No. 751,903. PATENTED FEB. 9, 1904.

A. C. EASTWOOD.

SYSTEM FOR THE OPERATION OF ELECTRIC MOTORS.

APPLICATION FILED SEPT. 25, 1903.

NO MODEL. 4 SHEETS—SHEET 1.

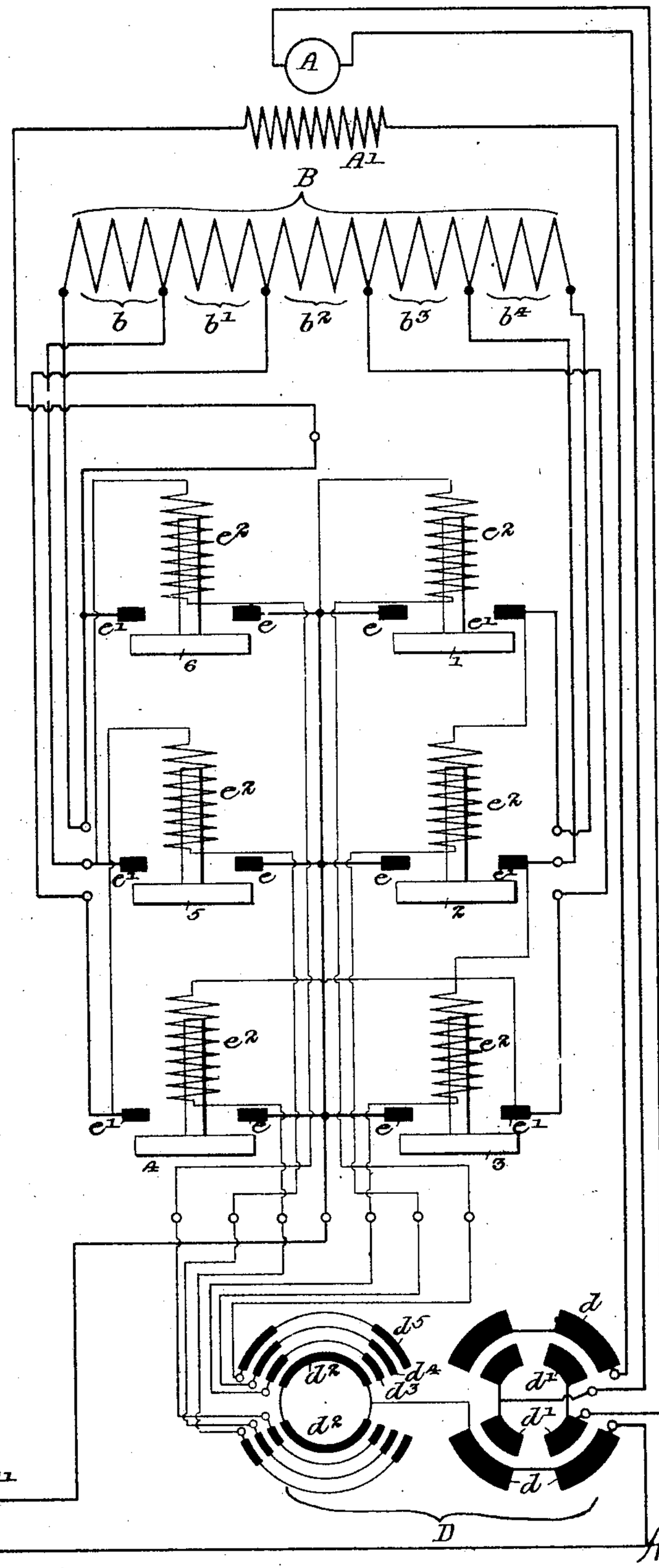


Fig. 1.

Witnesses.
Louis A. Buck.
Titus H. Irons.

Inventor;
Arthur C. Eastwood
by his Attorneys,
Howson & Howson

No. 751,903.

PATENTED FEB. 9, 1904.

