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REMOTE CONTROL SYSTEM

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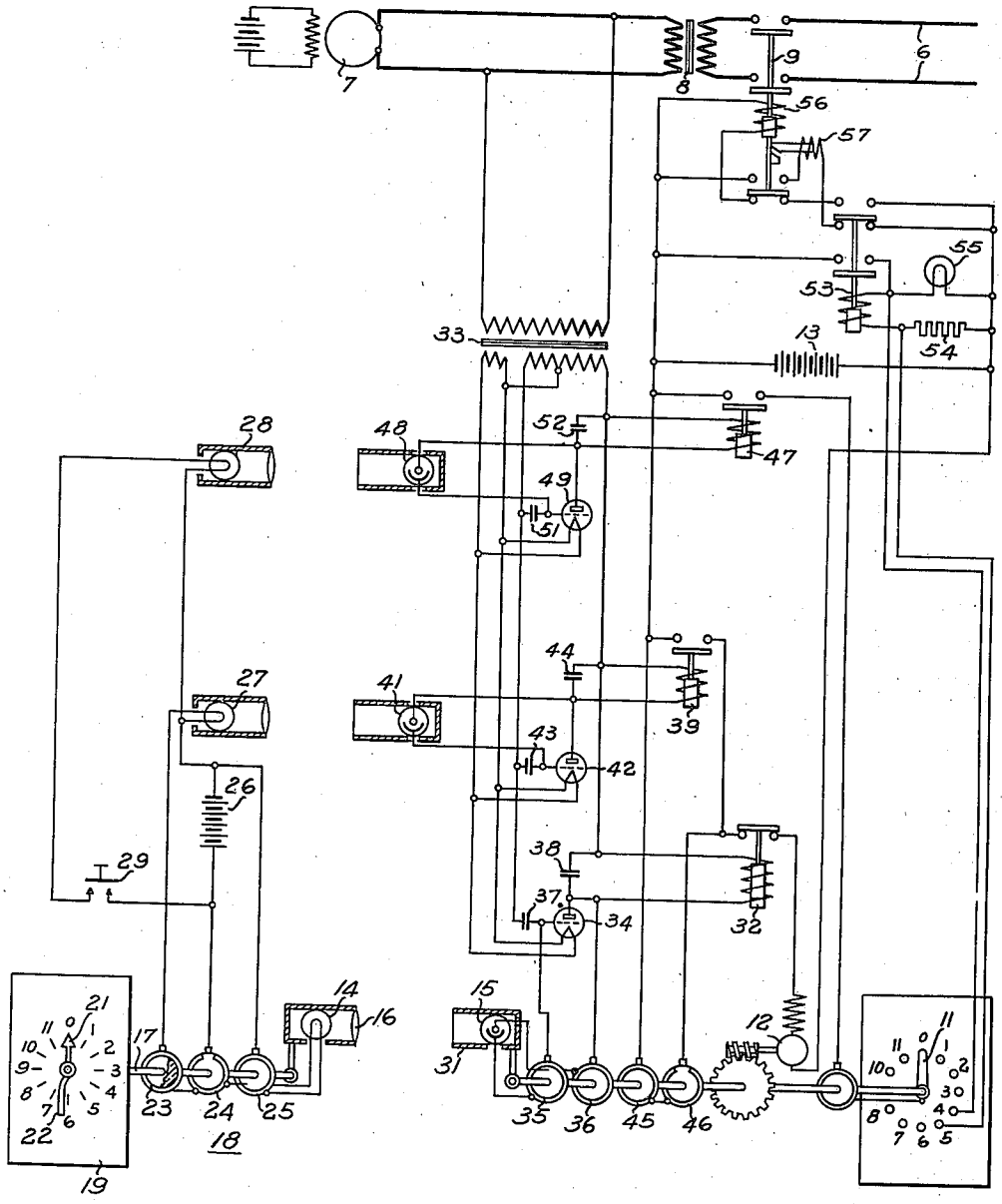

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REMOTE CONTROL SYSTEM

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This invention relates in general to improvements in signaling systems and more particularly to means for supervising and controlling the operation of apparatus and circuits operating at high voltages.

In the operation of high voltage apparatus and circuits, it is generally necessary to utilize signaling circuits for transmitting indications or control signal impulses between circuits associated with high voltage equipment and low voltage circuits which are accessible to the operator in charge thereof. To permit the transmission of such signals without any possibility of danger to human life, it is preferable to utilize a signaling system comprising sending and receiving equipment interconnected through light sources and associated light sensitive devices so as to remove all physical contact between the sending and receiving ends of the system. When signal impulses have to be transmitted from a common point to a large number of circuits, the use of a separate light source and a separate light sensitive device for each circuit renders the system excessively expensive and complicated. It is therefore preferable to connect the circuits over which signals are to be transmitted to a selector switch and to control the actuation of the switch by means of a source of light which may be focused toward different points.

