(No Model.)

E. M. BENTLEY.

SERIES MULTIPLE CONTROLLER FOR ELECTRIC MOTORS.

No. 575,454. Patented Jan. 19, 1897.

Fig. 1.

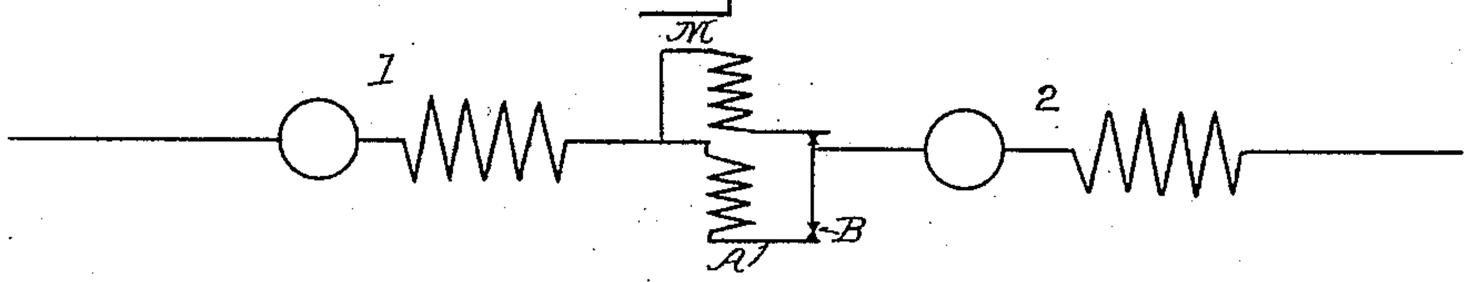


Fig. 2.

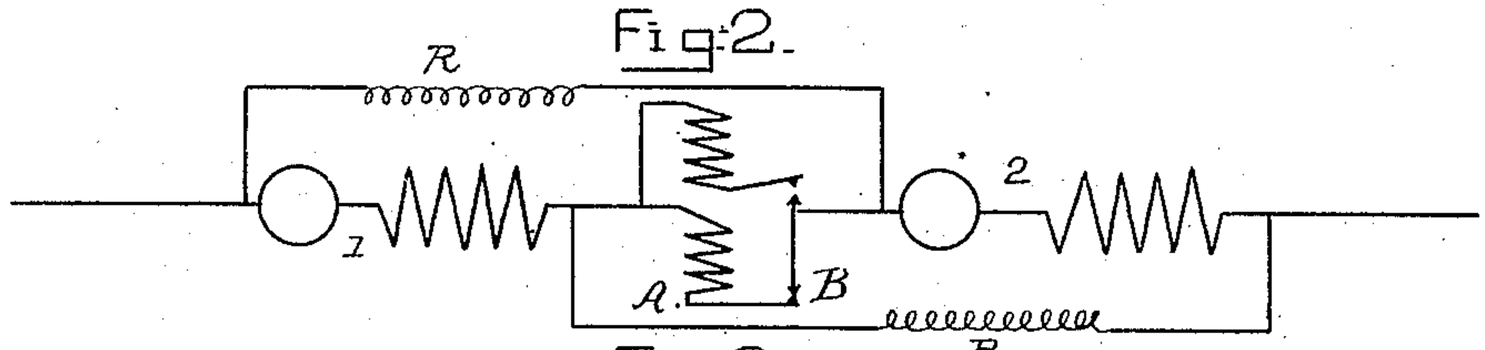


Fig. 3.

