with segment B a circuit will be established from battery 6, through the indicator magnet 4, conductor 25, left-hand contact of relay 3, winding of relay 2, right-hand contact of relay 2, conductor 23, contact 10 of relay 9, the winding of the magnet 12, brush *b*, segments B and A, brush *a*, conductor 28, the winding of magnet 14, conductor 29, brush *d*, segments D and E, brush *e*, conductors 30 and 24 to the opposite pole of battery 6. Under this circuit condition the control magnet 14 at the receiving station is energized and the control device 16 is moved upward. The motion of this device causes the roller 18 to move one notch. In doing so, contact 21 is opened, which opens the circuit through the winding of polar relay 9, which is in parallel with the circuit that includes the magnets 12 and 14. The opening of the circuit through the winding of relay 9 reduces the current flowing from the source 6 through the indicator magnet 4 to such extent that the said magnet releases. This causes the indicator 8 to be moved in a counter-clockwise direction due to the pressure of the spring 37 on the armature 33, thereby signifying to the operator at the controlling or sending station that the controlled apparatus at the receiving station has operated. The opening of contact 21 also releases relay 2 which opens its right-hand contact by means of which it was locked up after the initial closing of the contact 22 of the control key 1. The opening of the circuit of relay 9, resulting from the opening of contact 21, in turn opens the circuit of the drum-switch magnet 12. The armature 42 will therefore be released and the switch will be restored to its normal position by the action of the springs 43—44. The system is therefore restored to its normal position for the transmission of another impulse from the control key. If this key is held closed in the position designated "raise" it will transmit but a single impulse until the controlled apparatus operates and opens the circuit. Then, another single impulse will be sent and the same sequence of operations will take place, the control device 16 being rotated another notch in a clockwise direction. In the lowering of the control device 16 or the rotation of its shaft in counter-clockwise direction is effected in a similar manner except that the key 1 is moved downward to close its contact 32. The closing of contact 32 establishes a circuit that includes not only the polar relay 9 but also the battery 7, the indicator magnet 5 and the relay 3. Since the polarity of battery 7 is opposite that of 6, the relay 9 will be moved in the opposite direction and will close the circuit that includes the drum-switch magnet 13. This will attract the armature 42 which will move the switch so that the contacts engage the lower segments thereof. A circuit will therefore be established through the segments H and I′ and also the segments E′ and F′, whereby the control magnet 15 will be energized and the impulse will be sent back to the indicator magnet 5 when the contact 21 is opened.

The object of relays 2 and 3 is to insure that loss of synchronism will not result in the event that the control key 1 is moved so rapidly that the drum-switch will not respond to the opening and closing of the contacts of the key, or that the control motor magnets do not have time to operate, and yet slowly enough that the polar relay operates and sends a pulse of current through the indicator motor magnets sufficient to cause these to step. Relays 2 and 3, as stated before, are marginal in that each operates prior to the energization of its corresponding magnet 4 or 5 that is connected in series with its corresponding relay upon the closing of the key 1. Relay 2, for example, operates substantially as soon as the contact 22 is closed by the movement of the key 1, whereas its corresponding magnet 4 does not become energized sufficiently to attract its armature and thus perform the first step of its operation, until relay 9 has operated and established a shunt path through the contacts *b* and *c* of the drum switch. The operation of relay 2 locks the circuit containing the indicator magnet and maintains it in locked condition, regardless of subsequent movements of the key 1, until the actuation of the con-

trolled apparatus opens the circuit at the pulsing springs and, by the deenergization of the indicator magnet 4, produces an indication of the actuation of the said controlled apparatus. As soon as the current through the circuit of relays 2 and 3 has reached a value sufficiently high to operate either of the motor magnets, depending upon which way the key has been thrown, the proper relay will pull up and lock itself up until the first interruption from the pulsing springs 19 and 20 occurs. Then, the relay is released. An additional set of springs on each of these relays prevents a short circuit in the event that the control key has been thrown rapidly from one position to the other before the releasing pulse has been sent back from the distant end. The importance of this will be apparent if the left hand contacts of the relays 2 and 3 are considered as eliminated from the circuit. When the key 1 is raised and closes its contact 22, relay 2 closes its right hand contact and it remains closed until the open circuit impulse is transmitted upon the opening of contact 21. If the key were moved to its lower position, thus closing contact 32 before relay 2 has been deenergized by the opening of contact 21, a circuit would be established from, say, the positive pole of battery 6 that will include the winding of magnet 4, conductor 25, winding of relay 2, contact 32, winding of relay 3, magnet 5, to the negative pole of battery 7. Since the relays 2 and 3 and the magnets 4 and 5 are of relatively low resistance an excessive current would flow that might damage the windings of the magnets or the relays. The presence of the left hand contacts of relays 2 and 3 prevents the closing of the circuit through one of the relays 2 and 3 after the circuit has been closed through the other until the opened circuit impulse has been transmitted by the opening of contact 21.

