No. 704,447. Patented July 8, 1902.

# A. C. EASTWOOD.

## PROTECTIVE OPERATING DEVICE FOR ELECTRIC MOTORS.

(Application filed Nov. 16, 1901.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

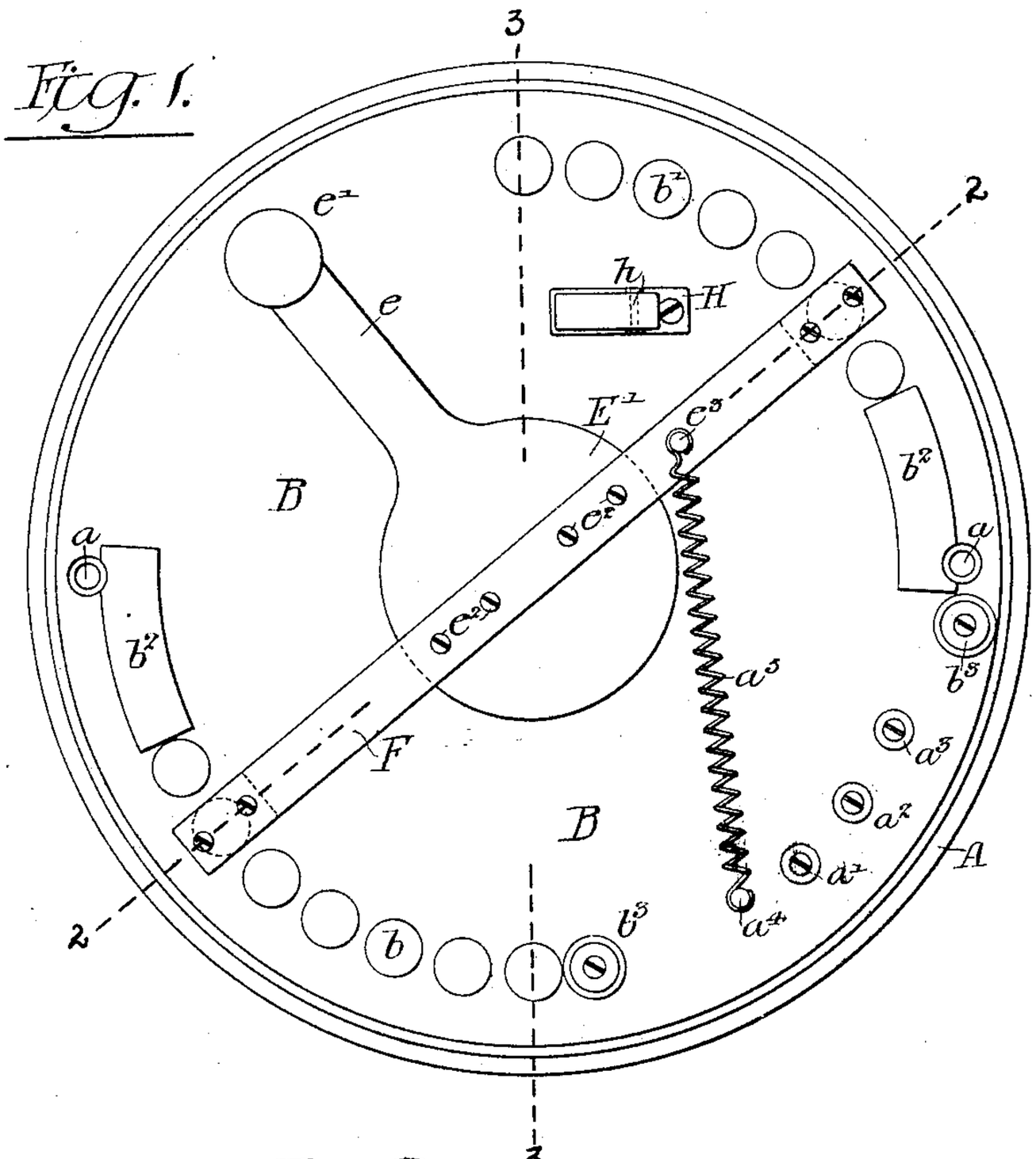


Fig. 2.