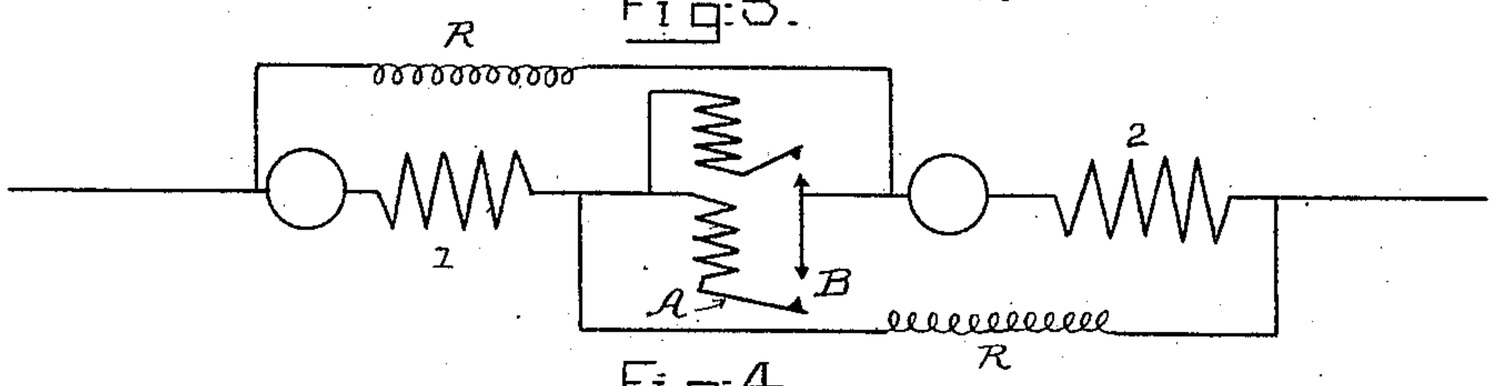
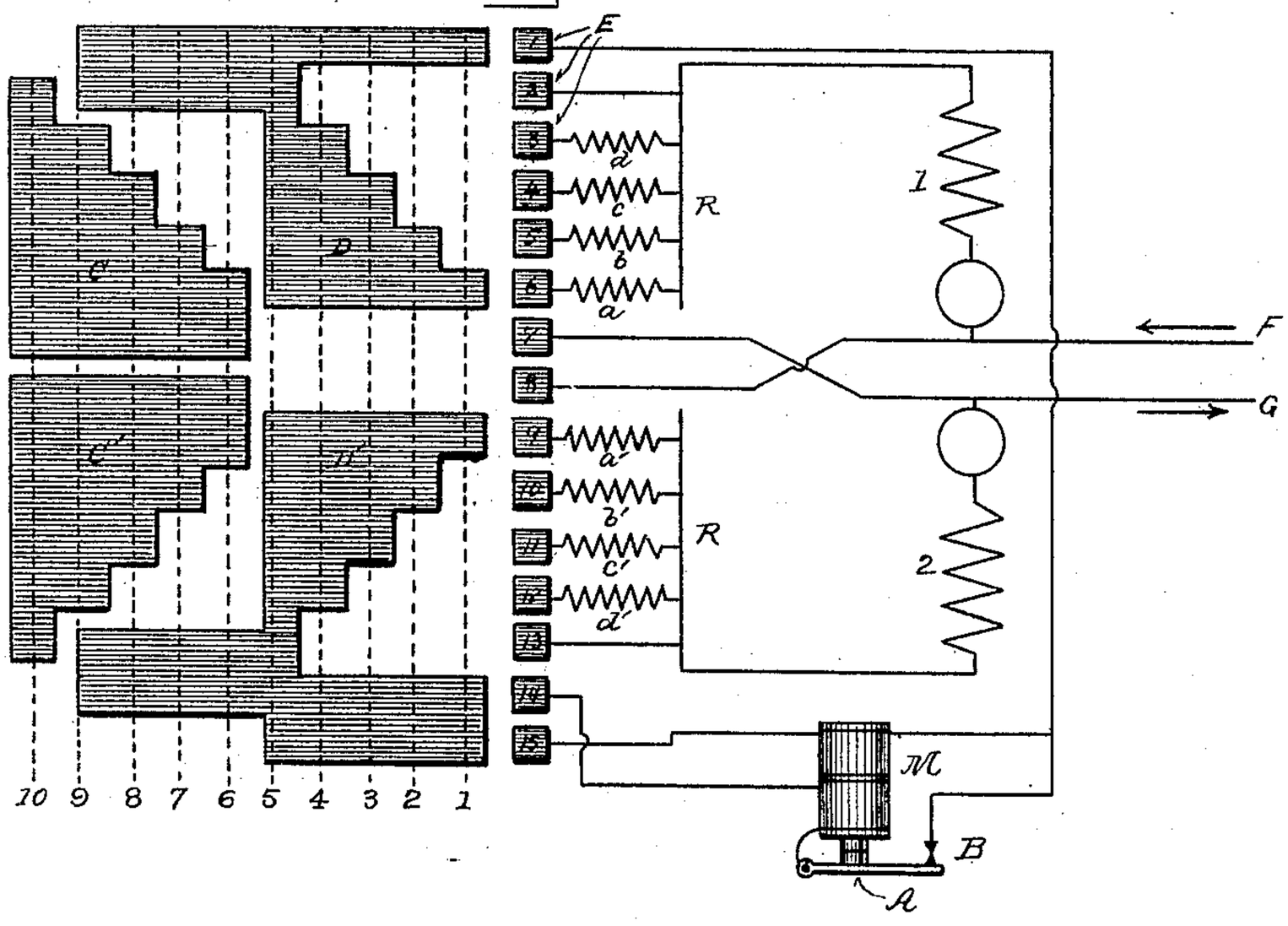


