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ELECTRIC CONTROL SYSTEM.

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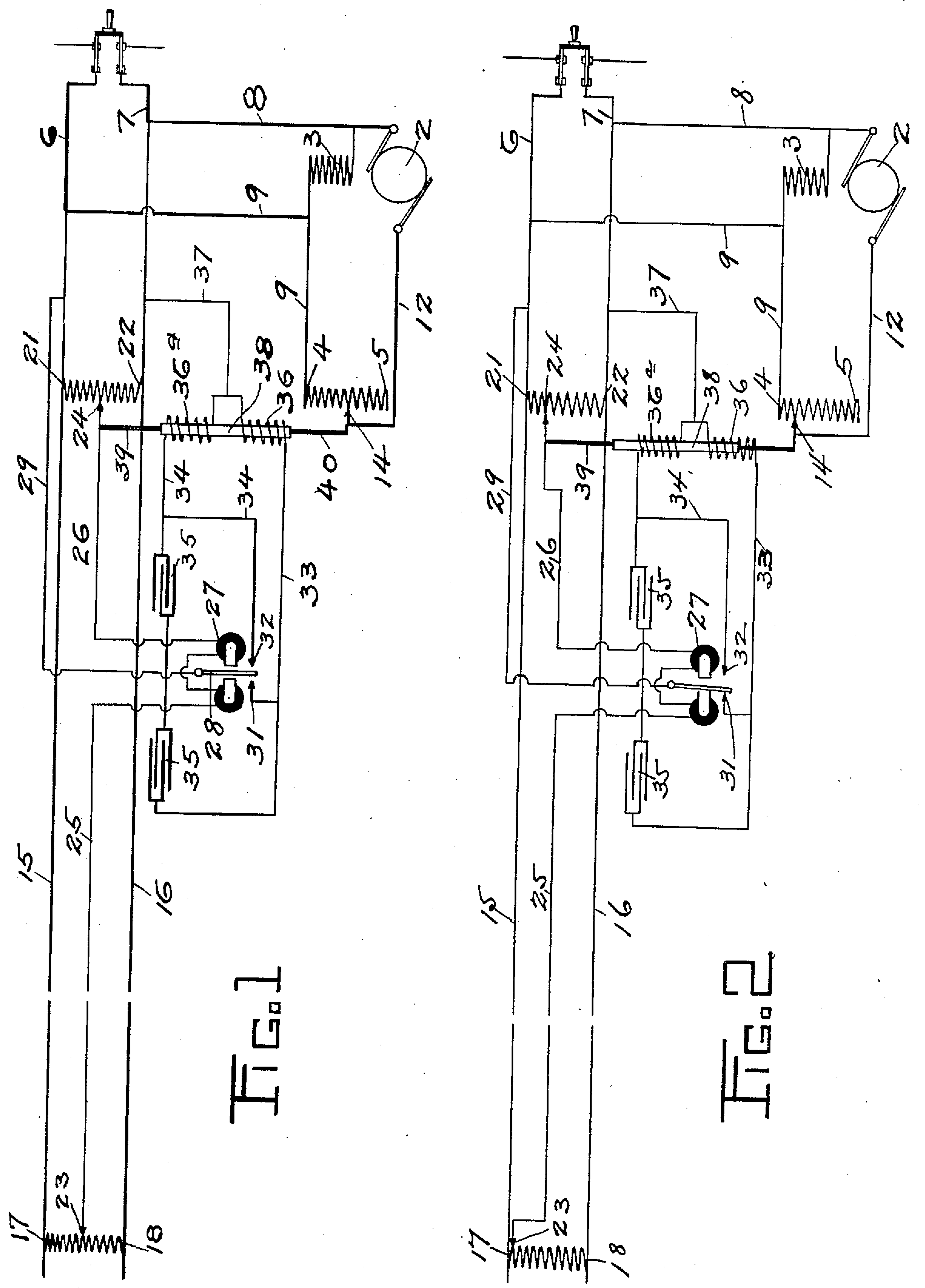

WITNESSES:

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ELECTRIC-CONTROL SYSTEM.

963,867. Specification of Letters Patent. Patented July 12, 1910.