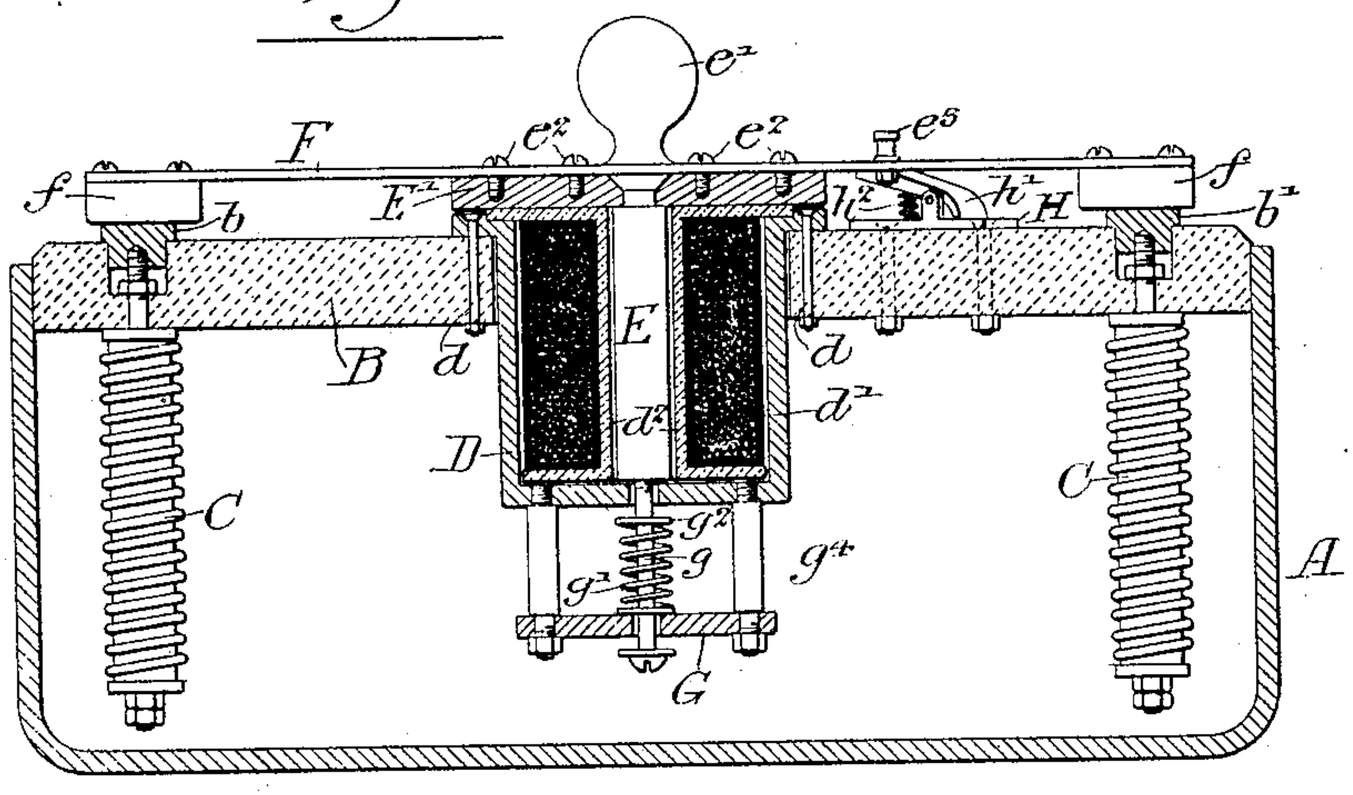


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Fig. 3.