A. C. EASTWOOD.

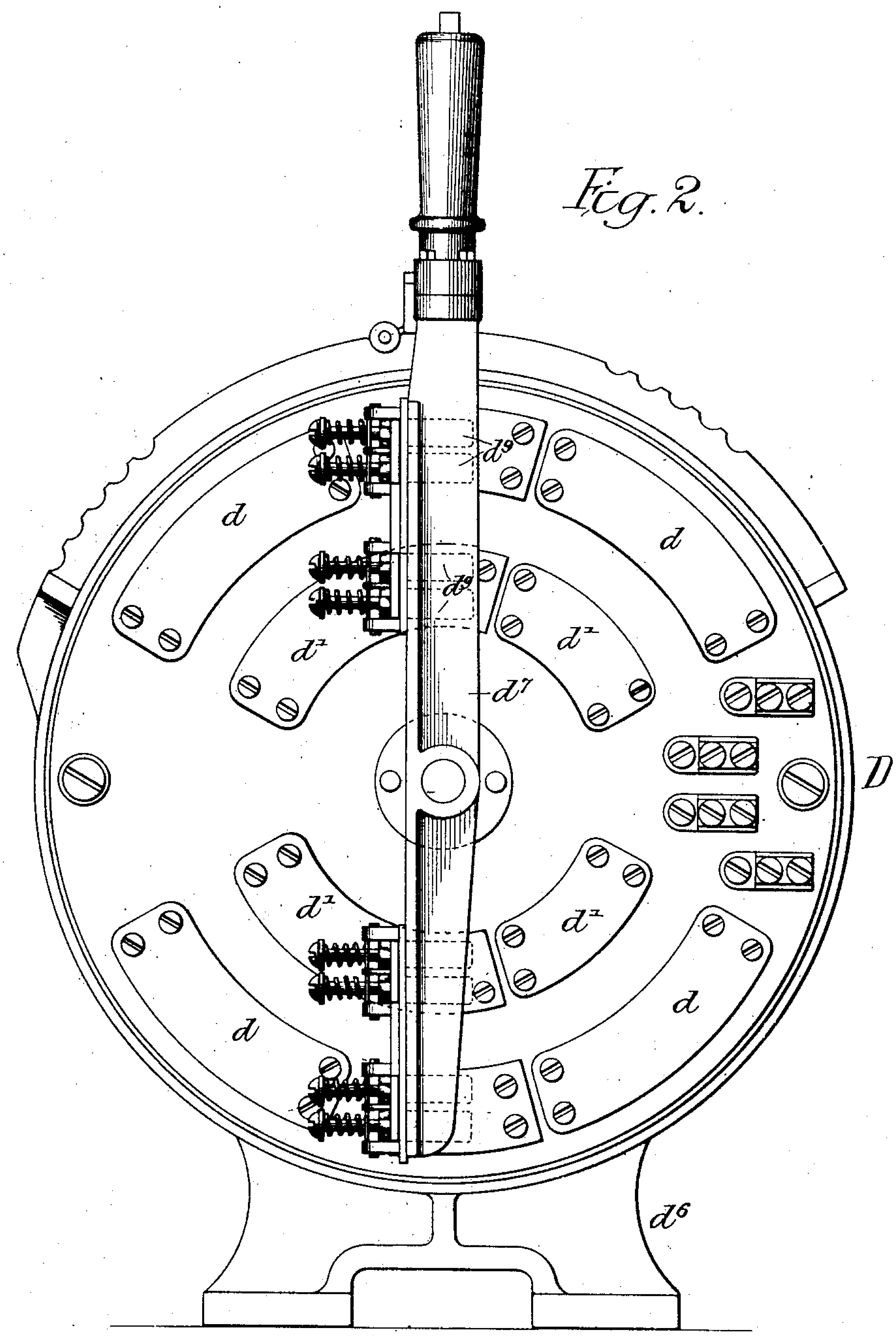
SYSTEM FOR THE OPERATION OF ELECTRIC MOTORS.

