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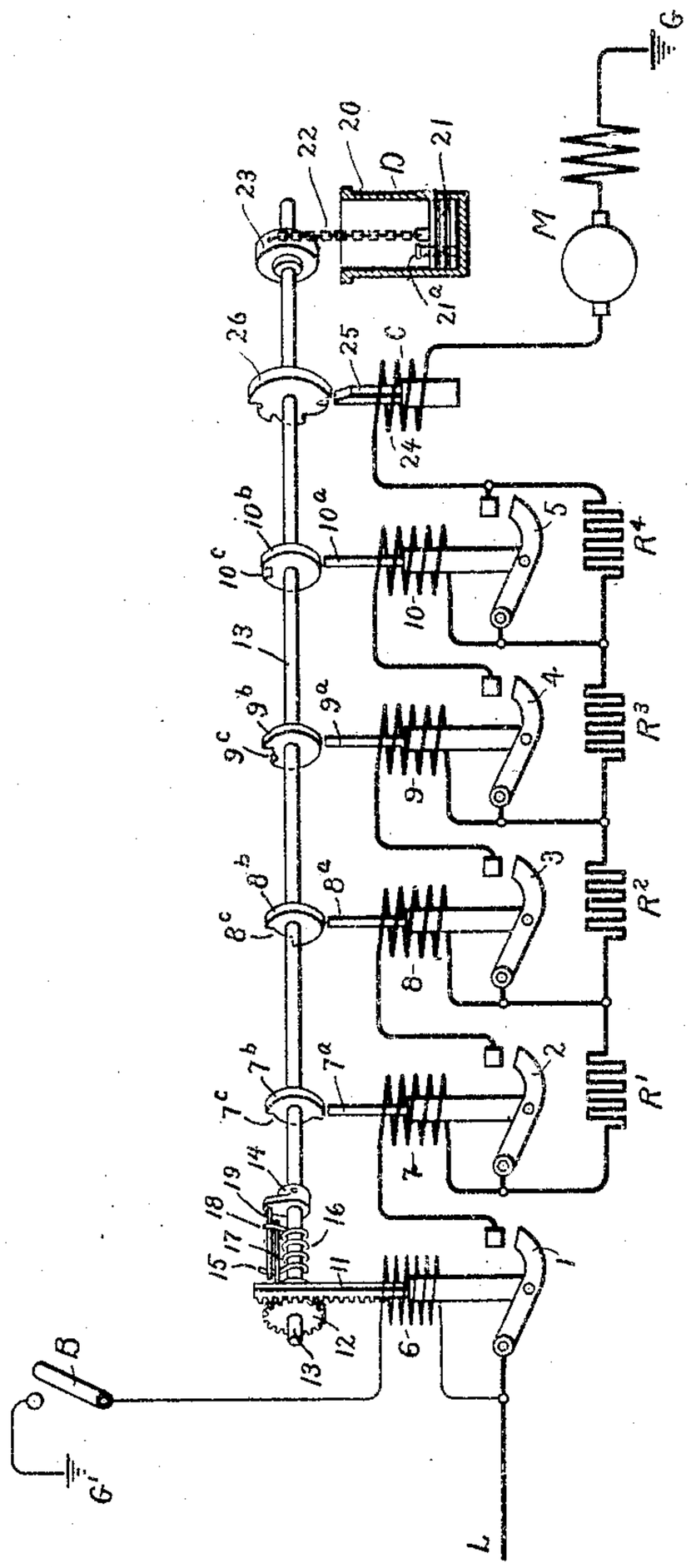
E. R. CARICHOFF.

MOTOR STARTER.

APPLICATION FILED MAY 12, 1904.

NO MODEL.



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No. 777,839. Patented December 20, 1904.

UNITED STATES PATENT OFFICE.

EUGENE R. CARICHOFF, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

MOTOR-STARTER.

SPECIFICATION forming part of Letters Patent No. 777,839, dated December 20, 1904.

Application filed May 12, 1904. Serial No. 207,686.