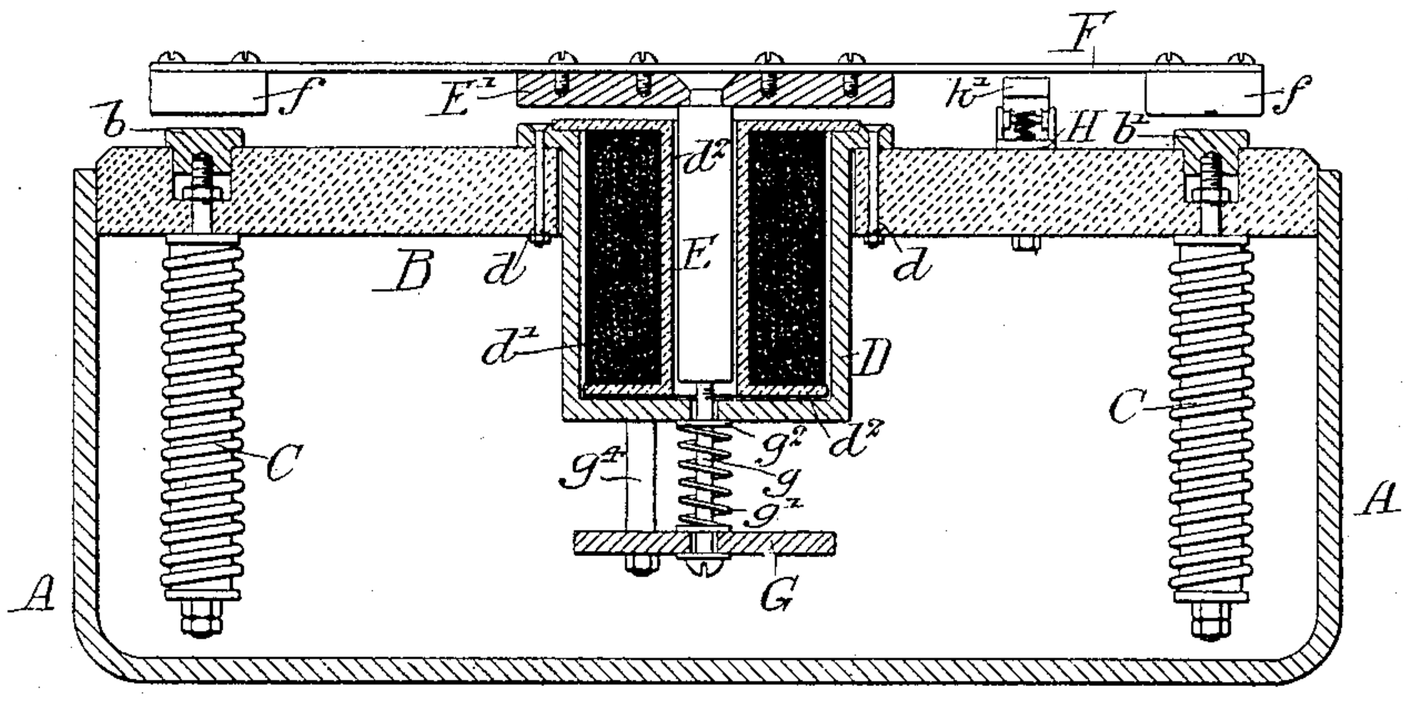



Fig. 4.

