(No Model.) 2 Sheets—Sheet 1.

J. P. B. FISKE.

ELECTRIC MOTOR CONTROLLER.

No. 485,620. Patented Nov. 8, 1892.

FIG. 1.

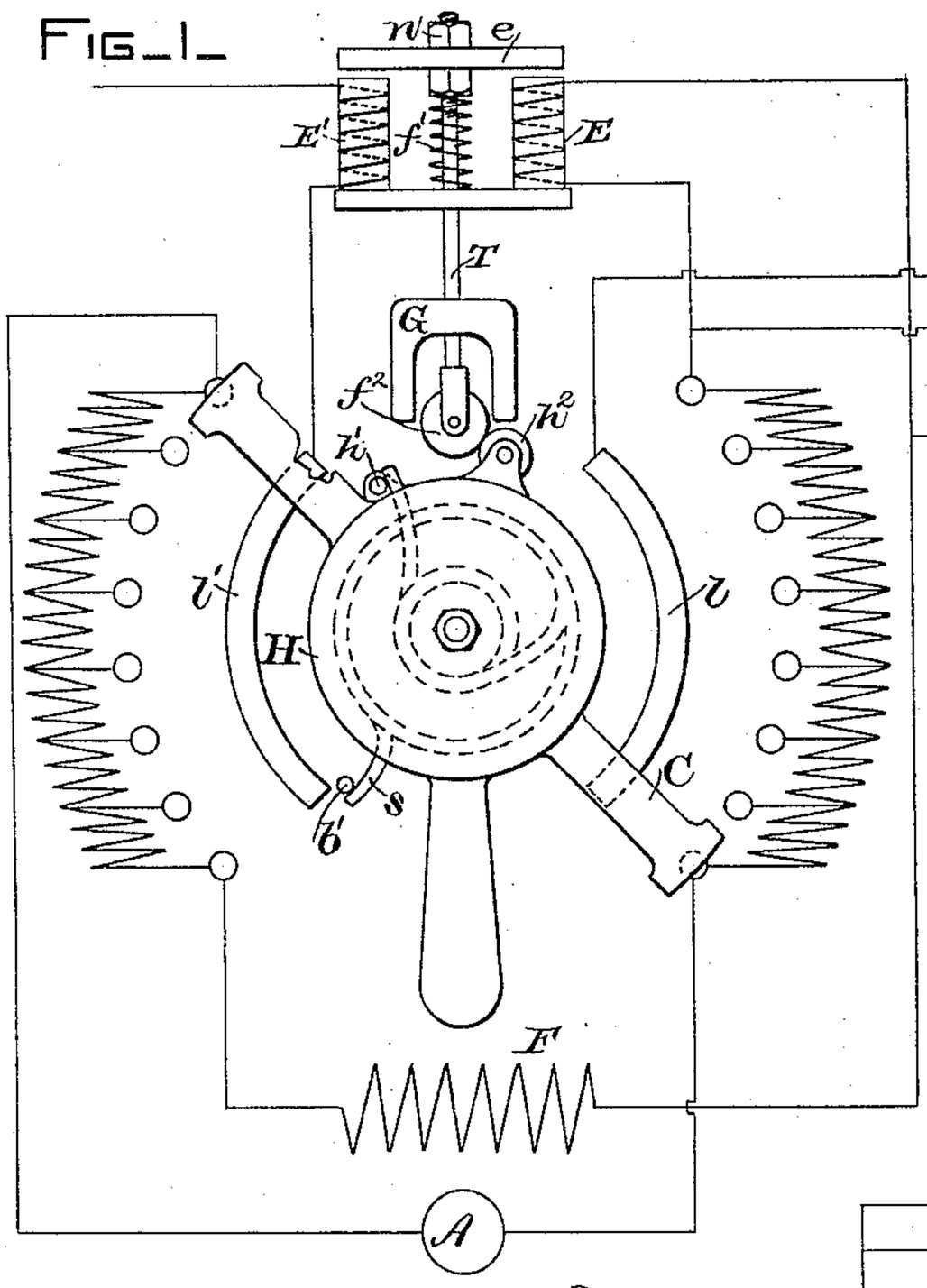


FIG. 4.