To all whom it may concern:

Be it known that I, EUGENE R. CARICHOFF, a citizen of the United States, residing in the city of East Orange, county of Essex, and State of New Jersey, have invented certain new and useful Improvements in Motor-Starters, of which the following is a specification.

My present invention relates to controlling devices for electric motors, and especially to that class of controlling devices known as "motor-starters."

The object of my invention is to simplify the construction and arrangement of a motor-starter which will be entirely automatic in its action and will operate to cut out the steps of the starting resistance at a predetermined rate in a positive manner.

My invention consists of a plurality of separately-actuated contacts or switches controlling an electric circuit, preferably controlling the sections of the starting resistance in a motor-circuit, the actuating-coils of said contacts or switches being successively connected in the controlled circuit each by the operation of the contact next in advance to produce an automatic progression of the contacts, together with independently-operated means for regulating the progression of said contacts.

The invention further comprises means for setting the regulating means in operation and a switch for primarily completing the controlled circuit, together with means for controlling this last-mentioned switch and regulating means from a distant point.

My invention also comprises other details of construction and arrangement, which will be hereinafter described, and specifically pointed out in the appended claims.

The accompanying drawing shows diagrammatically a motor-starter and its connections embodying the preferred form of my invention.

Referring now to the diagram, M represents the motor to be controlled. The resistance-sections R', R^2, R^3, and R^4, which are cut into the motor-circuit as the motor is started and successively cut out as the motor accelerates, are controlled by the separately-actuated contacts or switches 1, 2, 3, 4, and 5. Each of the actuating-coils 7, 8, 9, and 10 of the switches 2, 3, 4, and 5, respectively, is of comparatively low resistance and is adapted to be connected in the motor-circuit in series with the motor by the action of the switch or contact next in advance. The switch or contact 1, which primarily completes the motor-circuit, may be operated in any desired manner. In the diagram I have shown said contact operated by a relatively high resistance coil 6, connected in shunt to the motor and controlled from a distant point by the switch or master-controller B. It will be seen that immediately after closing the first contact—namely, the contact 1—the remaining contact will close in rapid succession if some regulating means for permitting a progression at a predetermined rate is not provided. Any form of regulating means which will cause the contacts to close at a predetermined rate may be employed; but I prefer to use the form of mechanical obstructing mechanism which will now be described.

Attached to the core of the coil 6 or operatively connected with the actuating means for the contact 1 is a rack 11, which engages a pinion 12, loosely mounted on the rotatable shaft 13. Carried by the pinion 12 is a pin 17, which engages one end, 15, of a spring 16, coiled about the shaft 13. The other end, 18, of said spring engages a pin 19, which is carried by the collar 14, rigidly fastened to the shaft 13. It will thus be seen that as the core of coil 6 is lifted to close the first switch the pinion 12 is rotated and the spring 16 placed under strain tending to rotate the shaft 13. This tendency to rotate is resisted and retarded by the action of the dash-pot D, which comprises the cylinder or cup 20, in which operates the piston 21, the rate of movement of which in an upward direction, and consequently the rate of progression of the contacts, is regulated by the adjustable valve 21^a.

The piston is connected to the drum 23 by means of the chain 22, the drum 23 being mounted rigidly on the shaft 13. As the shaft 13 rotates the obstructing devices or notched disks 7^b, 8^b, 9^b, and 10^b, which normally prevent the switches 2, 3, 4, and 5 from closing after their actuating-coils have been energized, are moved into a position to allow the projections 7^a, 8^a, 9^a, and 10^a, carried by the cores of the switches 2, 3, 4, and 5, to engage the recesses 7^c, 8^c, 9^c, and 10^c, respectively. This permits the switches to close at a predetermined rate, each switch completing the circuit of the actuating-coil of the next following switch. Furthermore, to prevent a too-rapid cutting out of the starting resistance—that is, to prevent an injurious flow of current through the motor while the latter is accelerating—I have provided an overload or checking magnet C, the actuating-coil 24 of which is connected in series with the motor in the motor-circuit and the core 25 of which is adapted to engage notches formed in the collar 26, carried by the shaft 13. The engagement of the core 25 with one of the notches of collar 26 locks the shaft 13 against rotation, and thereby checks the progressive action of the contacts.

