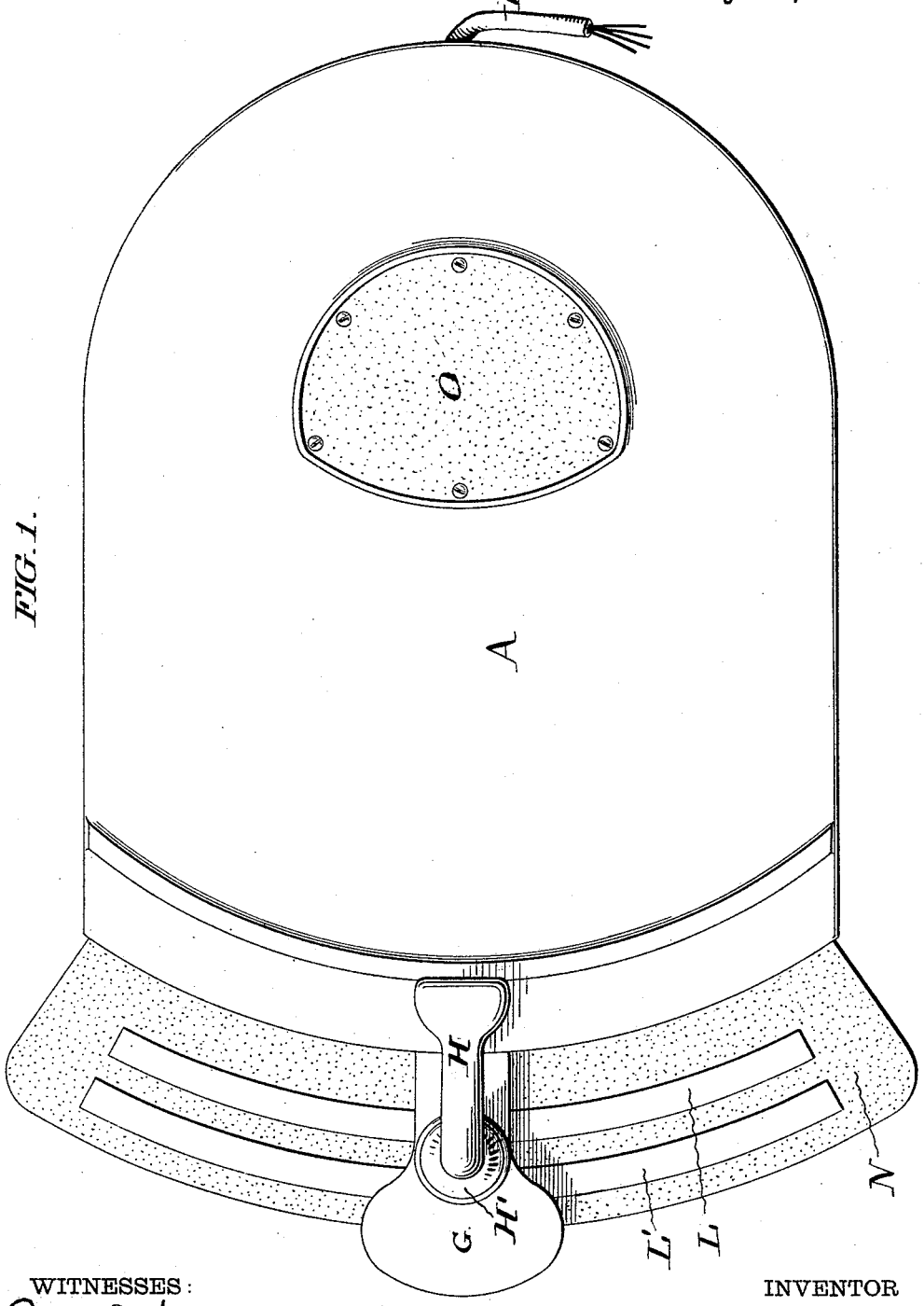
(No Model.) 4 Sheets—Sheet 1.

C. H. RICHARDSON.

CONTROLLING MECHANISM FOR ELECTRIC MOTORS.

No. 523,444. Patented July 24, 1894.

FIG. 1.



WITNESSES:

Edw. F. Simpson, Jr.