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To all whom it may concern:

Be it known that I, WILLIAM M. CHUBB, a citizen of the United States, and a resident of the city and county of San Francisco and State of California, have invented new and useful Improvements in Electric-Control Systems, of which the following is a specification.

The invention relates to improvements in the control of electric apparatus and has reference more particularly to the provision of a system whereby the control and regulation of electrical apparatus can be effected in a cheaper and more effective manner than is now the case.

The invention is particularly applicable for use in the control of motors, arc lamps, or other electrical apparatus, that are situated at a distance from the point of control and from which point it is desirable to control the operation thereof.

The object of the invention is to provide a system for controlling the operation of electrical apparatus from a point distant therefrom by a simpler and more economical method than is at present in use.

Another object of the invention is to provide a system whereby electrical apparatus may be controlled from a point distant from the installation thereof by means of a control circuit carrying a very small current.

For the purposes of description and in the drawings, I have shown the system applied to an electric motor, but it is understood that I do not confine myself to such use of the system but have described and illustrated it as it shows one of the simple forms of use.

In starting or varying the speed of an electric motor, it is the general practice to vary the current through the armature by varying the external resistance in the armature circuit, and to control a motor from a distance it is necessary either to run the armature circuit to the desired point and insert a variable resistance, or rheostat, at that point, or to insert a system of contactors and relays in the control circuit. In the former case, the armature current being large it is evident that the wires of the external armature circuit between the motor and the rheostat at the point of control would have to be very heavy to make the I^2 R loss and the voltage drop proportionately small. It is the custom at present to string heavy cables from the motor to the point of control so that the resistance of the lead wires will be comparatively low. This method of starting an electric motor is one that is not always convenient to adopt in practice and the purpose of the present invention is to overcome the objections that pertain to such a method. In the latter case, the system is very complex and costly, requiring a relay for each variation of the resistance in the armature circuit.

My invention is particularly adapted for use in search light control, both in traversing, elevating and depressing the beam and in the control of the positions of the carbons to produce the desired arc or spark gap. It is necessary in this work to have the control station removed a considerable distance from the light, so that the observers can see objects upon which the beam is projected. The operation of the light is effected by electric motors and it is desirable to have the operation of the motors under perfect control for starting, stopping and varying the speed and reversing. It is quite important in traversing that the rate of travel of beam can be made identical with that of the moving object at which it is projected and complete control of the electric motors is necessary.

If smaller wires were used in the external armature circuit the drop in potential would be so great that the variable resistance of the rheostat at the point of control would hardly be perceptible at the motor, and, owing to the low voltage, the motor would operate very inefficiently and would carry only a small fraction of its rated capacity.

In the present invention I have provided a control circuit extending from the main circuit which not only requires a very small current for its operation, but said current passes only when the resistance in the armature circuit of the motor is being varied.

My invention consists of a circuit connected to the motor circuit and extending to any desirable point, a variable resistance at that point, and means at the motor whereby the armature resistance is varied in proportion as the resistance at the control point is varied, and means for holding the armature resistance at any desired point within the range of the external resistance, or for reversing the direction of rotation of the motor.

The following description explains at length the nature of my said improvements and the manner in which I proceed to apply the same in the production of a system of motor control; reference being had to the accompanying drawing.

Figure 1 is a diagrammatic representation of the system of my invention showing the control circuit in inoperative condition. Fig. 2 is a diagrammatic representation showing the control circuit in operation to vary the external resistance in the armature circuit of the motor.

In the drawings I have shown a shunt wound motor 2, the coil 3 representing the field winding and the resistance 4—5 the external resistance in the armature circuit. It is obvious that other types of motors which are controlled by varying the resistance in either field or armature circuit could also be controlled by this system. And I do not wish to limit myself to the control of motors, as many other varieties of electrical apparatus can be controlled by the same system. Current is supplied by the mains 6 and 7 that lead from any suitable source of power and from which the energy is taken to drive the motor. The motor is connected on one side directly to the main 7 by the lead 8, and on the other side to the main 6 through a variable resistance or rheostatic device 4—5 and the leads 9 and 12. The field winding 3 is shunted across the wires 8 and 9, and the external armature resistance 4—5 is placed between the wires 9 and 12, but is not connected to the wire 12 at 5, so that the armature circuit may be opened to stop the motor. The contact point 14 on the end of the wire 12 is movable over the resistance 4—5 thereby varying the resistance of the armature circuit according to its position. It is common practice to control the motor by varying the external armature resistance and the motor will be under perfect control from a distant point, provided the contact point 14 can be moved at will over the resistance 4—5 from said distant point. The control circuit extends from the motor to the point from which the motor is to be controlled, and consists of the conductors 15—16, both of relatively small diameter in proportion to the feed wires 6—7, which are connected to the main feed wires 6—7 respectively, at the motor. A resistance 17—18 is placed across the circuit 15—16 at the point of control and a like resistance 21—22 is placed across the circuit at the motor. These resistances are made large in proportion to the resistance of the circuit 15—16, so that the greatest percentage of the drop over the line occurs over the resistances and not over the circuit wires.

