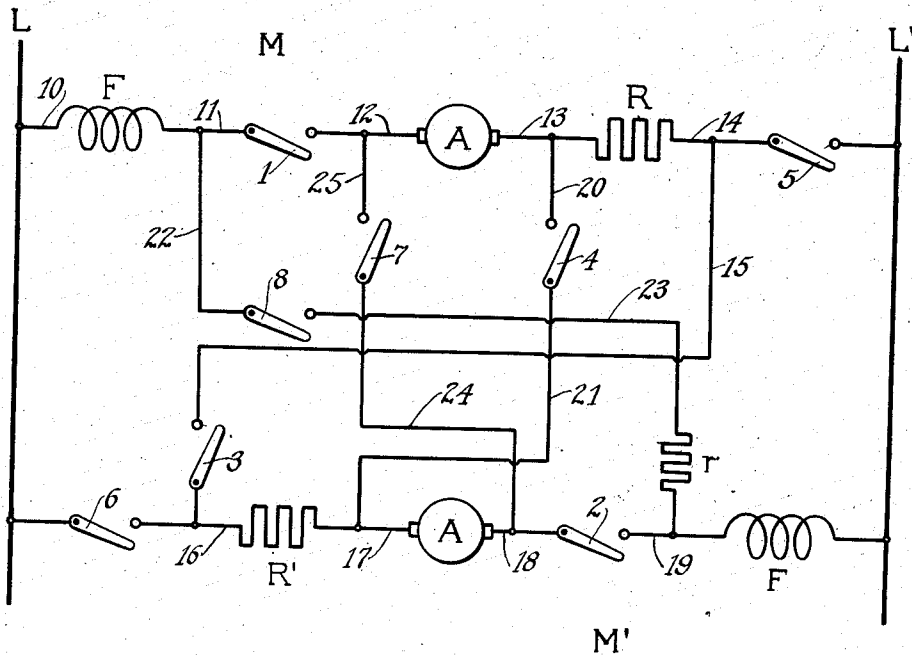


W. M. SHALLCROSS.  
 MOTOR CONTROLLER.  
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1,136,621.

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# UNITED STATES PATENT OFFICE.

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## MOTOR-CONTROLLER.

1,136,621.

Specification of Letters Patent. Patented Apr. 20, 1915.

Application filed January 6, 1913. Serial No. 740,434.

*To all whom it may concern:*

Be it known that I, WILMER M. SHALLCROSS, 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 Motor-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 motor controllers.

It is one of the objects of my invention to provide a simple but efficient controller operable to establish series-parallel connections for a plurality of motors, and when desired to cause the motors to act as a dynamic brake.

A further object of my invention is to provide for the accomplishment of the aforesaid invention with a minimum number of switches.

Other objects and advantages of my invention will hereinafter appear.

In order to fully and clearly disclose my invention I shall describe the embodiment thereof illustrated in the accompanying drawing, it being understood that my invention is susceptible of embodiment in other forms.

The controller illustrated comprises a plurality of switches which in practice may be electromagnetically operated and controlled by any suitable master switch to be operated in a manner hereinafter set forth. Of course in practice the switches might be of any other preferred type.

The various switches are shown as controlling two motors M and M', each comprising an armature A and a series field winding F. The switches 1, 2, and 3 are, as will be hereinafter more fully set forth, adapted to connect the motors M and M' in series through resistances R and R'. The resistance R is associated with the motor M and the resistance R' with the motor M'. For the purpose of simplifying the illustration of the controller, I have shown the resistances R and R' as each consisting of a single step, but it should be understood that in practice these resistances may be divided into as many steps as desired to permit of variation thereof in the usual manner. Switch 4 coöperates with the switches 1 and

2 when switch 3 is open to connect the two motors in series with the resistances R and R' excluded from circuit. Switches 5 and 6 coöperate with switches 1, 2, and 4 to establish a Wheatstone bridge connection for the two motors and resistances R and R' as a preliminary step to the change over from series to parallel connection. The switch 4 upon opening interrupts the Wheatstone bridge connection, leaving the two motors in parallel with their respective resistances in series therewith. Switches 7 and 8 coöperate with switch 3 to establish circuits for causing the two motors to act as a dynamic brake.

I shall now more fully explain the functions of the various switches, at the same time fully and clearly describing the circuit connections established thereby. Assume that current is supplied from lines L and L' and that switches 1, 2, and 3 are closed. Current will then flow from line L by conductor 10 through the series field winding of motor M, by conductor 11, through switch 1, by conductor 12 through the armature of motor M, by conductor 13 through the resistance R, by conductors 14 and 15 through switch 3 to conductor 16, thence through resistance R' by conductor 17 through the armature of motor M', by conductor 18 through switch 2, by conductor 19 through the field of motor M' to line L'. It will thus be seen that the two motors are connected in series and that the resistances R and R' are included in circuit therewith. Assume now that switch 4 is closed. The resistances R and R' will be short-circuited. This short-circuit extends from conductor 13 by conductor 20 through switch 4 by conductor 21 to conductor 17. Switch 3 is maintained closed until after the switch 4 is closed to maintain the continuity of the motor circuit during the change in circuit connections. Switch 3 is opened prior to the next step of operation. Assume now that switches 1, 2, and 4 are left closed and switches 5 and 6 closed. This establishes the Wheatstone bridge connection above mentioned. The motor M and its resistance R are then connected directly across the lines by switches 1 and 5 and the motor M' and resistance R' are likewise connected directly across the line by the switches 2 and 6, while opposite terminals of the motor armature are directly connected through the