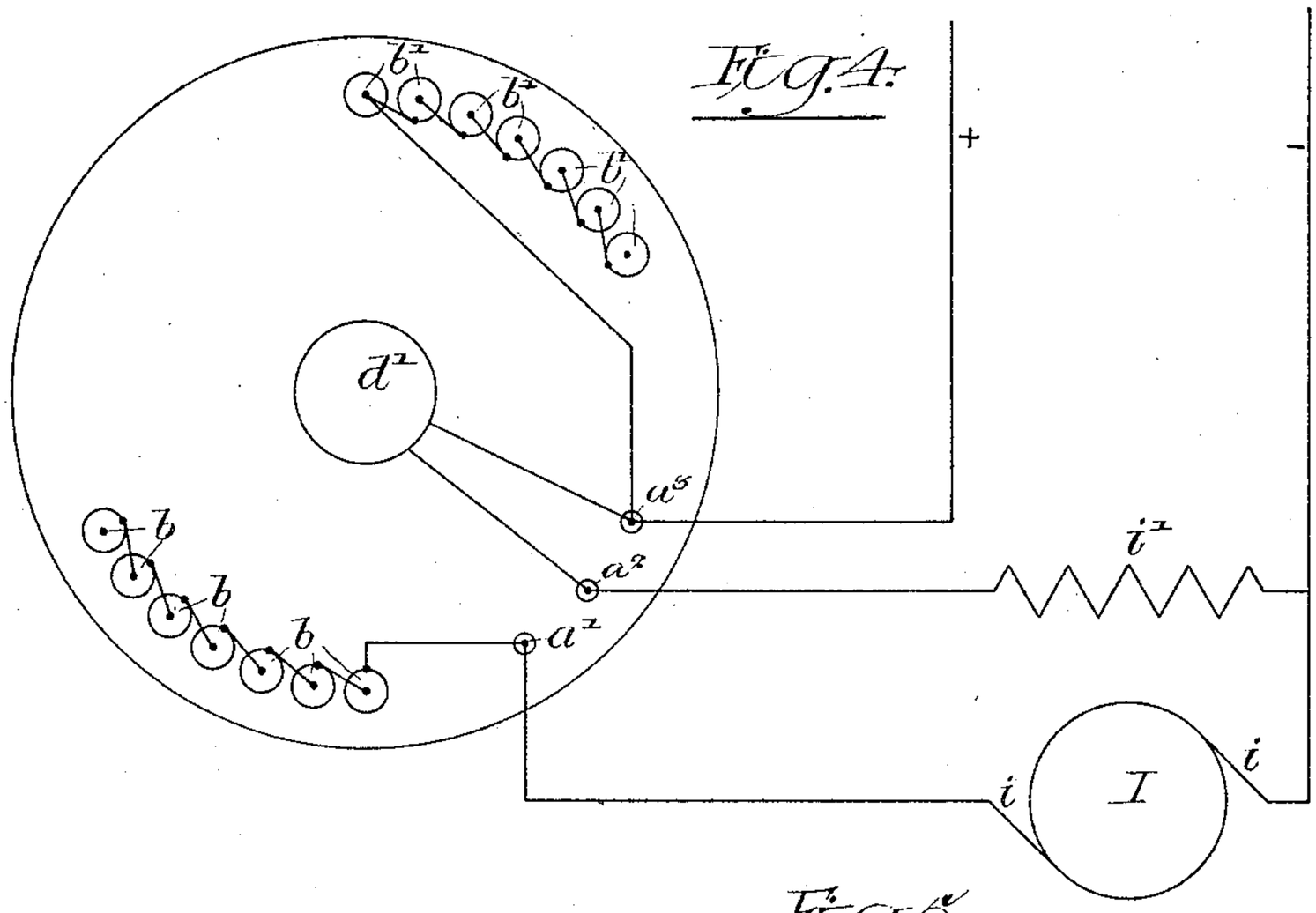
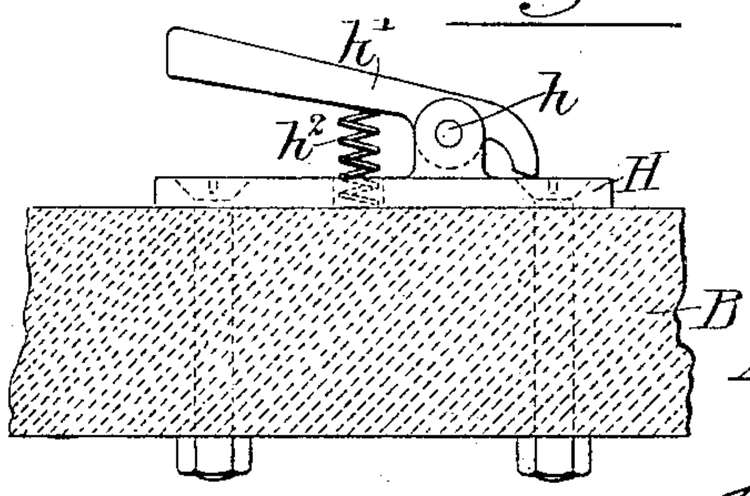



Fig. 5.