Robt. L. Gordon

INVENTOR

C. H. Richardson

By Atty

J. C. Dayton.

(No Model.) 4 Sheets—Sheet 2.

C. H. RICHARDSON.

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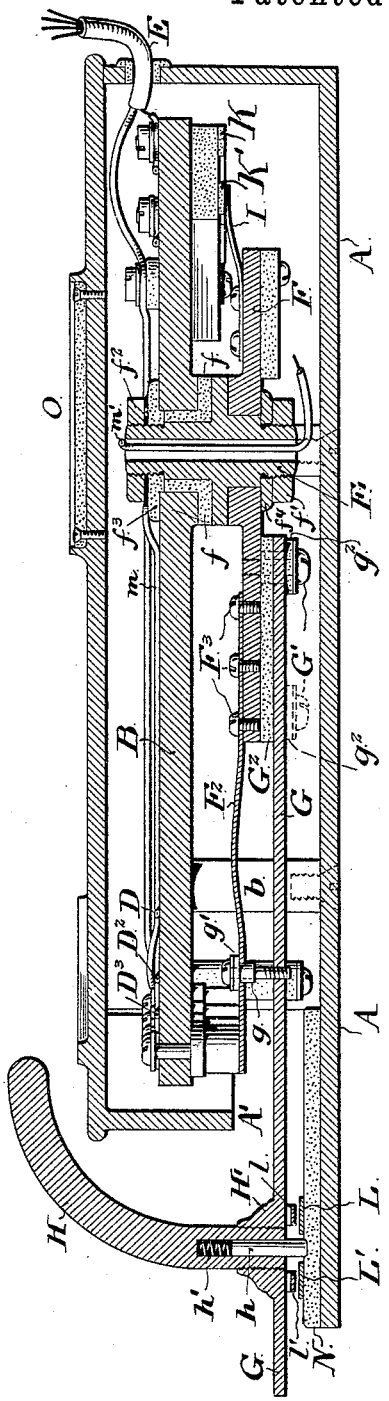
FIG. 2.



WITNESSES:

Edw. F. Simpson, Jr.

Robt. C. Gordon

INVENTOR

C. H. Richardson

By Offy

J. H. Peyton.

(No Model.) 4 Sheets—Sheet 3.

C. H. RICHARDSON.

CONTROLLING MECHANISM FOR ELECTRIC MOTORS.