switch 4. This preserves the continuity of the motor circuit during the change from series to parallel connections, which latter connections are established by opening the switch 4 which breaks the Wheatstone bridge connections, leaving the two motors in parallel across the line. After the parallel connections have been established the resistances R and R' may be short-circuited, if desired, but it has been deemed unnecessary to herein illustrate means for this purpose. As is well understood in the art the successive changes in circuit connections above described serve to accelerate the motors. Likewise, as is well understood in the art, the motors may be slowed-down by operating the switches in an inverse order to that just described. Assume now that the controller has been returned to establish series connections including the resistances R and R', *i. e.*, by closure of switches 1, 2, and 3, and that it is desired to cause the motors to operate as a dynamic brake. The motors may be made to operate as a dynamic brake by opening the switches 1 and 2 and closing the switches 7 and 8. Closure of the switch 8 connects the field windings across the lines, while the switches 3 and 7 connect the motor armatures in a closed loop including the resistances R and R'. This insures strong fields for the motors and in consequence they will generate a braking current which will flow through the closed loop in which the motor armatures are connected, the resistances serving to modify the braking effect of the motors.

The circuit of the field windings may be traced from line L by conductor 10 through the field winding of motor M to conductor 11 by conductor 22 through the switch 8 by conductor 23 through a suitable resistance *r* to conductor 19 and thence through the field winding of motor M'. The closed loop including the motor armatures may be traced from the right hand terminal of the armature of motor M by conductor 13 through the resistance R by conductors 14 and 15, through the switch 3, by conductor 16 through resistance R', by conductor 17 through the armature of motor M', by conductors 18 and 24 through switch 7, by conductor 25 to conductor 12 and thence to the left hand terminal of the armature of the motor M. If an increased dynamic braking effect is desired, the resistances R and R' may be wholly or partially excluded from circuit, as desired, by any well-known means.

It is thus to be observed that the controller illustrated provides for the acceleration of the motors by series parallel connection without interruption of the continuity of the motor circuit and also provides for dynamic braking, and that the dynamic braking is effected by the mere addition of two single pole switches and that three single pole

switches serve to establish all dynamic braking connections.

While the controller illustrated is of the non-reversing type, it should be understood that the same may, in practice, be made of the reversing type without affecting the principles thereof.

What I claim as new and desire to secure by Letters Patent is:

1. A controller for a plurality of series motors, comprising a plurality of sets of motor leads, line leads, means for connecting said sets of motor leads to said line leads for either series or parallel connection, and means coöperating with said former means to connect the armature leads of said sets to form a single dynamic braking circuit and to connect the field leads of said sets to said line leads.

2. In a controller for a plurality of electric motors, in combination, a plurality of sets of motor leads each including armature leads and field leads, line leads, means including a switch for connecting all of said motor leads to said line leads and two single pole switches coöperating with said former switch to connect said armature leads for dynamic braking and to connect said field leads to said line leads.

3. In a controller for a plurality of electric motors, in combination, a plurality of sets of motor leads, line leads, means for connecting said motor leads to said line leads for either series or parallel connection of the motors and two single pole switches coöperating with said means to connect the armature leads of said sets for dynamic braking and to establish connections between the field leads of said sets and said line leads.

4. In a controller for a plurality of electric motors, in combination, a plurality of sets of motor leads, line leads, a plurality of switches for connecting said sets of motor leads to said line leads for either series or parallel connection of the motors, and switches coöperating with certain of said former switches to establish dynamic braking connections for the armature leads of said sets and to establish connections between the field leads of said sets and said line leads.

5. In a controller for a plurality of electric motors, in combination, motor leads, line leads, switches controlling said leads for either series or parallel connection of the motors, and two single pole switches coöperating with one of said first mentioned switches to adjust said connections for dynamic braking.

6. In a controller for a plurality of electric motors, in combination, means for establishing series or parallel connections for the motors including a plurality of switches and two single pole switches electrically con-

5 nected with said means and cooperating with one of said former switches to establish a dynamic braking circuit for the motor armatures and a separate exciting circuit for the motor fields.

7. The combination with two electric motors having a series connection between the armatures thereof, two switches for connecting said motors in series to a power circuit and two single pole switches one to connect the motor fields in series to the power circuit and the other to connect the motor armatures in a closed loop.

8. The combination with a power circuit, of two series motors one having its field permanently connected to the positive side of said power circuit and the other having its field permanently connected to the negative side of said power circuit and the armatures of both motors being disconnected from their respective fields, and four switches two of the same being adapted to connect the motors in series to said power circuit and the other two being adapted to connect the motor fields in series to said power circuit and to connect the armatures in a closed loop for dynamic braking.

9. The combination with a power circuit, of two series motors one having its field permanently connected to the positive side of said power circuit and the other having its field permanently connected to the negative

side of said power circuit and the armatures of both motors being disconnected from their respective fields, two single pole switches for connecting the motors in series to said power circuit and two other single pole switches for connecting the motor fields in series to said power circuit and connecting the motor armatures in a closed loop for dynamic braking, said closed loop being disconnected from the power circuit upon the opening of one of said first two mentioned switches.

10. A controller for a plurality of electric motors comprising a plurality of sets of motor leads, line leads, six single pole switches for establishing either series or parallel connections between said motor leads and said line leads, resistances for maintaining connection of said leads during the series and parallel transitions and two single pole switches cooperating with one of said first mentioned switches to connect certain of said motor leads together for a dynamic braking circuit and to connect other of said motor leads to said line leads.

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

WILMER M. SHALLCROSS.

Witnesses:

FRANK H. HUBBARD,  
TEKLA BOAT.