The operation of the motor-starter is as follows: When the master-controller or switch B is closed, a shunt-circuit is completed from line L through the actuating-coil 6 and switch B to ground at G′. Contact 1 is therefore closed, and the regulating means is set in operation by the winding up of spring 16. The motor-circuit thus completed may be traced as follows: from line L through the switch 1, the actuating-coil 7 of switch 2, resistance-sections R′, R^2, R^3, and R^4, the coil 24 of the overload-magnet, and motor M, to ground at G. Coil 7 of the switch 2 is now energized, and said switch tends to close, but is prevented from doing so by the obstructing device 7^b until the shaft 13 is moved into such position that the projection 7^a engages the notch 7^c and permits the core to move so as to close the switch 2. The closing of said switch 2 shunts the section R′ of the resistance through the actuating-coil 8 of the switch 3. The actuating-coil 8 is thereby energized and the switch tends to close, but is prevented from doing so by the obstructing device 8^b until the shaft 13 rotates into such a position that the projection 8^a engages the recess 8^c. The switch 3 then closes, shunting the section R^2 of the resistance through the actuating-coil 9 of the switch 4. The closing of this switch is retarded, as before described with reference to switches 2 and 3. When the switch 4 is closed, the resistance-section R^3 is shunted through the actuating-coil 10 of switch 5, which is prevented from closing until the shaft 13 moves into such position that the projection 10^a engages the recess 10^c. When the switch 5 is closed, all the resistance is cut out and the motor is connected across the line in circuit with the series-actuating coils of the switches and the actuating-coil of the overload-magnet C. These actuating-coils are of very low resistance and do not appreciably cut down the flow of current through the motor-circuit. If at any time the current in the motor-circuit rises above a predetermined value, the overload-magnet C will operate to lock the shaft 13 against rotation to prevent further cutting out of the starting resistance until the counter electromotive force of the motor rises to such an extent that the current drops to its proper or predetermined value. The regulating mechanism should be made adjustable, so that any desired rate of progression of the contacts of the motor-starter may be obtained. This I propose to accomplish by providing the dash-pot piston with an adjustable valve.

Although I have shown and described a specific arrangement of the contacts and connections therefor, I do not wish to be limited thereto, as many changes and modifications may be made without departing from the spirit and scope of my invention, and I aim in the appended claims to cover all such modifications.

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

1. In combination, an electric circuit, a plurality of separately-actuated contacts controlling said circuit, actuating-coils for said contacts successively connected in the controlled circuit each by the operation of the contact next in advance to produce an automatic progression of the contacts, independently-operated means for regulating the progressive closing of said contacts, and a switch for primarily completing the controlled circuit.

2. In combination, an electric circuit, a plurality of separately-actuated contacts controlling said circuit, actuating-coils for said contacts successively connected in the controlled circuit each by the operation of the contact next in advance to produce an automatic progression of the contacts, means for regulating the progressive closing of said contacts, means for adjusting said regulating means to obtain any desired rate of progression, and a switch for primarily completing the controlled circuit.

3. In combination, an electric circuit, a plurality of separately-actuated contacts controlling said circuit, actuating-coils for said contacts successively connected in said circuit in series with the contacts already operated, means for regulating the progressive closing of said contacts, a switch for primarily completing said circuit, and means for operating said switch and said regulating means.

4. In combination, an electric circuit, a plu-

rality of separately-actuated contacts controlling said circuit, actuating-coils for said contacts successively connected in said circuit in series with the contacts already operated, means for regulating the progressive closing of said contacts, a switch for primarily completing said circuit, an actuating-coil for said switch and said regulating means, and a master controlling-switch for said last-mentioned coil.

5. In combination, an electric circuit, a plurality of separately-actuated contacts controlling said circuit, actuating-coils for said contacts successively connected in said circuit in series with the contacts already operated, means for regulating the progressive closing of said contacts, a switch for primarily completing said circuit, means for operating said switch and said regulating means, and means for retarding the operation of said regulating means so as to obtain a predetermined rate of progressive closing of the contacts.