Fig. 4.



Witnesses.
L. H. Latimer.
L. T. Shaw.

Inventor.
Edward M. Bentley

UNITED STATES PATENT OFFICE.

EDWARD M. BENTLEY, OF LAWRENCE, NEW YORK, ASSIGNOR TO THE GENERAL ELECTRIC COMPANY, OF NEW YORK.

SERIES-MULTIPLE CONTROLLER FOR ELECTRIC MOTORS.

SPECIFICATION forming part of Letters Patent No. 575,454, dated January 19, 1897.

Application filed November 13, 1896. Serial No. 611,938. (No model.)

To all whom it may concern:

Be it known that I, EDWARD M. BENTLEY, a citizen of the United States, residing at Lawrence, Queens county, State of New York, have invented certain new and useful Improvements in Series-Multiple Controllers for Electric Motors, of which the following is a specification, reference being made to the accompanying drawings, wherein—

Figures 1, 2, and 3 represent diagrammatically the principle of my invention, and Fig. 4 represents the development of a cylindrical switch embodying the aforesaid principle.

My invention consists in a series-multiple controller wherein the motors are changed from series to multiple by shunting each of them with a resistance and interrupting the series circuit at a point between the two inner terminals of the shunts.

My invention also consists in the apparatus herein described by which the motors are regulated by resistance and automatically changed from series to multiple in the manner described.

Referring to Fig. 1, two motors, Nos. 1 and 2, are shown in series with a magnet M included in circuit between them. The said magnet has two coils in parallel branch circuits, of which one contains a circuit-breaker B, controlled by the armature A of the magnet. If the two motors are each shunted by a resistance R and the inner ends of the two shunts are connected to the series circuit upon opposite sides of the magnet M, respectively, it will be apparent that the said magnet will be included in the cross-wire of a Wheatstone bridge and that when the resistances R bear the proper relation to the resistances of the motors 1 and 2 there will be no current passing through the magnet, so that the series circuit can be broken at such an instant without any arc, leaving the two motors in multiple, as shown in Fig. 3, each with a resistance R in series with it. By means of the magnet M it is possible to automatically interrupt the series circuit at the instant when the current therein is at a minimum and all possibility of an arc is removed. I provide that the upper half of the coil of magnet M shall be disconnected from circuit at the time of shunting the motors, as indicated in Fig. 2. This leaves the lower coil only in circuit and places the control of the series circuit entirely in the magnet, so that it may drop its armature A when the current falls to zero and open the circuit-breaker B.

Referring to Fig. 4, C C′ and D D′ represent four metallic plates, which in practice will be placed on the surface of a rotating cylinder in the ordinary manner now followed in the construction of controllers of this kind. Adjacent to the said plates is a series of contact-fingers E′ E^2 to E^{15}. These contact-fingers will be of any well-known description, and in the usual manner will form the terminals of the motor and resistance-circuits, as represented in the drawings. Thus motor No. 1 will have its two terminals connected, respectively, to E^2 and E^8, while its latter terminal will also be connected to the incoming circuit-wire F. The fingers E^3, E^4, E^5, and E^6 will be connected, respectively, to the several terminals of the multiple resistances *d*, *c*, *b*, and *a*. In like manner the contact-fingers E^9, E^{10}, E^{11}, and E^{12} will be connected, respectively, to the several terminals of the multiple resistances *a′*, *b′*, *c′*, and *d′*. Motor No. 2 will have its terminals connected, respectively, to E^7 and E^{13}, while the former terminal will also be connected to the outgoing circuit-wire G. The magnet M will have one terminal connected to E′ and the two terminals of its branch circuits to E^{14} and E^{15}, respectively. The former branch will include armature A and circuit-breaker B.