APPLICATION FILED SEPT. 25, 1903.

NO MODEL.

4 SHEETS—SHEET 2.

Fig. 2.



Witnesses:
Titus H. Irons.
Augustus B. Coppes

Inventor,
Arthur C. Eastwood,
by his Attorneys
Howson & Howson

No. 751,903. PATENTED FEB. 9, 1904.

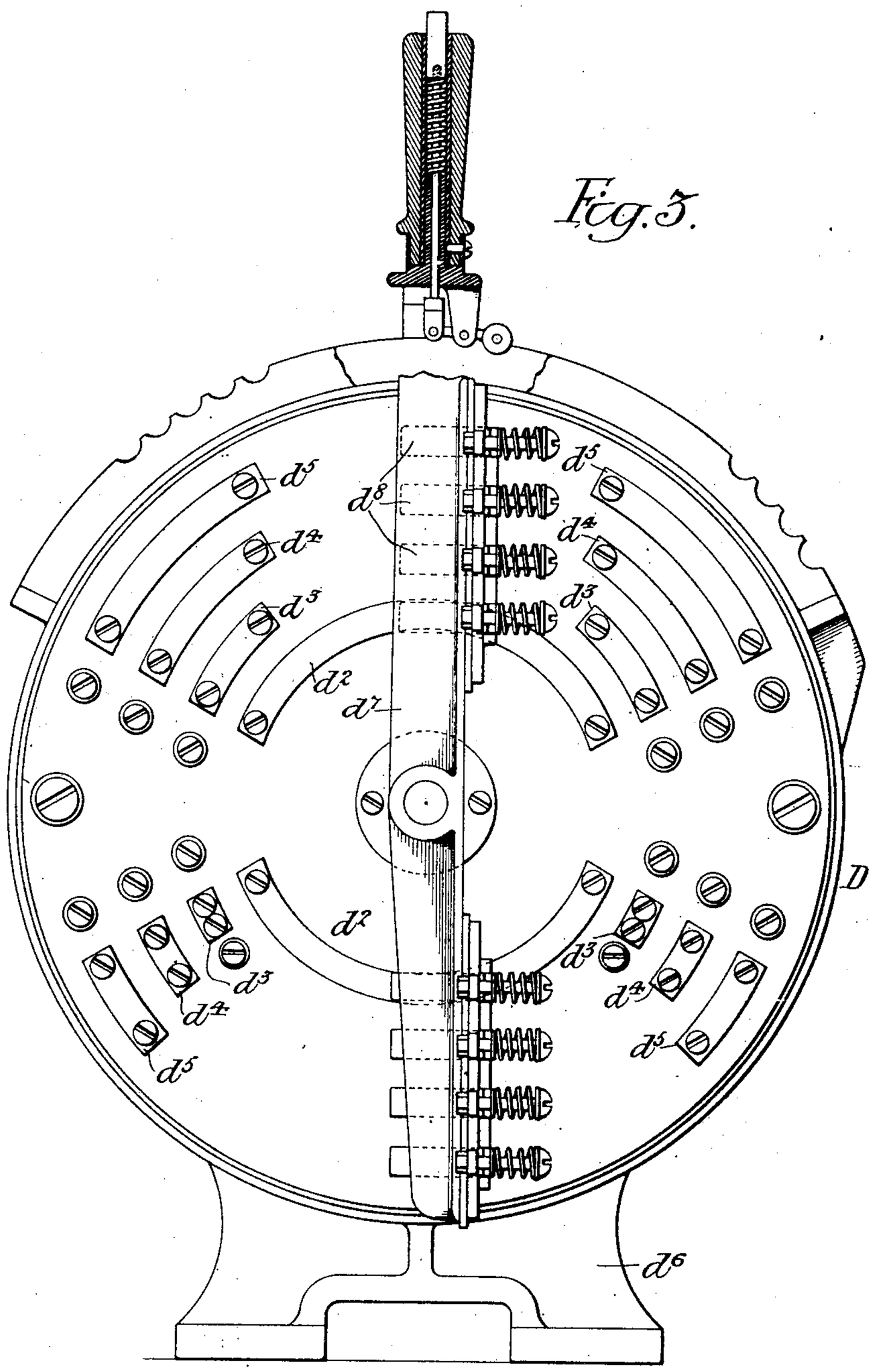
A. C. EASTWOOD.