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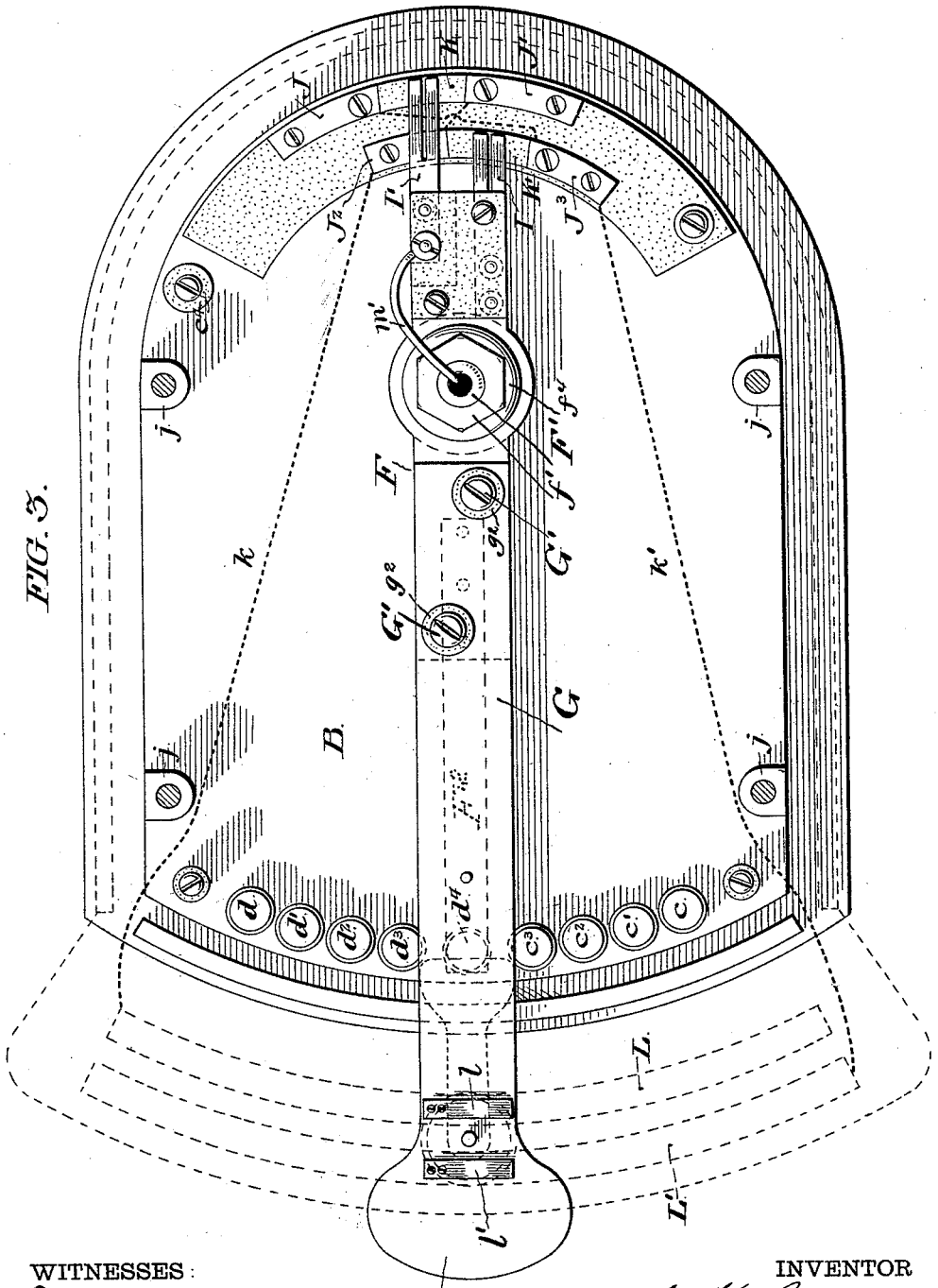
FIG. 3.



WITNESSES:

Edwd. F. Simpson Jr.

Robt. E. Gordon

INVENTOR

C. H. Richardson

By Atty's Dyer & Taylor.

(No Model.) 4 Sheets—Sheet 4.

C. H. RICHARDSON.

CONTROLLING MECHANISM FOR ELECTRIC MOTORS.

No. 523,444. Patented July 24, 1894.