In the system of my invention I employ the circuits of the Wheatstone bridge in which the current enters at 21, and divides at that point, part passing through the circuit 21—22 and part through the circuit 21—17—18—22, the proportion of current passing through each circuit varying inversely as the resistance thereof. Assuming that 21 is the point of higher potential and 22 is the point of lower potential, it is evident that there is the same drop of potential over each of the circuits 21—22 and 21—17—18—22. Therefore, there are corresponding points in each circuit where the potentials are the same and if these points were connected there would be no current passing through the connecting wire, as is demonstrated in the Wheatstone bridge. As the resistance of the coils 17—18 and 21—22 are much higher than the resistance of the wires 15—16, it is evident that a plurality of points will be found on the resistance 17—18 which are at the same potential with corresponding points on the resistance 21—22. Therefore, if the contact points 23 and 24 are on points of like potential on the two resistances, there will be no current flowing through the circuit 25—26. And if the contact points are not on points of the same potential, a current will flow through the circuit 25—26 from the point of high potential to the point of low potential and such current will flow as long as there is a difference of potential between the ends of the circuit.

A polarized relay 27 is arranged in the circuit 25—26 and is actuated when the contact points 23—24 are on points of different potential and a current is passing through the circuit. The arm 28 of the relay moves to one side or the other according as the point 23 or 24 is of the higher potential. The arm 28 of the relay is connected to the conductor 15 through the wire 29 and the outer end of the arm 28 rests between the contact points 31 and 32 on the conductors 33 and 34 respectively. Condensers 35 are placed in these circuits to relieve the relay 27 of any sparking which would occur at the gap between the arm and the contact points 31 and 32. The current in the conductor 33 passes through the solenoid 36 and through the conductor 37 to the conductor 16, and the current in the conductor 34 passes through the solenoid 36ª and thence through the conductor 37 to the conductor 16. The solenoids are arranged to cause a longitudinal movement of the iron core 38. This iron core is caused to move in one direction or other by one or other of the two solenoids, the circuit of which is closed between the contact point and the arm 28 of the relay. A current passing through the solenoid 36 will cause the iron core 38 to move toward the solenoid 36ª and a current through the solenoid 36ª will cause it to move toward the solenoid 36. The contact point 24 is attached to one end of the iron core 38 by an insulating rod 39 and the contact point 14 is attached to the other end by the insulating rod 40. As the iron core is moved by the solenoids, the contact point 24 is moved over the resistance 21—22, and the contact point 14 is moved over the external armature resistance 4—5, thereby varying the speed of the motor. Dash-pots and other similar appliances may be used on the iron core 38 to damp its action and prevent it from moving the contact points over the resistances too rapidly which would have the effect of varying the armature current too suddenly. A solenoid is energized only when the arm 28 of the polarized relay is in contact with one of the contact points 31—32 and this condition occurs only when the contact points 23—24 are at different potential, and a current is passing through the circuit 25—26. The relay and the solenoids are arranged so that a current passing from contact 23 as a point of higher potential, through the relay will bring the arm 28 in contact with the contact point 31 which will cause the solenoid 36 to move the iron core 38 toward the solenoid 36ª, bringing the contact point 24 nearer the point 21 and also moving the contact point 14 over the resistance 4—5 with the effect of varying the resistance of the armature circuit. The iron core will move until the contact point 24 contacts with a point on the resistance 21—22 which is at the same potential as the point 23. When the contact 24 reaches this point there will be no current flowing through the relay circuit and the arm 28 will break contact with the contact 31 and the iron core will remain stationary. It is seen, therefore, that any motion of the contact 23 will cause a similar motion of the contact 14 and the armature resistance can be varied as desired. It is to be understood, however, that I do not limit myself to the use of a solenoid, as it is evident that other means, such as a small motor, can be used to accomplish the same purpose.