It is therefore one of the objects of the present invention to provide a signaling system by means of which signals may be transmitted to a plurality of circuits through an optical system common to all the circuits.

Another object of the present invention is to provide a signaling system by means of which a selector switch may be actuated to different operating positions under the control of an optical system.

Objects and advantages other than those above set forth will be apparent from the following description when read in connection with the accompanying drawing, which diagrammatically illustrates one embodiment of the invention applied to the control of a high voltage circuit breaker.

Referring more particularly to the drawing by characters of reference, reference numeral 6 designates a high voltage alternating current circuit adapted to be energized from a generator 7 through a transformer 8 and a circuit breaker 9. Circuit 6 is assumed to be operable at such high voltage that the transmission of control impulses to the operating means of circuit breaker 9, for example, is difficult to effect in a manner which avoids all danger to human life. The transmission of such control impulses and of any other signals required for the supervision of circuit 6 is accordingly obtained by means comprising a selector switch 11 adapted to be moved into any desired plurality of operating positions to selectively control a plurality of circuits. Switch 11 may be placed in a rest position marked zero and in a plurality of operating positions marked 1 to 11 but it will be understood that the switch may be provided with any other number of operating positions. Switch 11 may be moved into the different positions thereof by means of a motor 12 energized from a suitable source of electric current such as a battery 13.

Motor 12 is controlled by means of a positioning system comprising a source of light such as an incandescent lamp 14 and a light sensitive device 15. Device 15 may be of any suitable known type such as the so-called selenium cell and the photovoltaic cell, but is preferably of the space discharge type known as phototube. Such phototube comprises essentially a glass bulb containing two electrodes separated by a space having a conductivity depending on the degree of illumination of the tube. Lamp 14 is provided with a suitable optical system such as a lens 16 whereby the light produced by the lamp may be projected as a beam. The position of the beam may be made variable by mounting lamp 14 and lens 16 eccentrically on the shaft 17 of a position selector 18. It will be understood, however, that the same result may be obtained by mounting only the lens or some other optical element controlling the beam on the shaft of the selector.

Selector 18 comprises a dial 19 marked with a rest position and different operating positions corresponding to the rest position and to the operating positions of switch 11. The positions of the selector are indicated on the dial by a pointer 21 mounted on shaft 17. The angular position of the shaft may be adjusted by suitable means such as a handle 22. Shaft 17 carries a plurality of slip rings 23, 24, 25 insulated therefrom. Slip rings 24 and 25 and the associated brushes cooperate to control the connection of lamp 14 with a suitable source of current such as a battery 26. Slip rings 23, 24 and the associated brushes likewise cooperate to control the connection of battery 26 with a second light source such as a lamp 27 arranged to project a beam of light of fixed position. Slip ring 24 is interrupted at one point thereof to open the connections of lamps 27 and 28 with battery 26 and thus render the lamps operative only upon movement of

selector 18 away from the rest position thereof. Battery 26 may be connected with a third light source such as a lamp 28 through a push button switch 29.

Phototube 15 may be mounted on the shaft of switch 11 to be moved by motor 12 through different positions corresponding to the positions desired for switch 11. Lamp 14 and phototube 15 are so disposed that the beam of light projected by lamp 14 impinges on phototube 15 only when selector 18 and switch 11 are in corresponding positions. It will be understood that such result may also be obtained by leaving the phototube stationary and by providing the shaft of switch 11 with a suitable optical system directing the beam toward the phototube. The phototube may be shielded from light emitted by sources other than lamp 14 by means of a hood 31.

The variations in the conductivity of phototube 15 in response to the position of the beam of light projected from lamp 14 are utilized to control the energization of a relay 32 controlling the connection of motor 12 with battery 13. Phototube 15 and relay 32 may be connected in any suitable known manner as, for example, through an electronic relay comprising a transformer 33 energized from generator 7. The coil of relay 32 is connected between one terminal and a tap of the secondary winding of transformer 33 through a valve 34 of the three electrode high vacuum type. Phototube 15 is connected between the anode and the grid of valve 34 through slip rings 35 and 36, and a capacitor 37 is connected between the grid of the valve and the other secondary terminal of transformer 33. A capacitor 38 is preferably connected in parallel with the coil of relay 32 to render the flow of current therethrough more uniform.