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# UNITED STATES PATENT OFFICE.

ARTHUR C. EASTWOOD, OF CLEVELAND, OHIO, ASSIGNOR TO THE ELECTRIC CONTROLLER & SUPPLY COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO.

## PROTECTIVE OPERATING DEVICE FOR ELECTRIC MOTORS.

SPECIFICATION forming part of Letters Patent No. 704,447, dated July 8, 1902

Application filed November 16, 1901. Serial No. 82,539. (No model.)

*To all whom it may concern:*

Be it known that I, ARTHUR C. EASTWOOD, a citizen of the United States, and a resident of Cleveland, Ohio, have invented certain Improvements in Protective Operating Devices for Electric Motors, of which the following is a specification.

My invention relates to certain new and useful improvements in starting and speed-regulating devices for electric motors, being particularly applicable to motors which are started and allowed to run for long periods of time without attention. In the case of such motors if the current should be cut off—as, for example, by the opening of a circuit-breaker—the motor would come to rest with its armature connected without resistance in circuit directly across the line. Should the current then be restored, its flow through the armature would be enormous and might prove destructive before the armature could begin to revolve and cut down the current with its counter electromotive force. To prevent this, many forms of starting and regulating devices have been devised which automatically disconnect the armature from the line when the current fails. Such devices have commonly been made with a contact-arm constructed to pass over a series of contacts to which are connected the various sections of the starting resistance, the arm working against a spring tending to return it to the off position. An electromagnet opposes the action of this spring and holds the arm in a given working position while the motor is running. When the current fails, this electromagnet is deënergized, and the spring returns the arm to the off position. In all devices of this description, however, in returning to the starting-point the contact-arm must pass over the resistance-contacts. As these contacts become roughened by wear and arcing the friction acting to prevent the motion of the contact-arm increases greatly, and when it reaches a certain point the return-spring cannot be relied upon to bring the arm to the off position when the current fails. If the arm rests in an intermediate position when the current is restored, a portion of the starting resistance and the armature as well are likely to be burned out. Such devices, therefore, are dangerous and result in frequent destruction of apparatus.

The object of my invention is to provide an automatic release which while being independent of the friction of the contacts will operate unfailingly upon the cessation of flow of the current.

A further object is to secure a perfectly-uniform pressure of the contact-arm on the contact segments or buttons, which will be independent of spring-pressure and will not deteriorate with use, thus preventing arcing and heating, and thereby greatly increasing the life of the apparatus.

Another object of my invention is to produce apparatus of the form described which will be simple in operation, easy of access for inspection and repair, and of such form that repairs when necessary can be made with a minimum expenditure of time and labor.

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

Figure 1 is a plan view of an electric controller embodying my invention. Fig. 2 is a sectional view of the same on the line 2 2, Fig. 1. Fig. 3 is a similar view taken on the line 3 3, showing the contact-arm in the position occupied at the moment after the current through the apparatus has been cut off. Fig. 4 is a diagrammatic view showing the electrical connections of a controller equipped with my invention; and Fig. 5 is a view, partly in section, of the spring-actuated stop for preventing movement of the contact-arm after it has been placed on the last point of the controller.