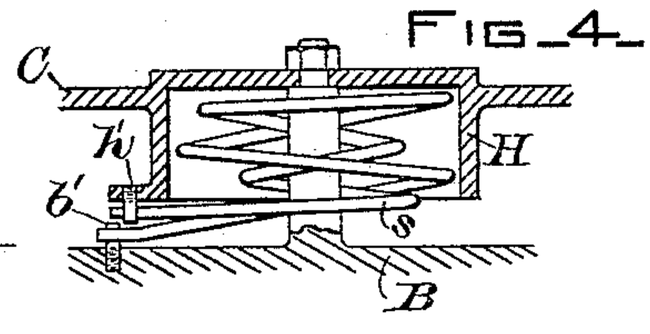


FIG. 5.

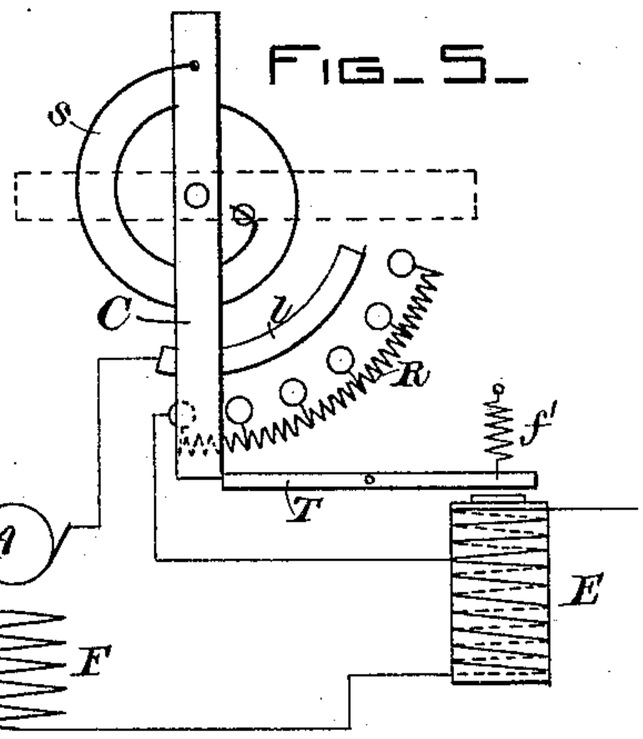


FIG. 3.