SYSTEM FOR THE OPERATION OF ELECTRIC MOTORS.

NO MODEL. APPLICATION FILED SEPT. 25, 1903.

4 SHEETS—SHEET 3.

Fig. 5.



Witnesses:-
Titus H Sons.
Augustus B. Copper

Inventor;
Arthur C. Eastwood,
by his Attorneys
Howson & Howson

No. 751,903. PATENTED FEB. 9, 1904.

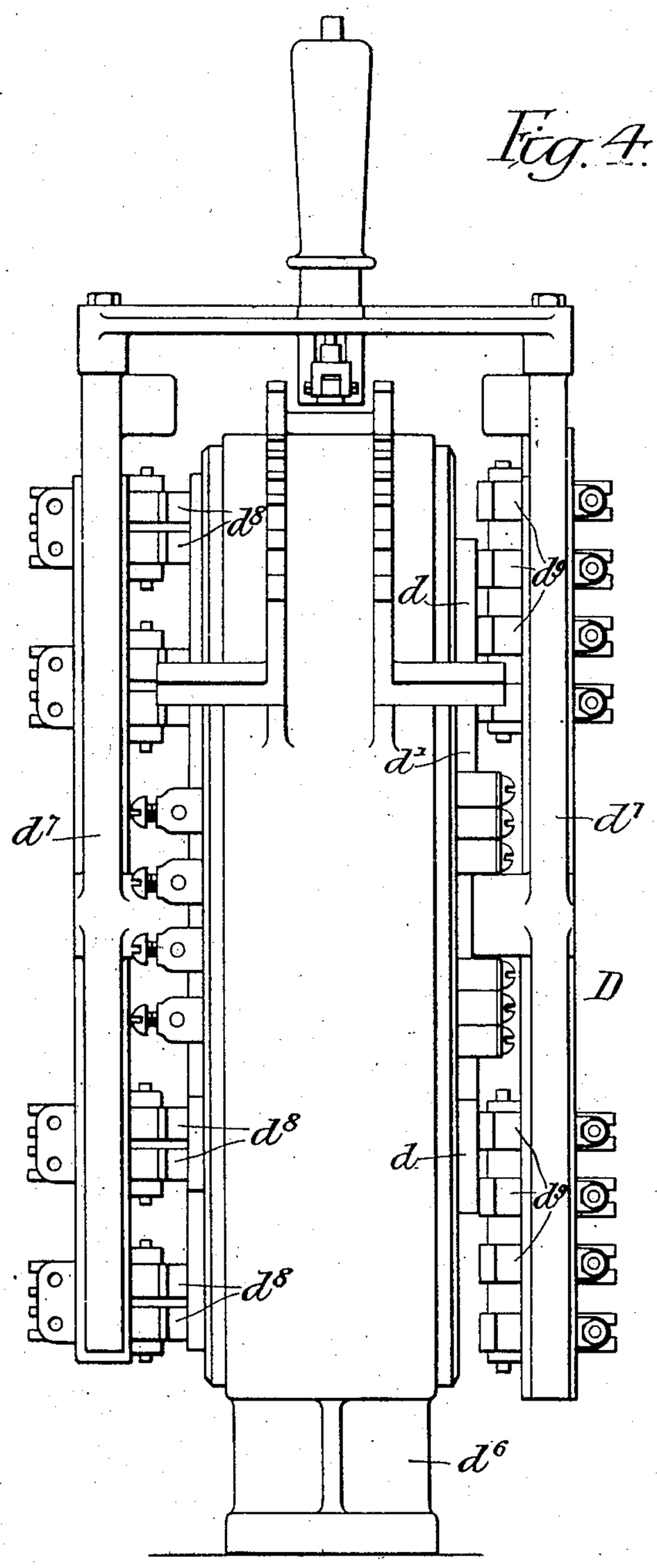
A. C. EASTWOOD.