In the above drawings, A is a containing casing or framework, usually of metal, to which is suitably attached, by means of screws $a$, a plate or slab B of insulating material, such as marble or slate. This has mounted upon it two sets of contact buttons or plates $b$ and $b'$ and plates of insulating material $b^2$, the said plates $b$ and $b'$ being arranged on the arc of a circle, each set with a stop $b^3$ to limit the motion of a contact-arm hereinafter described. Electrically connected to the contact-buttons are resistance-coils C, preferably of the type

and made in the manner shown and described in my allowed application for United States Patent, Serial No. 76,660, filed September 26, 1901. There is a circular opening in the center of the slab B, through which projects a flanged casing or magnet-frame D, of steel or iron, this being held in position by means of small screws $d$ and extending into the interior of the casing A. Within the frame D are the windings of a magnet $d'$, coiled upon a spool $d^2$ of insulating material. There is a tubular opening through the center of this spool, through which extends a core E of magnetic material, usually of soft iron. This has fixed to its upper end a circular disk E', also of magnetic material and provided with a projecting portion $e$, on the end of which is an upwardly-projecting handle $e'$. Held to the disk E' by means of screws $e^2$ and in a position at right angles to the arm $e$ is a metallic arm F, carrying upon its ends brushes or fingers $f$, the said arm being constructed to move in the arc of a circle, so as to bring the fingers successively into contact with the buttons $b$ and $b'$.

From the lower end of the core or plunger E a headed rod $g$, preferably of brass, extends downward, passing through an opening in the magnet-frame D and also through a yoke-piece G, which is held in position by two pieces $g^4$, projecting from the bottom of the magnet-frame D. A spring $g'$ is confined between the said yoke-piece G and a collar $g^2$, fixed to the rod $g$, upon which said spring is carried.

Preferably in the position shown in Fig. 1 a metallic plate H is fixed to the upper face of the slate slab B, and this has upwardly-projecting lugs which serve as a bearing for a pin $h$. Journaled on this pin is a lever $h'$, one end of the same normally resting upon the plate H and the other and longer end being held up by a spring $h^2$, thus maintaining the lever in the position shown in Fig. 5.

$a'$, $a^2$, and $a^3$ are terminals for the connection of wires from an electric motor and the current-supply mains, and there is a stud $a^4$, fixed in the slab B, from which a spring $a^5$ extends to a similar stud. The action of the spring is to keep the contact-arm F in the "off" position, with its fingers over the insulating-plates $b^2$ and with one end resting against the stop $b^3$.

In Fig. 4 is illustrated the diagram of the connections of a shunt-wound motor when used with a controller provided with my invention. In this figure I is the armature of the motor, having brushes $i$ and a field-winding $i'$, one of the brushes being connected to a terminal $a'$ on the controller, while one terminal of the field-winding is connected to a second terminal $a^2$ of the controller. The second field-terminal as well as the other brush of the armature are both connected to the negative supply-main, the positive main being connected to the terminal $a^3$ of the controller. From this a wire leads to one end of the series of contact-buttons $b'$, the resistances connected to these being electrically coupled in the manner well known to the art. The winding of the magnet $d$ is connected in series with the field-winding of the motor $i$, its terminals being connected to the terminals $a^2$ and $a^3$ on the controller. The terminal $a'$ is connected to the end of the series of contact-buttons $b$, which also have their resistances connected together in the ordinary manner. If now current be allowed to flow to the supply-mains, the contact-arm being in its off position, said current will pass from the positive main into the magnet-winding, through the terminal $a^3$, passing out through the terminal $a^2$, and energizing the fields $i'$ of the motor. Immediately upon the current entering the magnet its plunger E, together with the keeper E', are drawn downward against the action of the spring $g'$, which would normally tend to keep this piece in the position shown in Fig. 3. When, however, these parts are drawn down, the contact-arm is also moved down and its fingers $f$ come in contact with the insulating-plates $b^2$. Now if it is desired to start the motor the contact-arm is moved over the contacts by turning the handle $e'$, its fingers being held against the same and at the level of the contact-plates by the continued action of the magnet upon the disk E' and plunger E. As the contact-arm is moved the motor is gradually speeded up in the usual manner, and the arm finally passes over the upwardly-projecting end of the lever $h'$, the spring $h^2$ being depressed and allowing the lever to be lowered sufficiently to permit of the passage over it of the arm F. It will be understood that such motion of this arm is against the action of the spring $a^5$, so that when the contact-arm finally passes over the lever $h'$ and rests upon the last contact-button of each series the spring is continually tending to return it to its off position and holds it against the end of the lever $h'$, which rises to its original position as soon as the said arm has passed over it. If now from any cause—as, for instance, the opening of the circuit-breaker—current should be cut off from the the supply-mains, the magnet $d'$ will be immediately deënergized, and the springs $g'$ will act to force up the plunger E and disk E' and with them will move the contact-arm F off from the contact plates or buttons. This would raise the said arm above the top of the lever $h'$, and the spring $a^5$ would immediately turn it, with the disk E', the plunger E acting as a pivot, thus restoring it to its off position against the stop $b^3$ and over the insulating-plates $b^2$. It will thus be seen that when current is flowing through the fields of the motor, and consequently through the coils of the magnet $d'$, the fingers of the contact-arm will have a positive and perfectly-uniform pressure on the contact-plates, this continuing as the arm, with its fingers, is moved over said plates. When, however, the current fails from any cause, the fingers are