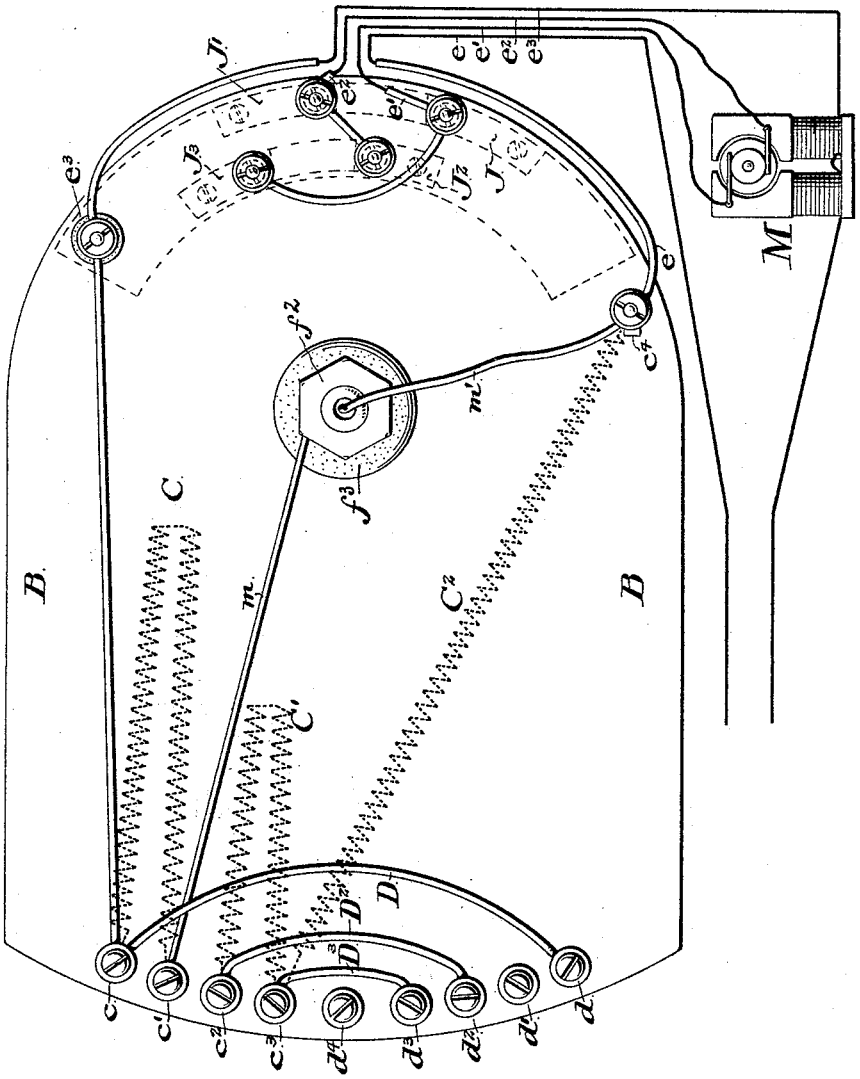


FIG. 4.

WITNESSES:

Edw. F. Simpson, Jr.

Robt. C. Gordon

INVENTOR

C. H. Richardson

By Atty J. R. Stetson

UNITED STATES PATENT OFFICE.

CHARLES H. RICHARDSON, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO THE S. S. WHITE DENTAL MANUFACTURING COMPANY, OF SAME PLACE.

CONTROLLING MECHANISM FOR ELECTRIC MOTORS.

SPECIFICATION forming part of Letters Patent No. 523,444, dated July 24, 1894.

Application filed April 26, 1894. Serial No. 509,114. (No model.)

To all whom it may concern:

Be it known that I, CHARLES H. RICHARDSON, of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Controlling Mechanism for Electric Motors; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to certain improvements, as hereinafter claimed, in means for starting, controlling the direction of rotation, varying the speed, and instantly arresting the motion of electric motors, as well as for switching off the current when the motor is thrown out of operation.

In accordance with my improvements, as shown in the accompanying drawings, the variable resistance by means of which the speed of rotation of the motor is varied is carried by the support or carrier and the actuating lever of the controlling mechanism as well as the reversing and stopping contacts are mounted within the carrier.

Figure 1 is a plan view showing my improvements as suitably applied to foot-actuated controlling mechanism. Fig. 2 is a longitudinal vertical central section. Fig. 3 is a view as seen from the bottom, looking upward, with the support or carrier removed. Fig. 4 is a view partly in plan and partly diagrammatic, with the support or carrier omitted.

As in this instance shown a support or carrier A for the entire controlling mechanism is provided in the form of a box or casing having a front opening A′ extending from side to side thereof. A resistance plate B, carrying resistance wires, preferably such as shown in United States Letters Patent of C. E. Carpenter, No. 481,781, dated August 30, 1892, is fixedly secured to the carrier A, by suitable means, such as the four posts *b* cast with the resistance plate and screwed to the carrier A. The resistance wires in enamel upon the resistance plate as in the said Carpenter patent, three of which wires, C C′ C^2, are shown, are connected with their respective contacts *c*, *c′*, c^2, c^3, c^4, which project below the bottom surface of the resistance plate. Conductors D D^2 D^3 respectively connect the contacts *c*, c^2, c^3, with corresponding contacts *d* d^2 d^3. These contacts *d* d^2 d^3, and a button or lug *d′* similar thereto are arranged on one side of the longitudinal center of the contact plate, and the contacts *c c′* c^2 c^3 on the other side thereof, the entire series being arranged in the arc of a circle, centrally in which arc is a button or lug d^4. The contact c^4 is suitably located upon the resistance plate and has coupled to it the conductor *e* of the cable E of conductors *e e′* e^2 e^3.

