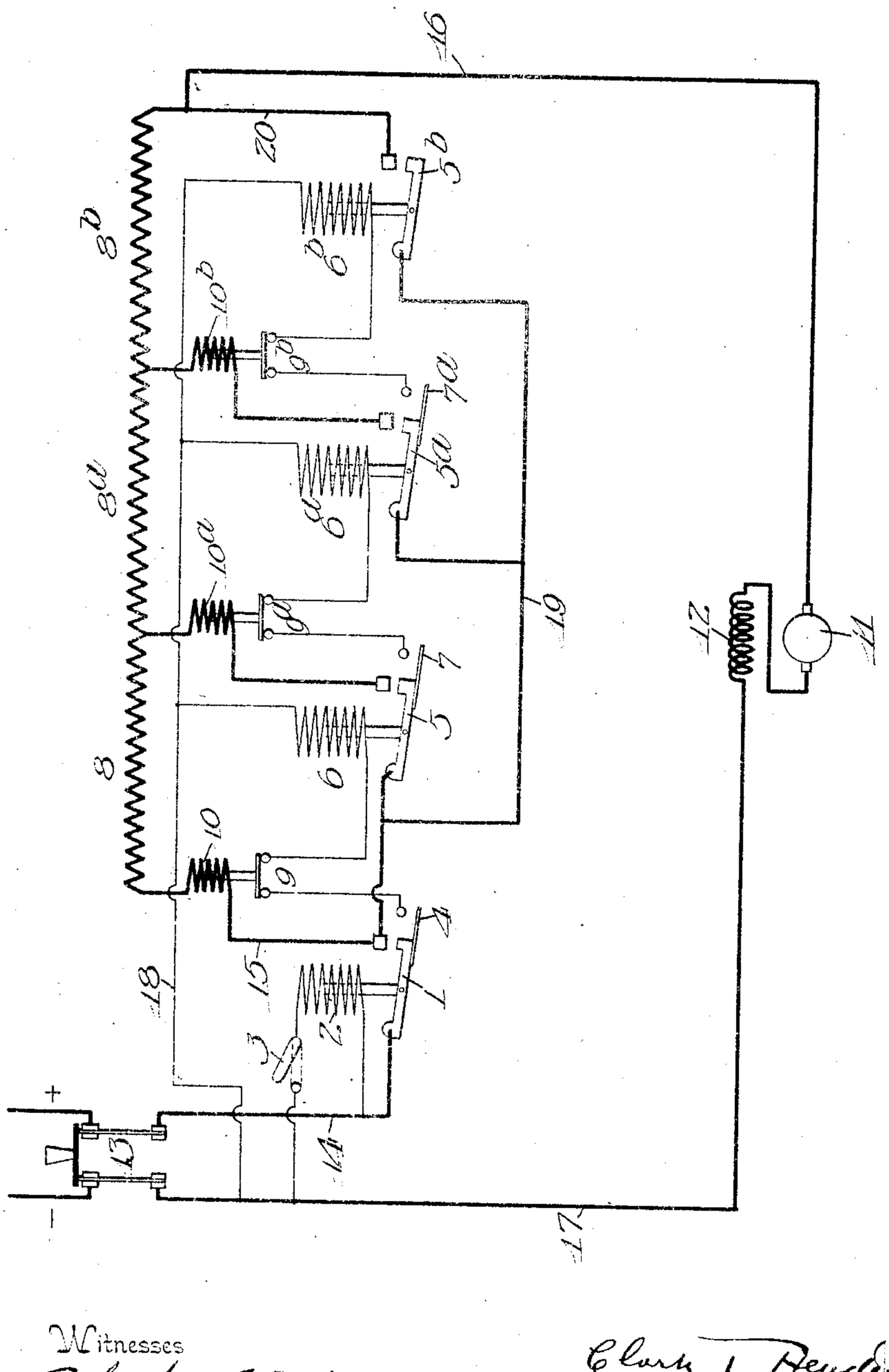
No. 890,979. PATENTED JUNE 16, 1908.

C. T. HENDERSON.

MULTIPLE SERIES RELAY CONTROLLER.

