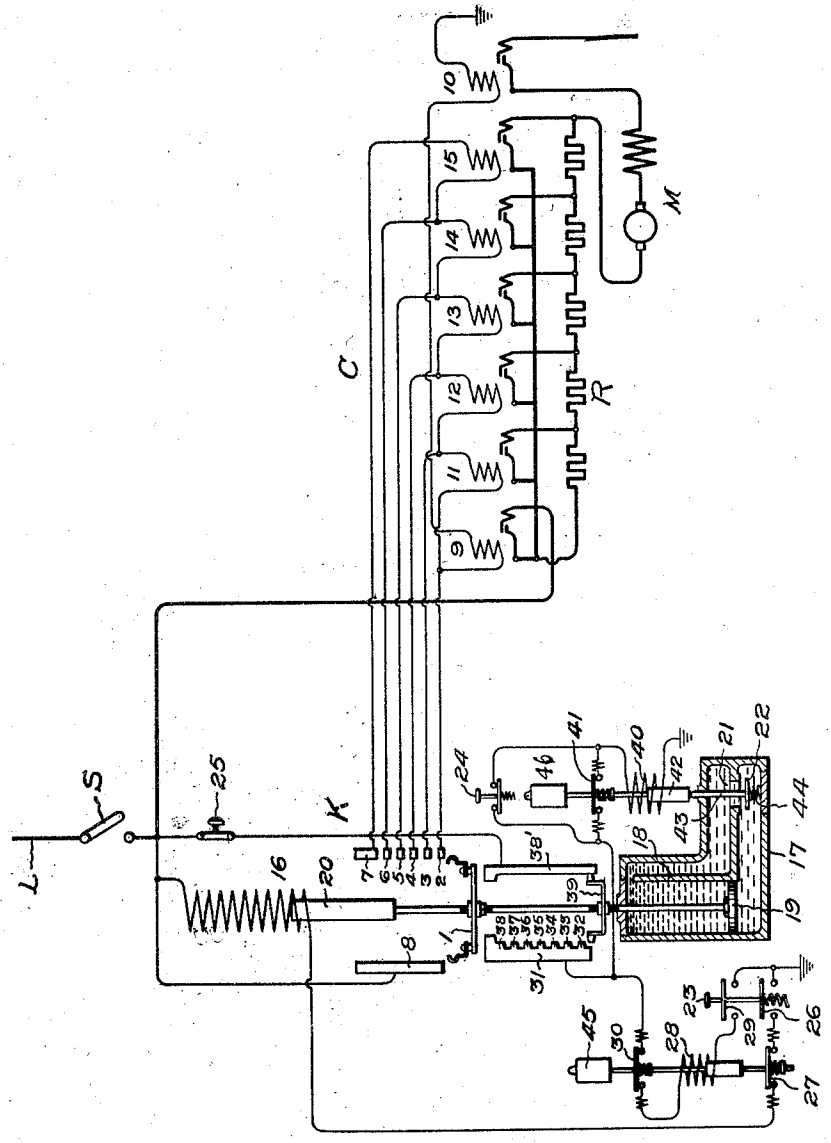
No. 885,446. PATENTED APR. 21, 1908.

A. T. CROCKER.

CONTROLLER.

APPLICATION FILED AUG. 1, 1906.



Witnesses;

Marcus L. Byng.

Benjamin B. Hicks

Inventor:

Arthur T. Crocker.

By Albert G. Davis

Atty.

UNITED STATES PATENT OFFICE.

ARTHUR T. CROCKER, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

CONTROLLER.

No. 885,446. Specification of Letters Patent. Patented April 21, 1908.

Application filed August 1, 1906. Serial No. 328,655.

To all whom it may concern:

Be it known that I, ARTHUR T. CROCKER, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Controllers, of which the following is a specification.

The present invention relates to controllers for electric motors, and has for its object to improve the construction and operation of such controllers.

In an application filed by George H. Hill on August 13, 1906, Serial No. 330,294, for improvements in control apparatus, there is disclosed and claimed a novel controller for electric motors, whereby a motor may be gradually accelerated to any desired speed and be slowed down gradually or abruptly, as may be desired, from any one of a plurality of stations, by simply pressing the proper push-button or other small switch.

Specifically considered, the present invention relates to the same type of controller, but comprises improvements in the actuating means for the controller to be hereinafter described and particularly pointed out in the claims.