A switch-actuating lever F is mounted to vibrate parallel to the under surface of the resistance plate B which constitutes a switch board, it will be seen. This lever F is shown as connected with the resistance plate in the following way: An opening in the plate is provided with a flanged bushing *f* of suitable non-conducting material, in which is inserted a tubular boss F′ of brass or other suitable metal having an annular flange resting against the bushing flange. The ends of the tubular boss are threaded and provided with nuts *f′* f^2, also of brass. A non-conducting washer f^3 is interposed between the resistance plate and the nut f^2. A metallic washer f^4 is interposed between the nut *f′* and the actuating lever F which vibrates on the boss. The actuating lever is provided with an electrically connected forwardly projecting flexible metallic arm F^2, shown as secured in place by screws F^3 at its rear end and connected near its front end by a headed pin or screw *g* with a forwardly projecting arm G of the lever. A non-conducting washer *g′* is interposed between the head of the screw *g* and the flexible arm, this screw and washer constituting a contact separator. The lever arm G has non-conducting connection at its rear end with the lever, two screws G′ G′ being shown as connecting this arm with the lever, with a non-conducting strip G^2 interposed between the lever and its arm, and non-conducting washers g^2 g^2 interposed between the screws and the lever arm. The washer *g′* is loosely applied to the screw *g* so as to allow slight downward movement of the lever arm G without depressing the flexible arm F^2, and near its

front end the lever arm is provided with an upwardly extending operating arm or projection H shown as screwed into a boss H′ on the lever arm, and having a detent pin *h* acted upon by a spring *h′*, for a purpose further on to be explained.

At its rear end the actuating lever F is provided with a flexible contact I electrically connected therewith in suitable well known way; and another flexible contact I′ is carried by the rear end of this lever but electrically insulated from it. Two pairs of curved contacts, consisting respectively of the plates J, J′ and J^2 J^3, are provided at the rear end of the resistance plate B, at its under surface, the contacts of the respective pairs being concentrically arranged, and the contacts of each pair being separated by their respective insulating strips K K′ let into the resistance plate flush with the contacts. The contacts of the two pairs are suitably insulated from the resistance plate.

The support or carrier A at its front end beneath the lever arm G is provided with two concentrically curved contact plates L L′ insulated from the carrier, and on the under side of the lever arm are two contact pieces *l l′* electrically connected with each other and adapted to make connection respectively with the plates L L′ when the lever arm is depressed. These contact plates L and L′ are electrically connected respectively with the contact plates J^2 and J^3, (or they may be connected with the plates J and J′) by conductors *k k′*.

A suitable motor, in this instance a series motor M (either a shunt or series motor may be used) is electrically connected with one of the line wires, and through the cable E of conductors with the motor controlling mechanism as follows. The line wire connects with one end of the field coils of the motor, the opposite end of the field coils connecting by conductor e^3 with contact *c*. The contact plates J′, J^2 are connected through conductor e^2 with one of the armature brushes of the motor, while contacts J, J^3 are connected by conductor *e′* with the other armature brush. Contact *c′* is permanently connected by conductor *m* with the boss F′ of the actuating lever. The conductor *e* (connected with the contact c^4) is permanently connected with that line wire which is not connected with the motor field coils, and is also connected by an insulated conductor *m′*, which preferably passes through the boss F′, as shown, with the flexible insulated contact I′.

In operation with the actuating lever in the position in which it is shown in Figs. 2 and 3, the motor is at rest, and the current to the motor broken. With the lever in this position it is yieldingly locked against movement by the detent pin *h* which engages a recess in a plate N of insulating material on the carrier A. With the actuating lever at one extreme of its movement and engaging by its arm F^2 with the contact *c* current passes by one line wire through the motor field and by conductor e^3 to contact *c* through the flexible arm F^2, into the actuating lever, thence through flexible contact I, contact plate J^2 and conductor e^2 to the motor armature, returning through the conductor *e′*, contact plate J, insulated flexible contact I′, insulated conductor *m′*, contact button c^4 and conductor *e* to the other line wire. In this position the full current is on and the motor runs at its highest speed. Moving the actuating lever arm F^2 into engagement with the next contact *c′* toward the center of the resistance plate, the conditions remain unaltered except that the resistance C is thrown into series with the motor field and armature, and the first reduction in speed takes place. Still further moving the actuating lever toward the center of the resistance plate brings the lever arm F^2 into engagement with the contact c^2 and throws the resistances C′ and C^2 into shunt with the armature, the resistance C remaining in series with the motor field and armature by means of the permanent connection *m*. This still further reduces the speed of the motor, while preserving a strong pull, as will be understood by reference to United States Letters Patent No. 503,453, dated August 15, 1893. Moving the actuating lever to bring its arm F^2 into engagement with the last contact c^3 reduces the shunt resistance around the armature to C^2, cutting out resistance C′, and reduces the speed to the lowest limit while still preserving a strong pull upon the motor armature in accordance with the invention set forth in said Patent No. 503,453.