Starting of motor 12 is controlled by means comprising a relay 39 operable to close the contacts thereof upon impingement of the beam of light projected by lamp 27 on a second phototube 41. The coil of relay 39 is connected with one secondary terminal and the secondary tap of transformer 33 through a valve 42 similar to valve 34. Phototube 41 is connected between the anode and the grid of valve 42 and a capacitor 43 is connected between the grid of valve 42 and the other secondary terminal of transformer 33. A capacitor 44 is preferably connected in parallel with the coil of relay 39. The contacts of relay 39 may be short circuited by a circuit comprising slip rings 45 and 46 of switch 11 only when switch 11 is moved away from the rest position thereof.

All the circuits controlled by switch 11 are adapted to be energized from battery 13 through switch 11 and through the contacts of a common relay 47 adapted to complete any circuit selected by switch 11. Relay 47 is operable to close the contacts thereof upon impingement of the beam of light projected from lamp 28 on a third phototube 48. Relay 47 is connected with transformer 33 through connections similar to those of relay 39 and comprising a valve 49 and capacitors 31 and 52. To simplify the drawing the circuits controlled by switch 11 have been omitted therein except a pair of circuits adapted to be selected by switch 11 to control different operations of a relay 53. One circuit comprises battery 13, the contacts of relay 47, switch 11 when actuated to position 4, the coil of relay 53 and a current limiting resistor 54. The other circuit comprises battery 13, the contacts of relay 47, switch 11 when actuated to position 5 thereof and resistor 54. Relay 53 is provided with holding contacts and with two other sets of contacts for connecting the closing coil 56 and the trip coil 57 of circuit breaker 9 with battery 13. It will be observed that selector 18 and push button switch 29, which control the operation of circuit breaker 9, are without physical contact with any circuit associated with closing coil 56 and trip coil 57, so that the operation of the selector and of the push button is without danger to the life of the operator even if a defect should develop in the insulation between circuit 6 and coils 56 and 57.

When the elements of the system are in the position shown in the drawing, lamps 14, 27 and 28 are without current. Phototube 15 is not illuminated and is substantially non-conductive. Transformer 33 then charges capacitor 37 through the grid and the cathode of valve 34, and the charge taken by the capacitor is such as to maintain the grid of valve 34 at a negative potential with respect to the cathode potential at least when the associated anode is at a positive potential with respect to the cathode. Valve 34 is thus maintained substantially non-conductive for the flow of current between the anode and the cathode thereof. Valves 42 and 49 are likewise maintained non-conductive when phototubes 41 and 48 are not illuminated.

When it is desired to close circuit breaker 9, the shaft of selector 18 is moved to position number 4. Upon departure of selector 18 from the rest position thereof, slip rings 23, 24 and 25 connect lamps 14 and 27 with battery 26. The beam of light projected from lamp 14 is then directed away from phototube 15, which is still in the rest position thereof. Lamp 27 illuminates phototube 41 which then provides a materially conductive connection between the anode and the grid of valve 42. Capacitor 43 discharges and the grid of valve 42 is able to reach a positive potential when the associated anode is at a positive potential with respect to the cathode. Valve 42 is thus rendered conductive and a pulsating current is transmitted from transformer 33 to the coil of relay 39 through valve 42. Relay 39 thus closes its contacts in response to movement of selector 18 away from the rest position thereof to connect motor 12 with battery 13. Motor 12 drives the shaft of switch 11 in the clockwise direction of rotation, for example.

When switch 11 reaches position 4 thereof, phototube 15 intercepts the beam of light projected from lamp 14. Phototube 15 becomes materially conductive and causes operation of relay 32 in the manner above described with respect to relay 39. Relay 32 opens the contacts thereof and thereby causes motor 12 to stop in response to impingement of the beam of light projected from lamp 14 on phototube 15. Switch 11 accordingly remains in position 4 thereof. The operator may then momentarily close push-button switch 29 to connect lamp 28 with battery 26. Lamp 28 illuminates phototube 48 which becomes conductive and causes operation of relay 47 in the manner above described with respect to relay 39. Relay 47, which is operable to complete any of the circuits controlled by switch 11 subject to insertion of the switch therein, then completes the connection of signal lamp 55 and of the coil of relay 53 with battery 13.