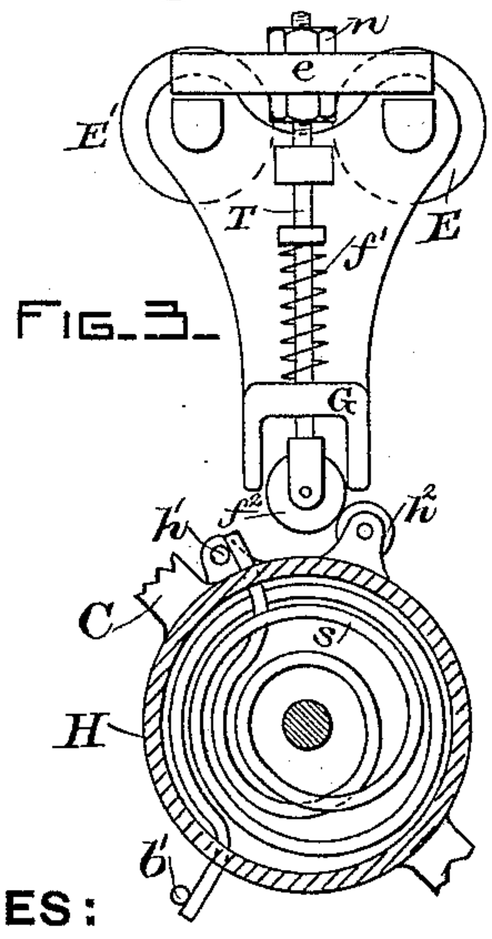
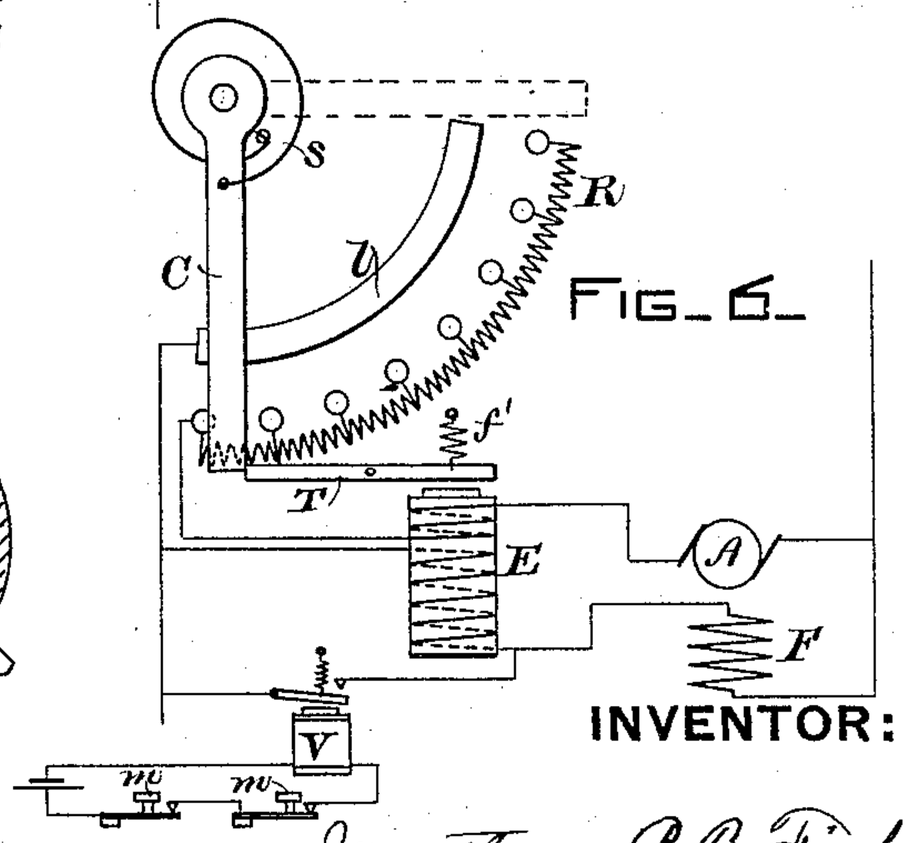


FIG. 6.



WITNESSES:

Allerne

L. L. Haynes.

INVENTOR:

Jonathan P. B. Fiske

by Bartlett Bladgett

ATTYS.

(No Model.) 2 Sheets—Sheet 2.

J. P. B. FISKE.

ELECTRIC MOTOR CONTROLLER.

No. 485,620. Patented Nov. 8, 1892.