The accompanying drawing illustrates diagrammatically a motor and control system constructed and arranged in accordance with the present invention.

Referring to the drawing, M indicates a motor of any preferred type arranged to be connected to the source of current supply L in series with more or less of the resistance R.

C is a controller of the separately-actuated contact type arranged to complete the motor circuit and control the amount of resistance contained therein.

K is a master controller for governing the operation of the motor controller. The master controller comprises the movable contact member 1, a series of fixed contacts 2—7, arranged in a row, and the fixed contact plate 8 placed parallel to the row of contacts. The contact 8 is adapted to be connected to the source of current supply and contacts 2—7, inclusive, are connected to the actuating coils of switches 9 and 10, 11, 12, 13, 14 and 15, respectively. Thus, as the movable contact member traverses the fixed contacts, the switches 9 and 10 are first closed, thereby connecting the motor to the source of current in series with all of the resistance; then, as the movable member of the master controller continues across the fixed contacts, switches 11, 12, 13, 14, and 15 are closed in succession; the closing of these switches eliminating the resistance R from the motor circuit step by step, until, in the final position of the master controller, wherein the movable contact member engages contacts 8 and 7, the motor is connected directly across the line. All these parts, including motor, the main controller, and the arrangement of contacts of the master controller may take any desired forms, since they of themselves constitute no part of the present invention.

The movable member of the master controller is preferably operated by means of a main solenoid 16, which is controlled in such a manner that the master controller may be operated step by step in either direction or be caused to return quickly to the off position, at the will of the operator.

17 is a receptacle filled with liquid and having therein an open-ended cylinder 18 in which operates a piston 19 connected to the core 20 of the solenoid 16.

21 is a by-pass between the ends of the cylinder, this by-pass being controlled by a valve 22. When this valve is open, as shown, the liquid in the receptacle is free to circulate, so that the piston may fall through the action of gravity if the solenoid 16 is deënergized. When the valve is closed, however, the liquid cannot flow upward through it, and the piston, therefore, cannot fall even though the solenoid 16 is deënergized. The movements of the master switch are therefore governed by controlling the circuit of the main solenoid 16 and by opening and closing the valve 22.

In order to simplify the circuits only one set of push-buttons has been illustrated, but it will be evident that any desired number of control stations having duplicate buttons may be used. Three controlling switches or push-buttons 23, 24, and 25, which are respectively accelerating, retarding, and emergency buttons, may be conveniently used. Push-button 23 has connected thereto a normally open switch 26 in the circuit including solenoid 16. In series with the switch 26 is an auxiliary switch 27 controlled by electro-magnet 28. The circuit of electro-magnet 28 passes through the normally open switch 29 operated by push-button 23, through a normally closed switch 30 associated with the electro-magnet itself and through an inter-

rupter 31. The movable member of the switch 30 is carried by a rod which rests upon but is not secured to the core of the solenoid 28, said rod being secured at its upper end to one of the members of an adjustable dash-pot 45 which retards the falling of said rod without interfering with its upward movement. This construction of solenoid switch is well known and forms no part of my invention.

The interrupter comprises a series of connected fixed contacts 32 to 38, inclusive, corresponding to the master controller contacts 2 to 7, an elongated contact 38′ corresponding to the contact 8 on the master controller, and a movable contact 39 connected to the core 20. The movable contact members of the interrupter and of the master controller, therefore, move in unison. The contact member 38′ is connected to line, and contacts 32 to 38 are all connected in parallel to the circuit including the coil of electro-magnet 28. 40 is an electro-magnet controlling the valve 22, and the circuit for this electro-magnet passes through the interrupter 31, as in the case of electro-magnet 20, through a normally closed push-button 24, and through a normally closed switch 41 associated with the core 42 of electro-magnet 40 and arranged in parallel with the push-button 24. The movable member of the switch 41 is carried by a rod which rests upon the core 42 and is connected at its upper end to one member of a dash-pot 46 which retards the closing of the switch 41 without hindering its opening in a manner similar to that in which the switch 30 is controlled. When the electro-magnet 40 is deënergized, its core rests upon a stem 43 connected to the valve 22 and presses the valve from its seat against the tension of a spring 44. When the electro-magnet is energized, the valve is held closed by the spring.