Relay 53 connects closing coil 56 of circuit breaker 9 with battery 13, thereby causing the circuit breaker to close. Relay 53 also closes the

holding contacts thereof, thereby maintaining its coil and lamp 55 energized independently of relay 47 and of switch 11. Push button switch 29 may then be allowed to reopen and selector 18 is preferably returned to the rest position thereof. Lamps 14, 27 and 28 are then all disconnected from battery 26 and relays 32, 39 and 47 returned to the position shown in response thereto. Motor 12 is then connected with battery 13 through the contacts of relay 32 and through slip rings 45 and 46. Motor 12 therefore moves switch 11 away from position 4 thereof. When switch 11 returns to the rest position the circuit of motor 12 is interrupted at slip ring 46 and motor 12 stops, leaving switch 11 in the rest position.

When it is desired to cause circuit breaker 9 to open, selector 18 is moved into position 5 thereof. Motor 12 is started in response thereto to bring switch 11 into position 5 and relay 47 is caused to momentarily close its contacts in the manner above described. Relay 47 and switch 11 in position 5 short circuit the coil of relay 53. Relay 53 returns to the position shown, thereby connecting trip coil 57 with battery 13. The trip coil withdraws the latch of circuit breaker 9 which is caused to open. Upon return of relay 47 to the position shown signal lamp 55 is disconnected from battery 13. Switch 11 is then preferably returned to the rest position thereof in the manner above described. The transmission of signal and control impulses to other circuits controlled by switch 11 would be effected in the manner outlined above.

Although but one embodiment of the present invention has been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

It is claimed and desired to secure by Letters Patent:

1. A control system comprising a pair of members each movable from a rest position into a plurality of operating positions, a light source mounted on one of said members, a light sensitive device mounted on the other one of said members and so arranged as to be illuminated by said source only when said members are in corresponding operating positions, a motor for actuating one of said members, means for starting said motor, and means responsive to illumination of said light sensitive device by said source for stopping said motor.

2. A control system comprising a pair of members each movable from a rest position into a plurality of operating positions, a light source mounted on one of said members, a light sensitive device mounted on the other one of said members and so arranged as to be illuminated by said source only when said members are in corresponding operating positions, a motor for actuating one of said members, means for starting said motor, means responsive to movement of said motor actuated member out of said rest position thereof for maintaining said motor operative, and means responsive to illumination of said light sensitive device by said source for stopping said motor.

3. A control system comprising a first member movable from a rest position into a plurality of operating positions, a light source mounted on said member, a second member movable from a rest position into a plurality of operating positions, a light sensitive device mounted on said second member and so arranged as to be illuminated by said source only when said members are in corresponding operating positions, a motor for actuating said second member, means responsive to actuation of said first member out of said rest position thereof to start said motor, means responsive to actuation of said second member out of said rest position thereof for maintaining said motor operative, and means responsive to illumination of said light sensitive device by said source for stopping said motor.

4. A control system comprising a first member movable from a rest position into a plurality of operating positions, a light source mounted on said member, a second member movable from a rest position into a plurality of operating positions, a light sensitive device mounted on said second member and so arranged as to be illuminated by said source only when said members are in corresponding operating positions, a motor for actuating said second member, means comprising a second light source and a second light sensitive device responsive to actuation of said first member out of said rest position thereof to start said motor, means responsive to actuation of said second member out of said rest position thereof for maintaining said motor operative, and means responsive to illumination of the first said light sensitive device by the first said source for stopping said motor.

5. A control system comprising a pair of members each movable from a rest position into a plurality of operating positions, a light source, a light sensitive device so arranged as to be illuminated by said source only when said members are in corresponding operating positions, a motor for actuating one of said members, means for energizing said motor when said members are in non-corresponding positions, and means for deenergizing said motor comprising means responsive to illumination of said device from said source and means responsive to movement of both said members into their respective said rest positions.

6. A control system comprising a pair of members each movable from a rest position into a plurality of operating positions, a light source, a light sensitive device so arranged as to be illuminated by said source only when said members are in corresponding operating positions, a motor for actuating one of said members, means responsive to actuation of the other one of said members out of said rest position thereof to start said motor and to render said source operative, and means responsive to illumination of said light sensitive device by said source for stopping said motor.

7. A control system comprising a pair of members each movable from a rest position into a plurality of operating positions, a light source, a light sensitive device so arranged as to be illuminated by said source only when said members are in corresponding operating positions, a motor for actuating one of said members, means for energizing said motor when said members are in non-corresponding positions, means for deenergizing said motor when said members are in corresponding ones of said operating positions comprising means responsive to illumination of said device from said source, and means for deenergizing said motor when said members are in said rest positions comprising means for rendering said source inoperative.

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