The parts having the arrangements shown in the drawings, it will be understood that the plates C C′ and D D′ are to be moved across the series of contact-fingers and establish certain connections between the contact-fingers, which will occupy in turn the position indicated by the respective dotted lines 1 to 10.

In position 1 the current entering at F will pass through motor No. 1, through resistance *a* to plate D, to finger E′, magnet M, fingers E^{14} and E^{15}, plate D′, resistance *a′*, motor No. 2 to outgoing wire G.

In positions 2 and 3 the resistances *b b′* and *c c′* will be brought into circuit in succession,

thereby diminishing the total amount of resistance in series with the motors.

In position 4 the resistances $d\,d'$ will be brought into circuit, thereby still further reducing the total resistance, and in position 5 the resistance will be entirely cut out, leaving the motors only in circuit and in series with each other.

In passing to position 6 the series connection will still be maintained, but each motor will be shunted by resistance, one by resistance a and the other by resistance a'. Thus motor No. 1 will be shunted by a circuit from contact-finger E^8 to plate C', finger E^9, resistance a' to the inner terminal of motor No. 2, while the latter motor will, in like manner, be shunted by a circuit from the terminal of motor No. 1 to resistance a, finger E^6, plate C, finger E^7 to outgoing terminal G. At the same time the branch circuit through magnet M, which terminates at E^{15}, will be opened, leaving the series circuit entirely under the control of the magnet M, so that at the instant of zero current the magnet will drop its armature A and open at B the bridge-circuit, which may be traced from the inner end of motor No. 1 to contact-finger E^2, plate D, finger E', magnet M, finger E^{14}, plate D', finger E^{13} to the inner terminal of motor No. 2. The bridge-circuit being opened at the proper instant the two motors will be, as already described, left in multiple with a resistance in series with each of them, which resistance is gradually reduced and finally cut out as the controller passes through positions 6, 7, 8, 9, and 10.

The reverse operation will be readily understood. The two motors being in multiple an increasing amount of resistance will first be inserted in series with each, until in passing from position 6 to position 5 the contact-finger E^{15} comes into connection with plate D' and reëstablishes the bridge-circuit. At the same time the high-resistance shunts are opened, leaving the two motors in series, while, as the controller moves from position 5 to position 1, the resistances are gradually inserted again until the circuit is finally opened, as shown in the condition indicated at Fig. 4.

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

1. A series-multiple controller for electric motors, comprising a shunt for the two motors containing a resistance, an automatic circuit-breaker placed in the series circuit between the two inner terminals of the shunts and dependent on the volume of current passing therein, substantially as described.

2. A series-multiple controller for electric motors comprising a shunting-resistance for each motor, an electromagnet in the bridge-circuit between the two motors at a point between the inner terminals of the two shunts and a circuit-breaker in the said bridge-circuit controlled by the said magnet, substantially as described.

3. A series-multiple controller for electric motors comprising two shunting-resistances R R and suitable contact-plates C C' and D D' for controlling said resistances and connecting them in shunt-circuits around the respective motors, magnet M in the bridge-circuit between contact-fingers E' and E^{14}, a circuit-breaker in the said bridge-circuit controlled by the said magnet and means for restoring the armature of the said magnet in the reverse movement of the controller, substantially as described.

4. The combination in a series-multiple controller of shunting-resistances for each motor, a magnet in the bridge-circuit at a point between the inner terminals of the two shunts, a circuit-breaker in the same circuit controlled by the said magnet and a supplementary coil on the said magnet shunting the said circuit-breaker and adapted to be connected in parallel with the other magnet-coil during the reverse movement of the controller, substantially as described.

In witness whereof I have hereunto set my hand this 11th day of November, 1896.

EDWARD M. BENTLEY.

Witnesses:
L. H. LATIMER,
L. T. SHAW.