When it is desired to stop the motor, the contact point 23 is moved to the low potential end 18 of the resistance 17—18. This makes contact point 24 the point of high potential and causes the current to flow from 24 through the relay, bringing the arm 28 in contact with contact point 32, energizing the solenoid 36ª and moving the iron core toward solenoid 36. This moves the contact point 14 past the end 5 of the armature resistance 4—5, and the armature circuit is opened stopping the motor. The iron core will remain in that position until it is again moved by the solenoid 36.

Fig. 1 shows the contact points 23—24 on points of equal potential and Fig. 2 shows contact point 23 on a point of higher potential than 24, the relay closed on contact 31 and the iron core moving the contact point 24 to a point of the same potential as 23 and contact point 14 varying the resistance of the armature circuit.

When it is desirable to control several motors from one point of control, it is necessary only to insert similar resistances across the circuit 15—16 and install a polarized relay and solenoid circuits at the motor, thus necessitating the addition of only one wire similar to conductor 25, extending from the motor to the point of control for each additional motor it is desirable to control.

It is understood that I do not limit myself to the control of motors and have referred to them in this specification for purposes of description and application.

I claim:

1. In an electric control system, a divided circuit, a resistance in each circuit, points of equal potential on the resistances, contacts on said points, a conductor connecting the contacts and electro-magnetic means in the conductor operated by the movement of one contact to a point of different potential to cause a solenoid to be energized, an iron core in the solenoid connected with the other contact point and adapted to be moved by the solenoid to cause the contact point to move to a point of like potential.

2. In an electric control system the combination with electric supply mains of a circuit connected to the mains at the apparatus to be controlled and extending to the point of control, a resistance in the circuit at the point of control and a similar resistance across the circuit at the apparatus corresponding points of equal potential on each resistance, contacts engaging said points, a polarized relay in the circuit connecting said contacts, an auxiliary circuit connected to the control circuit and governed by the relay, means for moving the contact point on the resistance at the point of control to a different potential and a solenoid in the auxiliary circuit for moving the contact point on the resistance at the apparatus to the same different potential and simultaneously vary the operation of the apparatus to be governed.

3. In an electric control system, the combination with electric supply mains of a circuit connected to the mains at the apparatus to be controlled and extending therefrom to the point of control, a resistance in the circuit at the point of control, a similar resistance across the circuit at the apparatus, sliding contacts engaging said resistances, a conductor connecting said contacts, a polarized relay in said conductor, an auxiliary circuit closed by said relay, a solenoid in said auxiliary circuit, an iron core in said solenoid adapted to move longitudinally therein as the contact point is moved over the resistance at the control end, insulated means connecting the contact on the

resistance at the apparatus with the iron core, means connected to the iron core for regulating electrical apparatus by the motion thereof, the core moving only when the contact on the control resistance and the contact on the resistance across the circuit at the apparatus are on points of different potential.

4. In a motor control system, the combination with an electric motor, electric supply mains and a rheostatic device in the armature circuit, of a circuit connected to the supply mains at the motor and extending to the point of control, a resistance in the circuit at that point, a similar resistance shunted across the circuit at the motor, sliding contacts engaging the resistances, a conductor connecting the contacts, a polarized relay in the conductor, an auxiliary circuit connected to the control circuit and closed by the relay, current flowing in one direction therethrough for one direction of current in the control circuit and in the opposite direction for a reversal of current in the control circuit, a solenoid in the auxiliary circuit, an iron core in the solenoid adapted to be moved longitudinally in opposite directions for oppositely flowing currents in the circuit, and insulated material connecting one end of the solenoid with the contact point on the resistance across the circuit at the motor and the other end with the rheostatic device in the armature circuit of the motor, the current flowing through the control circuit, and the solenoid only when the contact points on the resistances are at different potential, said solenoid being arranged to maintain the contact on the resistance at the motor at the same potential as the contact on the resistance at the point of control.

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Witnesses:
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