While this invention has been disclosed as embodied in a particular form it is to be understood that it is capable of embodiment in other and different forms without departing from the spirit and scope of the appended claims.

What is claimed is:

1. In a remote control system, the combination with a source of potential of a relay, an indicating device, means for operating the indicating device including a magnet and means actuated on the energization and then the deenergization of the magnet to operate the device, a circuit including the source, relay and the magnet, a key for closing said circuit, the resistance of said circuit being such that the relay will be effectively energized while the magnet will not be effectively energized upon the closing of the key, a rotary switch including an operating magnet therefor controlled by the relay, contacts connected with the switch and associated with said circuit to shunt the relay and thereby cause the effective energization of the magnet, a magnetically controlled device connected with said rotary switch and responsive to the operation of said relay and rotary switch, and means controlled by the controlled device to deenergize the magnet of the indicating device and thereby cause the operation of the indicating device.

2. In a remote control system, the combination with sources of potential of opposite polarity of an indicating device including an indicator and two magnets, each having means actuated upon the energization and then the deenergization of said magnet to operate the indicator, the direction of operation of one magnet being opposite to that of the other, a key having a movable arm and two contact points, a polar relay, a circuit including one of said sources, one of said indicator magnets, one of the contact points and the movable arm of the said key and the winding of the said polar relay, another circuit including the other source, the other indicator magnet, the other contact point and the movable arm, and the winding of the said polar relay, means controlled by the said polar relay to shunt the winding thereof, the resistance of the shunt path being such as to increase the current through an indicator magnet sufficiently to cause its operation, and means controlled by the said shunting means to diminish the current through the said magnet to release the means actuated by the said magnet, thereby effecting a movement of said indicator.

3. In a remote control system, the combination with sources of potential of opposite polarity of an indicating device including an indicator, and two magnets, each having means actuated upon the energization and then the deenergization of said magnet to operate the indicator, the direction of operation of one magnet being opposite to that of the other, a key having a movable arm and two contact points, a polar relay, two control relays, a circuit including one of said sources, a winding of one of said magnets, the winding of the polar relay, one contact point and the arm of the said key, the armature and contact of the first control relay and the winding of the second, another circuit including the other source, the winding of the other indicator magnet, the winding of the polar relay, the other contact point and the armature of the said key, the winding of the said first relay and the armature and contact of the said second relay, means controlled by the said polar relay to shunt the winding thereof to increase the current through an indicator magnet sufficiently to operate it, means controlled by the shunting means to diminish the current through the said magnet to release the means actuated by the said magnet, thereby effecting a movement of said indicator, the said control relays

having their contacts so arranged that the operation of one relay opens the circuit of the other relay and maintains it open until the indicating device connected with the circuit of the first mentioned relay operates.

4. In a remote control system, the combination with a source of potential of an indicating device comprising a magnet, an indicator, means responsive to the energization and then the deenergization of the said magnet to operate the said indicator, a relay, a switch, a circuit including the said source, the winding of the said magnet, the winding of the said relay and the said switch, a translating circuit having means responsive to the operation of the said relay to shunt the winding of the said relay whenever the latter operates, the resistance of the said translating circuit in parallel with the winding of the said relay being such as to increase the current through the indicating magnet to such extent as to cause its operation, and means responsive to the operation of the translating means to effectively reduce the current through the said magnet to such extent as to release the means actuated by the said magnet, thereby effecting a movement of said indicator.

In testimony whereof, I have signed my name to this specification this 9th day of October, 1924.

WILLIAM H. T. HOLDEN.