SYSTEM FOR THE OPERATION OF ELECTRIC MOTORS.

APPLICATION FILED SEPT. 25, 1903.

NO MODEL. 4 SHEETS—SHEET 4.

Fig. 4.



Witnesses:—
Titus H. Sims.
Augustus B. Coppie

Inventor,
Arthur C. Eastwood,
by his Attorneys
Howson & Howson

No. 751,903. Patented February 9, 1904.

UNITED STATES PATENT OFFICE.

ARTHUR C. EASTWOOD, OF CLEVELAND, OHIO.

SYSTEM FOR THE OPERATION OF ELECTRIC MOTORS.

SPECIFICATION forming part of Letters Patent No. 751,903, dated February 9, 1904.

Application filed September 25, 1903. Serial No. 174,647. (No model.)

To all whom it may concern:

Be it known that I, ARTHUR C. EASTWOOD, a citizen of the United States, residing in Cleveland, Ohio, have invented certain Improvements in Systems for the Operation of Electric Motors, of which the following is a specification.

My invention relates to an improved combination of apparatus for the operation of electric motors; and it consists more particularly of an improved system designed to control the starting and subsequent speeding up of an electric motor in which after the circuit through it is first completed sections of resistance in said circuit are successively cut out.

The object of the invention is to provide a system of the above character which shall possess relatively few working parts and which shall be of the utmost simplicity consistent with proper action.

A further object of the invention is to provide a system by which the starting of a motor may be controlled by an operator through the medium of an auxiliary controller, which shall in turn operate mechanism for closing the various switches to cut out successive sections of resistance.

These objects I attain as hereinafter set forth, reference being had to the accompanying drawings, in which—

Figure 1 is a diagrammatic view of my improved controlling system, indicating the connections of the various pieces of apparatus required. Fig. 2 is a side elevation of one face of the improved form of controller employed in my system. Fig. 3 is a side elevation, partly in section, illustrating the face of the controller opposite to that shown in Fig. 2. Fig. 4 is an end elevation of the controller.

In the above drawings, A represents the armature of a motor which in the present instance is of the direct-current-series type. A′ illustrates the field-winding of said motor, and B is a coil of starting resistance of any desired material, which is divided into a number of sections b, b', b^2, b^3, and b^4.

D is the controller preferably employed in my improved system, and this is shown in detail in Figs. 2, 3, and 4, as described hereinafter. It may, however, be said that said controller has on one face a series of metallic segments or contact-plates d and d', arranged, as shown, on arcs of concentric circles, said plates being relatively large and of substantial cross-section, inasmuch as they are designed to carry the total current delivered to the motor. It will be noted that certain of these heavy contact-plates (designated by the reference-letter d) are connected in pairs, while those designated by the reference-letter d' are similarly connected in other pairs which lie ninety degrees distant from the first pairs. The face of the controller opposite to that having the contacts d and d' is provided with other series of contact-plates, also arranged on the arcs of concentric circles, of which it will, however, be noted that there are four, the innermost set of contacts d^2 being in electrical connection with each other, while the succeeding sets d^3, d^4, and d^5 are connected together in two pairs of two each, lying diametrically opposite to each other.

Reference-numerals 1, 2, 3, 4, 5, and 6 represent magnetically-operated switches, each of which consists of main contacts e and e' and a solenoid e^2, by which a switch bar or blade (not shown) may be made to bridge or electrically connect said main contacts when the solenoids are properly energized by current.