APPLICATION FILED SEPT. 6, 1907.



Witnesses
Robert A. Weir
Franklin H. Hubbard

Clark T. Henderson Inventor
By Edwin B. H. Lowe Jr Attorney

UNITED STATES PATENT OFFICE.

CLARK T. HENDERSON, OF MILWAUKEE, WISCONSIN, ASSIGNOR TO THE CUTLER-HAMMER MFG. CO., OF MILWAUKEE, WISCONSIN, A CORPORATION OF WISCONSIN.

MULTIPLE-SERIES RELAY-CONTROLLER.

No. 890,979. Specification of Letters Patent. Patented June 16, 1908.

Application filed September 6, 1907. Serial No. 391,593.

To all whom it may concern:

Be it known that I, CLARK T. HENDERSON, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented new and useful Improvements in Multiple-Series Relay-Controllers, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

My invention relates to improvements in electric motor controllers, and it applies particularly to motor controllers in which the starting resistance is controlled by means of a plurality of independent switches.

The object of my invention is to provide certain improvements in means whereby these switches will respond successively and the progressive operation of said switches will be arrested while there is an abnormal current.

In accordance with the preferred form of my invention, I provide a series of electromagnetically operated switches, which control the starting resistance. These switches are provided with auxiliary switches by means of which when one of said resistance switches is closed, it completes the circuit of a succeeding switch. Accordingly the switches are closed successively. The circuit of the operating winding of each switch is further controlled by means of an electro-magnetically operated relay switch, there being an independent relay switch for each operating winding. The operating winding of each relay switch is connected in circuit in series between its preceding resistance switch and the motor armature. Accordingly if one of the switches closes, the operating winding of the succeeding switch is connected in circuit, and if the current is abnormal, said relay switch will respond and prevent the next resistance switch from being closed. The operating winding of each relay switch is so connected in circuit that when its corresponding resistance switch is closed it is short circuited, and thereby rendered inoperative so that it cannot cause said switch to open.

In order to more particularly set forth the characteristic features of my invention, I shall describe the controller which is diagrammatically illustrated in the accompanying drawings and exemplifies my invention as it may be embodied in practice.

I provide a main switch 1 which is operated by an electro-magnetic winding 2, the circuit of which is controlled by a hand switch or other suitable means 3. The main switch is provided with an auxiliary contact 4. I also provide a plurality of resistance switches 5, 5^a and 5^b, which are operated by means of electro-magnetic windings 6, 6^a and 6^b respectively. The resistance switches 5 and 5^a are provided with auxiliary contact 7 and 7^a respectively. The resistance switches 5, 5^a and 5^b control resistance sections 8, 8^a and 8^b respectively. The resistance switches 5, 5^a and 5^b have associated therewith relay switches 9, 9^a and 9^b, respectively, which are operated by electro-magnetic windings 10, 10^a and 10^b, respectively adapted to respond to a predetermined current.

The motor may be of any suitable type. I have illustrated a series wound motor having an armature 11 and a field winding 12. A switch 13 may be placed in the line from which power is obtained.

I shall now describe the operation of my controller.

If the hand switch 3 be closed the winding 2 will be energized, and accordingly the main switch 1 will be closed. The motor circuit is thus completed from the positive line through conductor 14, main switch 1, conductor 15, relay winding 10, resistance 8, 8^a and 8^b, conductor 16, armature 11, field winding 12 and conductor 17 to the negative line. Accordingly the motor is started with all the starting resistance in circuit. Windings 6, 6^a and 6^b are connected to the negative line by means of conductor 18. When the main switch 1 is closed, winding 6 is connected to the positive line through auxiliary contact 4, and relay switch 9. Accordingly it will respond and close resistance switch 5 which will short circuit resistance 8 and winding 10 and connect relay winding 10^a in circuit. The resistance switch 5 will not be closed if the current in the motor circuit be abnormal, as the circuit of the winding 6 will be opened by the relay switch 9, while the current is abnormal, the relay switch 9 being opened by the relay winding 10 which is connected in series with the motor and adapted to respond to a predetermined current. As soon as the motor current subsides to a normal amount, the relay switch 9 will close and then the resistance winding 6 will be energized and the resistance switch 5 will be closed.