6. In combination, an electric circuit, a plurality of separately-actuated contacts controlling said circuit, actuating-coils for said contacts, each connected in said circuit by the operation of the contact next in advance, a switch for primarily completing said circuit, mechanical obstructing devices for preventing the closing of said contacts, and means for removing said mechanical obstructing devices so as to regulate the progressive closing of said contacts at a predetermined rate.

7. In combination, a plurality of resistance-sections, a motor, a plurality of separately-actuated contacts controlling said motor and resistance-sections, actuating-coils for said contacts, said coils being successively energized by each being included in circuit with said motor by the closing of the contact next in advance, a switch for primarily completing the circuit through the motor, and independently-operated means for regulating the progressive closing of said contacts at a predetermined rate.

8. In combination, a plurality of resistance-sections, a motor, a plurality of separately-actuated contacts for controlling said motor and resistance-sections, actuating-coils for said contacts, said coils being successively energized by each being included in circuit with said motor by the closing of the contact next in advance, a switch for primarily completing the circuit through the motor, independently-operated means for regulating the progressive closing of said contacts at a predetermined rate, and means located at a distant point for controlling said regulating means.

9. In combination, a plurality of resistance-sections, a motor, a plurality of separately-actuated contacts for controlling said motor and resistance-sections, actuating-coils for said contacts, said coils being successively energized by each being included in circuit with the motor by the closing of the contact next in advance, independently-operated means for regulating the progressive closing of said contacts at a predetermined rate, a switch for primarily completing the circuit through the motor, an actuating-coil for said switch, and a master controlling-switch for said last-mentioned coil.

10. In combination, a plurality of resistance-sections, a motor, a plurality of separately-actuated contacts for controlling said motor and resistance-sections, actuating-coils for closing said contacts successively, certain of said coils being energized by each being included in the motor-circuit in shunt to a resistance-section by the closing of the contact next in advance, a switch for primarily completing the motor-circuit through the resistance-sections, and independently-operated means for regulating the progressive closing of said contacts at a predetermined rate.

11. In a motor-control system, a motor, a plurality of resistance-sections adapted to be connected in circuit with said motor, a plurality of separately-actuated contacts controlling said resistance-sections, actuating-coils for said contacts, each connected in circuit with the motor by the operation of the contact next in advance, a switch for primarily completing the circuit of said motor, regulating means comprising mechanical obstructing devices for preventing the closing of said contacts, and means for removing said obstructing devices so as to permit the progressive closing of said contacts at a predetermined rate.

12. In a motor-control system, a motor, a plurality of resistance-sections adapted to be connected in circuit with said motor, a plurality of separately-actuated contacts controlling said resistance-sections, actuating-coils for said contacts, each connected in circuit with the motor by the operation of the contact next in advance, a switch for primarily completing the circuit of said motor, regulating means comprising mechanical obstructing devices for preventing the closing of said contacts, means for removing said obstructing devices so as to permit the progressive closing of said contacts at a predetermined rate, and an overload device to prevent the movement of the regulating means and arrest the progressive action when the current in the motor-circuit rises above a predetermined value.

13. In a motor-control system, a motor, a plurality of resistance-sections adapted to be connected in circuit with said motor, a plurality of separately-actuated contacts controlling said resistance-sections, actuating-coils for said contacts, each connected in circuit with the motor by the operation of the contact next in advance, a switch for primarily

completing the circuit of said motor, regulating means comprising mechanical obstructing devices for preventing the closing of said contacts, means for removing said obstructing devices so as to permit the progressive closing of said contacts at a predetermined rate, an actuating-coil for operating said regulating means and for closing the switch which primarily completes the motor-circuit, and a master-switch for controlling said last-mentioned coil from a distant point.

In witness whereof I have hereunto set my hand this 9th day of May, 1904.

EUGENE R. CARICHOFF.

Witnesses:
ROBERT TILESTON,
LEO C. FOSS.