raised above the contact-plates, and the contact-arm is returned to its off position without touching the same, friction between the two thus being naturally eliminated. As there is no resistance to turning between the plunger E and its bearing within the magnet-spool, the friction here is practically nothing. There is consequently no danger of the arm not being released when the current fails, nor is there any chance of its sticking before reaching its off position.

It will be understood that while I have illustrated my invention as applied to a starting-box for an electric motor it may be used with equal advantage on an electric controller or any other form of rheostatic apparatus in which the contact-arm may be allowed to rest on any of the contact-plates for an indefinite time without injury from the continued flow of current. In such a case the lever or stop $h'$ would be dispensed with, the spring $a^5$ being designed to permit the friction between the contact-arm and the contact-plates to hold said arm from moving as long as the magnet is energized while still being sufficiently powerful to return the arm to its off position when the current is cut off.

I claim as my invention—

1. The combination with an operating device for electrical apparatus, said device having contact-plates, of a contact-arm for said plates, means acting upon said arm to return it to its off position when it is moved therefrom, and means for holding said arm at a level such that it will contact with said plates, with means operative upon said arm at its center of rotation for moving the arm away from said level whereby it is allowed to return to its off position without engaging the contact-plates, substantially as described.

2. The combination with an operating device for electrical apparatus, said device having contact-plates, of a contact-arm for said plates, means for acting upon said arm to return it to its off position when it is moved therefrom, and a magnet for holding said arm at a level such that it will contact with said plates as long as the magnet is energized, with means for moving the arm away from said level when the magnet is deënergized, whereby said arm is allowed to return to its off position without engaging the contact-plates, substantially as described.

3. An operating device for electrical apparatus, said device having contact-plates connected to resistances, a rotatable arm having electrical mechanism for holding it in engagement with the plates when the controller is operated, means for moving the arm at right angles to the plane of its rotation away from the level of said plates, and means for returning the arm to its off position when it has been so moved away from said level, substantially as described.

4. An operating device for electrical apparatus, the same having contact-plates connected to resistances, a movable arm operative in connection with the plates for throwing more or less of said resistance into circuit, means operated by an electric current for retaining the arm in working relation with the contact-plates, and means for moving the arm away from the level of the plates when the said arm-retaining means are out of action, and means for returning the arm to its off position when it has been so moved away from said level, substantially as described.

5. An operating device for electrical apparatus, said device having contact-plates connected to resistances, a rotatable arm having a magnet for holding it in engagement with the plates when the controller is operated, means for moving the arm at right angles to the plane of its rotation away from the level of said plates when the magnet is deënergized, and means for returning the arm to its off position when it has been so moved away from said level, substantially as described.

6. An operating device for electrical apparatus, said device having contact-plates connected to resistances, a rotatable arm having a magnet for holding it in engagement with the plates when the controller is operated, means for moving the arm at right angles to the plane of its rotation away from the level of said plates when the magnet is deënergized, means for returning the arm to its off position when it has been so moved away from said level, and means for preventing movement of the arm from its full-on position as long as said magnet is energized, substantially as described.