If the current becomes abnormal after resistance section 8 is removed from circuit by resistance switch 5, the relay winding 10^a will respond and open relay switch 9^a, opening the circuit of winding 6^a. As soon as the current becomes normal the relay switch 9^a will be closed and then winding 6^a will be connected to the positive line through relay switch 9^a, auxiliary switch 7, resistance switch 5 and main switch 1. When switch 5^a is closed relay winding 10^b is connected in circuit in series with the motor armature and resistance 8^b, and the relay winding 10^a is short-circuited. If the current be abnormal relay winding 10^b will respond and open relay switch 9^b, thereby opening the circuit of winding 6^b and preventing resistance switch 5^b from closing. As soon as the current becomes normal relay switch 9^b will close and winding 6^b will be connected to the positive line through relay switch 9^b, auxiliary contact 7^a, resistance switch 5^a, conductor 19, main switch 1. Switch 5^b will now be closed by winding 6^b and short-circuit resistance section 8^b and relay winding 10^b. The motor circuit will then extend from the positive line through conductor 14, main switch 1, conductor 19, switch 5^b, conductor 20, conductor 16, armature 11, field winding 12, conductor 17 to the negative line. The resistance switches thus operate sucessively to remove the starting resistance from circuit step by step. If the current becomes abnormal at any stage in the process, the closure of the switch next in order of operation, would be arrested by its corresponding relay switch.

Inasmuch as each switch, when it is closed, short-circuits its corresponding switch it is rendered independent of any subsequent abnormal increase in current, and accordingly the switches that have been closed will not be opened, and the switch next in order of operation will be prevented from closing, inasmuch as the circuit to its corresponding relay winding is closed by the switch that has preceded in operation.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is

1. In a motor controller, in combination, a plurality of resistance switches operated successively, a plurality of resistance sections controlled by said switches, a plurality of electro-magnetically operated relay switches, one for each of said resistance switches and each being connected in circuit to control the circuit of the operating winding of its corresponding resistance switch, and electrical connections whereby the operating winding of each of said relay switches is connected in circuit in series with the motor armature when the next preceding resistance switch is closed and is removed from circuit when its corresponding resistance switch is closed.

2. In a motor controller, in combination, a plurality of electro-magnetically operated switches, a plurality of resistance sections controlled by said switches, a plurality of electro-magnetically operated relay switches, one for each of said resistance switches and each adapted to control the operating winding of its corresponding resistance switch, and electrical connections whereby the operating winding of each relay switch is connected in circuit in series with the motor armature by the resistance switch that precedes it in order of operation and is short-circuited by its corresponding resistance switch.

3. In a motor controller, in combination, a plurality of resistance switches, a plurality of operating windings one for each of said switches, a plurality of resistance sections controlled by said switches, a plurality of electro-magnetically operated relay switches one for each of said resistance switches and each connected in circuit to control the circuit of the operating winding of its corresponding resistance switch, and electrical connections whereby the closing of each resistance switch closes the circuit through the operating winding of the next succeeding resistance switch, connects the operating winding of the corresponding relay switch thereof, in circuit in series with the motor armature, and short-circuits its own relay switch.

4. In a motor controller, in combination, a plurality of electro-magnetically operated resistance switches, a plurality of resistance sections controlled by said switches, a plurality of electro-magnetically operated relay switches, one for each of said resistance switches and each adapted to control the operating winding of its corresponding resistance switch, electrical connections whereby the operating winding of each of said relay switches is connected in circuit in series with the motor armature by the resistance switch that precedes it in order of operation and is short-circuited by its corresponding resistance switch, and a main switch for closing the armature circuit adapted to close the circuit through the operating winding of the relay switch controlling the first resistance switch.

In witness whereof, I have hereunto subscribed my name in the presence of two witnesses.

CLARK T. HENDERSON.

Witnesses:
FRANK H. HUBBARD,
ALEXANDER H. LIDDERS.