The operation is as follows: Assuming that the switch S is closed, then, upon pressing push-button 23, a circuit is completed through the solenoid 16, causing the core of the solenoid to be drawn upward and carry with it the movable contact members of the controller and of the interrupter. When the master controller reaches the first operative position, so as to cause switches 9 and 10 of the motor-controller to close, contact 39 of the interrupter engages with contact 32, and a circuit is thereupon completed from the source through the interrupter, through the electro-magnet 28, and to the ground. Electro-magnet 28, being thus energized, operates to open switches 27 and 30, thus breaking its own circuit and that of the main solenoid. It will be seen, however, that the electro-magnet 40 has also been energized, so as to cause its core to release the valve stem; thereby permitting the valve to close and hold the piston 19 against downward movement while the main solenoid remains deënergized.

As soon as the switch 27 has been closed by the dropping of the core of the electro-magnet 28, if the button 23 is still pressed down, the circuit of the main solenoid 16 is again completed and the movable member of the controller carrying the movable contact 39 begins to rise, this movement being permitted by reason of the fact that the valve 22 acts as a check-valve and permits the liquid to flow from the upper end of the cylinder down into the lower end. The dash-pot 45 is set to permit the switch 30 to close shortly after the core of the coil 28 has dropped and closed the switch 27, but the switch 30 does not close until the movable contact 39 has moved upward sufficiently to break connection with the fixed contact 32. The switch 30, however, closes before the movable contact 39 reaches the fixed contact 33 so that when the contact 39 does reach the contact 33 a circuit is completed as before from the interrupter 31, through the switch 30, coil 28 and switch 29 to ground. This causes the core of the coil 28 to rise immediately and break the circuit of the controller actuating coil 16 at 27, at the same time opening the switch 30 and interrupting the circuit through the coil 28. The core of the coil 28, therefore, drops and the operation is repeated. In this way the controller is caused to rise step-by-step if the button 23 is held pressed down. If the button 23 is released at any time the master controller will stop its movement and be maintained at the step at which it then is, owing to the check-valve action of the valve 22. The electro-magnet 40 operates intermittently, but its operation is of no consequence during the upward movement of the master controller since the valve 22 does not retard the upward movement of the master controller under any condition.

If it is desired to stop the motor quickly, the emergency button 25 is pressed and the circuit of electro-magnet 40 thereby interrupted, so that the core drops and holds the valve 22 open. The weight of the core 20 and attached parts is sufficient to cause the movable contact member of the master controller to be quickly brought to the off position when the valve 22 is thus held open.

Assuming that the master controller is in one of its running positions, for example, that position in which the movable contact member 1 is in engagement with the fixed contacts 5 and 8 and the movable contact 39 is in engagement with the fixed contacts 35 and 38′, and that it is desired to move the master controller backward one step, this may be accomplished as follows: The push-button 24 is depressed thereby interrupting the circuit through the coil 40 which has been receiving current from the line through emergency button 25, contact 38′, movable contact 39, contact 35 of interrupter 31 and through the push-button 24. The deënergi-

zation of the coil 40 allows the core 42 to drop thereby opening the valve 22 and allowing the liquid to flow from below the piston 19 to above it.

The rod upon which the movable member of the switch 41 is mounted is retarded in its dropping by means of the adjustable dash-pot 46 in a manner similar to that in which the switch 30 is retarded in its closing movement. As soon as the valve 22 opens, the master switch begins to descend and the movable contact 39 leaves the fixed contact 35 thereby interrupting the circuit from the interrupter 31 to the push-button 24 and making it permissible to release the push-button 24. It is obvious, therefore, that if it is desired to move the master controller backward but one step it is only necessary to depress the push-button 24 momentarily. The switch 41 closes while the movable contact 39 is falling from the fixed contact 35 to fixed contact 34, and when the contact 39 engages with the contact 34 a circuit is completed to the coil 40, through the switch 41 and also through the push-button 24, provided that has been released. The energization of the coil 40 causes the core 42 to rise and permits the valve 22 to close thereby stopping the downward movement of the master controller. If the push-button 24 has been maintained depressed the circuit through the coil 40 will be interrupted at the switch 41 and the core 42 will drop and the operations just described repeated. From this it is clear that by holding the push-button 24 depressed the master switch may be caused to move step-by-step from any "on" to the "off" position.

Although I have described but one modification of my invention, namely, the preferred embodiment thereof, I do not desire to be limited to the particular modification shown, since in its broader aspects my invention covers also various other modifications, as will be evident from the appended claims.