7. An operating device for electrical apparatus, said device having contact-plates connected to resistances, a contact-arm for said plates rotatably carried by the controller, a spring acting to retain said arm in its off position, a magnet having an armature fixed to the arm, a second spring acting to move the armature away from the magnet and a stop for retaining the arm in its full-on position against the action of the first spring, substantially as described.

8. An operating device for electrical apparatus, said device having contact-plates and a contact-arm, said controller being provided with means for retaining the arm in contact with the plates as long as current flows normally through the supply-mains, said controller also having means for moving the arm away from the contact-plates and returning it to the off position without engagement with said plates upon the cessation of the flow of current, substantially as described.

9. An operating device for electrical apparatus, said device having plates electrically connected to resistances and an arm, carried on a rotatable bar, for contacting with the plates, means for returning the arm to its off position when it has been moved therefrom, means for moving the bar longitudinally and thereby moving the said arm away from the said plates, with a magnet electrically con-

nected so as to be energized when current flows in the supply-mains, said magnet holding the arm at a level to contact with the plates, against the action of the means for moving said bar longitudinally, substantially as described.

10. The combination of an operating device for electrical apparatus, said device carrying a magnet, a movable core to said magnet having fixed to it a rotatable contact-arm, contact-plates on the controller connected to resistances and placed to be engaged by said arm, a spring acting on said core to force it away from the magnet, said spring holding the contact-arm away from the level of the contact-plates when the magnet is deënergized, a spring acting on the arm to return the same to its off position and a stop on the controller engaging the contact-arm when it is in a full-on position and preventing its rotation as long as the magnet is energized, substantially as described.

11. In an operating device for electrical apparatus, a magnet having a core movable into and out of said magnet and rotatable within the magnet, an armature fixed to said core and carrying a contact-arm, contact-plates therefor placed to be engaged by the arm when the armature is magnetically held to the magnet, a spring-controlled stop on the device holding the arm in its full-on position, with means for moving the armature so that the arm is free to pass over the stop, and means for returning said arm to its off position, substantially as described.

12. In a device of the character described, a magnet-frame held to the insulating-plate of the controller, a magnet and an armature therefor, a revoluble core for the magnet fixed to the armature, a bar projecting from said core, a yoke carried by the magnet-frame, a spring on said bar tending to force the core and armature away from the magnet, and a contact-arm fixed to the armature, said arm being at a level to engage the contact-plates of the device when the magnet is energized, and being held away from the same when the magnet is deënergized, substantially as described.

13. In a protective operating device for electric motors, the combination of a controller having a number of contact-plates connected to resistances and a contact-arm whereby said resistances are successively cut out of circuit with the armature of the motor, a magnet in series with the field of the motor, with means whereby the magnet holds said arm in engagement with the contact-plates as long as the field of the motor is energized, and means for moving said arm off of the contacts and then returning it to its off position upon the failure of the current, substantially as described.

14. In a current-controlling device for electrical apparatus, the combination of contact-plates connected to resistances, a contact-arm for said plates provided with means for holding it in engagement with certain of the plates when the device is in operation, together with means for automatically moving said arm away from the level of said contact-plates upon the cessation of the flow of current in the device, substantially as described.

15. In a protective operating device for electrical apparatus, the combination of contact-plates, a contact-arm for the same, a magnet for holding said arm in engagement with said contacts as long as the device is in operation and mechanism for moving said arm away from the level of the plates upon the cessation of the flow of current through the device, substantially as described.

16. A protective operating device for electrical apparatus, having contact-plates connected to resistances, a contact-arm for the plates, a magnet connected in series with the circuit through said device and operative upon said arm when current flows through the device to hold the same in engagement with the contact-plates, together with means for moving the arm away from the plane of the contact-plates upon the cessation of the flow of current through the device, 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,
HERBERT S. GLIDDEN.