During all adjustments of the actuating lever so far described, it will be understood that the flexible contacts I and I′ remain in engagement with the contact plates J^2 and J, respectively, allowing the current to pass through the motor armature. By moving the arm F^2 of the actuating lever into engagement with the contact d^3 the operation which takes place when the contact c^3 is engaged by the lever arm is repeated except that the direction of rotation of the motor armature is reversed by reason of contacts I and I′ making contact with contacts J^3 and J′ and reversing the direction of current through the armature, in well known way. The variations in speed, with the lever arm F^2 engaged with other contacts of the series *d d′* d^2 d^3 will be understood from the description above given in connection with the operations resulting from engagement of the lever arm with the contacts in the series *c c′* c^2 c^3. The above described movements are imparted to the actuating lever by the toe of the operator pressing against the operating arm H of the actuating lever.

To suddenly stop the motor the lever arm G is forcibly depressed by the foot, bringing the contact springs *l l′* into engagement with contact plates L L′ and short-circuiting the motor armature through conductors *k k′* connected respectively to contacts J^2 and J^3, thus

causing the armature to act as a generator of current and quickly come to rest. As it is well to always have a resistance in series with the motor when this short circuiting takes place, to avoid injury to the motor from an excess of current, the contact separator pin *g* carried by the lever arm G is adapted to pull the arm F^2 away from the contacts *c*, *c'*, c^2, c^3, *d*, *d'*, d^2, d^3, which always insure the insertion of the resistance C in circuit with the motor before the short-circuiting takes place, if the contact F^2 is on the contacts *c* or *d* and the motor running at the highest speed.

It will be seen that the mechanism is compactly arranged and properly supported by the carrier, within which the entire mechanism except the slightly projecting arm and attachment of the actuating lever is contained and so protected and that the actuating lever may be readily worked by way of its operating arm H by the operator's toe with the heel of the foot on the rest O, or that the arm H may be adjusted by the operator without placing his heel upon the rest, when standing in any convenient position, as in front or at the side of the apparatus. The end of the lever arm G projecting in advance of the operating arm H may be pressed against sidewise or downwardly to adjust the actuating lever.

I claim as my invention—

1. The combination in controlling mechanism for electric motors, of the carrier, the variable resistance, the contacts thereof, the reversing contacts, the armature short-circuiting contacts, the contact separator, and the switch actuating lever for throwing the variable resistance and reversing contacts into operation, and serving by, a single movement, while occupying any position of its adjustment, to throw the armature short-circuiting contacts into operation and by means of the contact separator to throw resistance into series with the field and armature, substantially as set forth.

2. The combination, in controlling mechanism for electric motors, of the carrier composed of the box or casing having the end or front opening, the resistance, the contacts thereof, reversing contacts, armature short-circuiting contacts, and contact separator all contained within the carrier, and the switch actuating lever mounted within the carrier and provided with the arm projecting therefrom by the end opening and adapted to be actuated by the foot, substantially as set forth.

3. The combination, in controlling mechanism for electric motors, of the carrier, the variable resistance, the contacts thereof, the reversing contacts, the armature short-circuiting contacts, the contact separator, the switch actuating lever adapted for throwing into operation the variable resistance and the reversing contacts, and the flexible arm of said lever serving to throw the short circuiting contacts into operation and also to throw resistance into series with the field and armature, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

CHARLES H. RICHARDSON.

Witnesses:

H. E. HAUKSNETT,

R. DALE SPARHAWK.