C and C′ are respectively the current-supply mains, the former of which is connected to one pair of the heavy contacts d and to the contacts d^2 of the auxiliary portion of the controller lying on the face opposite to that first mentioned. The second pair of the contacts d is connected to one end of the field-coil A′ of the motor, while the second end of said field-coil is not only connected to one of the main contacts e' of the switch 6, but is also connected to one end of the resistance-coil B. The second end of said coil is connected to the main contact e' of the switch 1, while all of the contacts e of the six switches are connected to the current-supply main C′. The remaining four main contacts e' of the switches 2, 3, 4, and 5 are connected, respectively, to four points on the resistance-coil intermediate of the sections b, b', b^2, b^3, and b^4. Of the magnets e^2 those belonging to the switches 1, 2, and 3 have one terminal connected, respec-

tively, to one pair of the contacts d^3 d^4 d^5, while those belonging to the switches 4 5 6 have in turn one terminal connected to the second pairs, respectively, of the same contacts. The magnet e^2 belonging to the switch 1 has its second terminal connected with the current-supply main C through the wire connecting the contacts e therewith, while the magnets of each succeeding switch have their second terminals in each case connected to the main contact e' of the switch, which in operation will be closed just before the magnet under consideration is energized. In other words, the magnet e^2 belonging to the switch 2 has its second contact connected to the main contact e' of the switch 1, while the magnet of the switch 3 has its second contact connected to the main contact e' of the switch 2, and so on.

By reference to Figs. 2 to 4, inclusive, the detail construction of the controller D will be understood, for, as shown, the controller consists of an inclosing case supported on a suitable base d^6, which casing is provided with two faces consisting of plates of insulating material having fastened to it the contacts d to d^5, inclusive. In the case illustrated the controller is substantially cylindrical in shape, and pivoted to it in the line of its axis is a U-shaped operating-handle d^7, carrying brushes arranged to bridge between adjacent pairs of contacts d and d' in one instance and between the contact d^2 and the contacts d^3, d^4, and d^5 in the other cases. The segments d^3, d^4, and d^5 on the upper half of the controller-face are of greater length than those on the lower portion, and it will be noted that this construction is so designed that when the operating-handle d^7 is turned on its pivot its brushes d^8 will first contact with and will allow current to flow to the upper one of the contacts d^5 from the contact-segment d^2, which is permanently connected to the supply-main C. As the handle is still further moved on its axis the upper one of the contacts d^4 is engaged by the brush and then the contact d^3, after which the brush on the lower end of the handle engages the relatively short contacts d^5 on the lower half of the controller, subsequently engaging the other lower contacts d^4 and d^3.

It will of course be understood that the brushes d^8, which engage the contacts d^2 to d^5, are electrically insulated from the brushes d^9, which bridge between the main current-carrying contacts d and d' on the opposite face of the controller, and it will be seen that the arrangement of the contacts is such that those on the two halves thereof formed by a vertical plane passing through the axis are in every way similar, with the exception of the connections between the contacts d and d', respectively, noted above.