What I claim as new, and desire to secure by Letters Patent of the United States, is,—

1. In combination, a controller having a plurality of operative positions, a solenoid, a solenoid core for actuating said controller, and means for energizing said solenoid and for automatically deënergizing it and again energizing it at predetermined points in the travel of the core corresponding to said operative points of the controller.

2. In combination, a controller having a plurality of operative positions, a solenoid, a solenoid core for actuating said controller, means for energizing said solenoid, and means for automatically deënergizing the solenoid at predetermined points in the travel of the said core and again energizing it a predetermined interval of time after each deënergization.

3. In combination, a movable member having a plurality of operative positions, a solenoid having a core for actuating said member, and means for automatically deënergizing said solenoid and again energizing it when the core reaches positions corresponding to said operative positions of the said member.

4. In combination, a movable member having a plurality of operative positions, a solenoid having a core for actuating said member, a master switch, and means controlled by said master switch for energizing said solenoid and for automatically deënergizing it and again energizing it when the core reaches positions corresponding to said operative positions of the said member.

5. In combination, a movable member having a plurality of operative positions, a solenoid having a core for actuating said member, a master switch, and means operative during the time said master switch is held closed for energizing said solenoid and for automatically deënergizing it and again energizing it when the core reaches positions corresponding to the said operative positions of said member, in order to cause said member to pass through any desired number of its operative positions step by step.

6. In combination, a movable member having a plurality of operative positions, a solenoid having a core for actuating said member, said core having a tendency to move out of the field of the solenoid, means for energizing said solenoid and for automatically deënergizing it and again energizing it when the core reaches positions corresponding to the said operative position of said member, and means for holding said core stationary during the said periods of deenergization of the solenoid.

7. In combination, a solenoid, a core for said solenoid, a relay controlling the solenoid circuit, an interrupter connected with said core for energizing the relay at predetermined points in the travel of the core, and means associated with the relay for interrupting the relay circuit upon the operation of the relay.

8. In combination, a solenoid, a relay for completing a circuit through the solenoid, a core for the solenoid, an interrupter connected with said core for causing the relay to operate to open the solenoid circuit at predetermined points in the travel of the core, and means associated with said relay for causing it to resume the position for closing the solenoid circuit after it has been caused to operate by the interrupter.

9. In combination, a solenoid, a relay for completing a circuit through said solenoid, a core for said solenoid, an interrupter associated with said core for energizing said relay at predetermined points in the travel of said core to cause the relay to open the solen-

oid circuit, and means associated with the relay for causing it to assume its circuit-closing position a predetermined interval of time after the energization thereof.

10. In combination, a controller having a plurality of operative positions, a solenoid, a solenoid core for actuating said controller, a relay for controlling the circuit of said solenoid, an interrupter associated with said core and arranged to cause said relay to deënergize said solenoid at points in the travel of the core corresponding to said operative positions of the controller, and means associated with said relay for causing it to energize the solenoid again after each such deënergization.

11. In combination, a controller having a plurality of operative positions, a solenoid, a solenoid core for actuating said controller, a relay for controlling the circuit of said solenoid, an interrupter associated with said core and arranged to cause the relay to deënergize said solenoid at points in the travel of the core corresponding to said operative positions of the controller, and means associated with said relay for causing it to energize the solenoid again a predetermined time after each such deënergization.

12. In combination, a controller having a plurality of operative positions, a solenoid, a solenoid core for actuating said controller away from the "off" position when the solenoid is energized and toward the "off" position when the solenoid is deënergized, a relay for controlling the circuit of the solenoid, an interrupter associated with the core and arranged to cause said relay to operate to deënergize the solenoid at points in the travel of the core corresponding to said operative positions of the controller, means associated with said relay for causing it to energize the solenoid again after each such deenergization, a second relay, and means associated with the latter relay for controlling the movement of the controller toward the "off" position.

13. In combination, a controller, a solenoid, a solenoid core for actuating said controller away from the "off" position when the solenoid is energized and toward the "off" position when the solenoid is deënergized, a switch and means controlled thereby for causing the solenoid and core to move the controller step by step away from the "off" position, a second switch and means controlled thereby for causing the core to move the controller step by step toward the "off" position, and a third switch for permitting the core to return the controller toward the "off" position by a continuous movement.

In witness whereof, I have hereunto set my hand this 31st day of July, 1906.

ARTHUR T. CROCKER.

Witnesses:

BENJAMIN B. HULL.

GRACE M. HANIGAN.