In the operation of my improved system motion of the operating-handle to one side or the other of its normal vertical position first permits current to flow from one of the contact-segments d to one of the segments d' and thence to one or the other of the terminals of the armature, depending on the direction in which said controller-handle is moved. From the armature the current returns to one of the contacts d' and passes through the brushes d^9 to the upper pair of the contacts d, from whence it flows to the field-coil A'. Since the contacts d are so placed angularly on the surface of the controller that the contact d^5 is not engaged by its brush until good contact has been made with said contact-segments d for an appreciable time, the current which would otherwise be free to flow through the resistance-coil B is compelled to stop at the main contact e'. Further motion of the operating-handle d^7 results in its brushes d^8 engaging one of the upper pair of contacts d^5, and reference to the diagram in Fig. 1 shows that current is then free to flow from the contact-segment d^2 through the segment d^5 to the solenoid e^2 belonging to the switch 1, and thence to the supply-main. The energization of this solenoid causes a switch-bar (not shown) to form connection between the main contacts e and e' of the first switch, with the result that current is thus free to flow as above described from the field-coil A' through the entire length of the resistance-coil B and to the supply-main C'. Further motion of the brush-handle in the same direction as above noted, while in no way altering the relative connections on that face of the controller illustrated in Fig. 2, causes another one of the brushes d^8 to engage the upper one of the contact-segments d^4, with the result that the solenoid e^2 belonging to switch 2 is energized. This, as above described, moves a switch-bar so as to permit current to flow between its main contacts e and e', it being noted, however, that the second terminal of this solenoid is connected to the contact e' on the resistance side of the switch 1. It will thus be seen that said switch is necessarily operated before switch 2, for if for any reason—as, for example, bad contact between the brushes d^8 and either of the segments d^2 or d^5—the solenoids of the switch 1 should fail to form connection between these main contacts e and e' subsequent energizing of any of the other solenoids belonging to other switches would be impossible, since each is connected to what may be designated as the "positive side" of the main switch immediately preceding it. The second terminal of the solenoid belonging to the switch 3 is connected to the main contact e' of switch 2, so that the said latter switch must be closed before the circuit through said solenoid of switch 3 can be completed. Motion of the controller-arm d^7 in the opposite direction—that is, toward its normal vertical position—results in the successive deënergizing of the various solenoids e^2, with the result that the switches are successively opened and the various sections of the resistance-coil B

again cut into circuit, which circuit is finally broken by the opening of switch 1.

If the operating-handle be moved from its normal position in a direction opposite to that described, the above cycle of operations is repeated in a manner similar to that noted, with the exception that the direction of the flow of current through the armature A of the motor is reversed by means of the well-known arrangement of the contacts *d* and *d'* on the controller-face illustrated in Fig. 2.

I claim as my invention—

1. The combination of an electric motor with a body of resistance divided into sections, switches for said sections, solenoids for the switches, and a controller having independent connections from itself to each solenoid for governing the action of the same, certain of the solenoids having one terminal connected to the controller and the other connected to a resistance-controlling switch other than the one upon which it operates, substantially as described.

2. In a system for the control of electric motors, the combination with a motor of a body of resistance composed of a number of sections, switches for cutting out the various ones of said sections, a solenoid for controlling the action of each switch, a controller having on one face a series of relatively heavy contact-pieces connected to the motor so as to serve as a portion of the reversing-switch, a series of relatively light contacts on the second face of the controller connected to the various solenoids, with a handle carrying independent contacts for engaging respectively said two sets of controller-contacts, substantially as described.

3. The combination of a motor with a body of resistance divided into a number of sections, a switch for each section, each having two contacts of which one is connected to its particular section of the resistance and the other is connected to one of the supply-mains, a solenoid for each switch, a controller governing the action of the solenoids, certain of said solenoids having one terminal connected to said controller and the other connected to the resistance side of a switch other than the one it controls, substantially as described.

4. The combination of a motor with a body of resistance divided into a number of sections, a switch for each section, each having two contacts of which one is connected to its particular section and the other is connected to one of the supply-mains, a solenoid for each switch, a controller constructed to successively energize the solenoids, said solenoids after the first each having one terminal connected to the controller and the other connected to the resistance side of a switch whose solenoid in operation is actuated before it, substantially as described.

5. The combination of a motor with a body of resistance divided into a number of sections, a switch for each section each having two contacts of which one is connected to its particular section and the other is connected to one of the supply-mains, a series of solenoids, a controller for energizing said solenoids one after the other, connections from the controller to one terminal of each solenoid, a connection from the second terminal of the first solenoid to be actuated to a current-supply main and connections from the second terminals of each of the remaining solenoids to the resistance side of the switches whose solenoids in operation are respectively energized before it, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ARTHUR C. EASTWOOD.

Witnesses:

C. W. COMSTOCK,

W. A. JONES.