FIG_2_

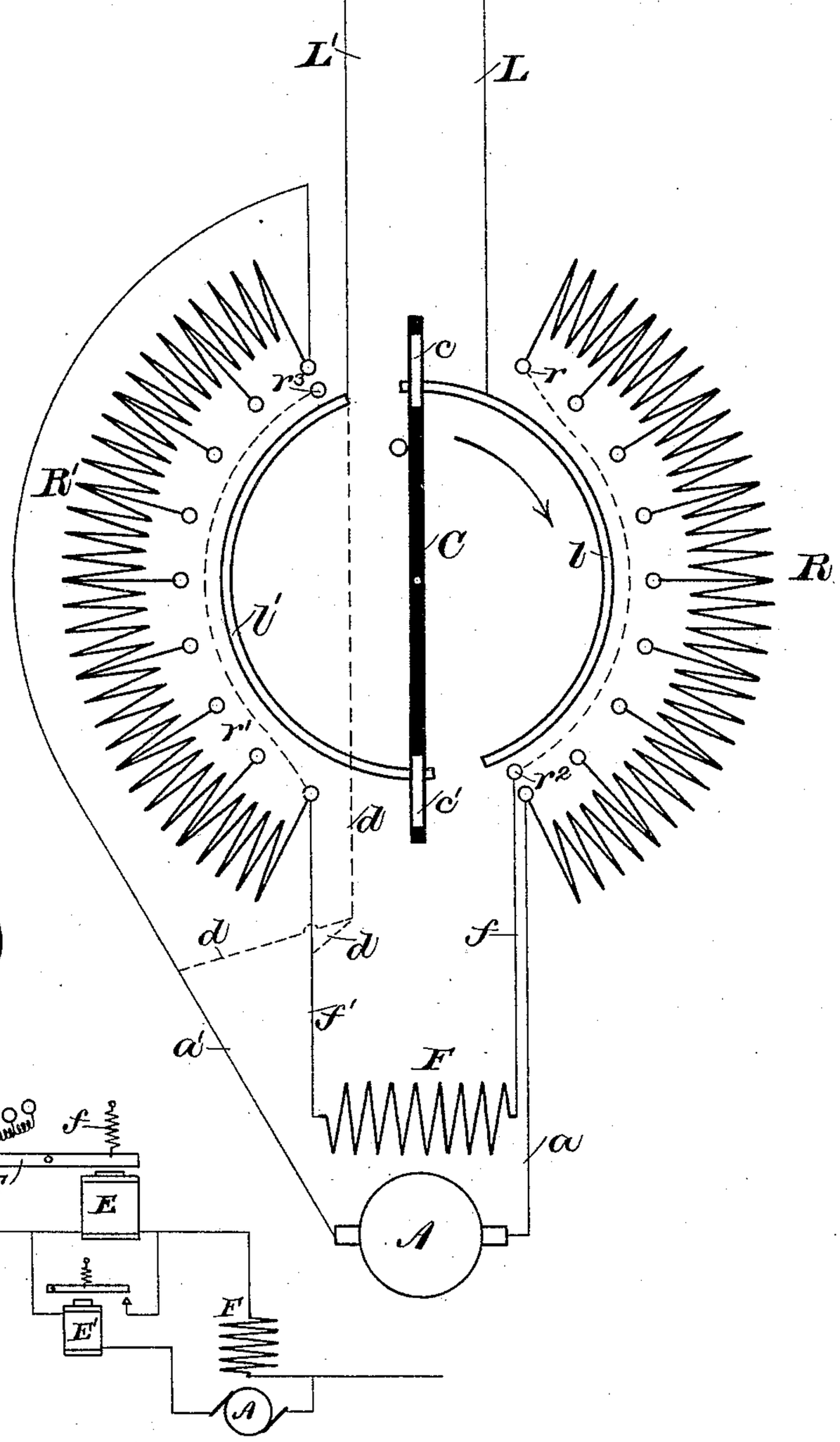


FIG_7_

WITNESSES:

A. Adline

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ATTYS.

UNITED STATES PATENT OFFICE.

JONATHAN P. B. FISKE, OF LYNN, MASSACHUSETTS, ASSIGNOR TO THE THOMSON-HOUSTON ELECTRIC COMPANY, OF CONNECTICUT.

ELECTRIC-MOTOR CONTROLLER.

SPECIFICATION forming part of Letters Patent No. 485,620, dated November 8, 1892.

Application filed February 5, 1892. Serial No. 420,388. (No model.)

To all whom it may concern:

Be it known that I, JONATHAN P. B. FISKE, a citizen of the United States, residing at Lynn, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Electric-Motor Controllers, of which the following is a specification.

This invention relates to controlling devices for electric motors and provides means for automatically restoring the switch-lever to its starting position on cessation or abnormal increase of such current, to means for providing a continuous, permanent, and reliable path for the field-magnet discharge, to means whereby the motor may be stopped from a distant point, and to other details hereinafter described and claimed.

In the accompanying drawings, Figure 1 is a diagram of a switch or starting and stopping rheostat embodying my improvements. Fig. 2 is a similar view of the starting-rheostat with the devices for automatic and distant control omitted. Figs. 3 and 4 show details, and Figs. 5, 6, and 7 show modifications.

In Fig. 2, C represents the controlling-lever of the rheostatic switch, here shown as a double-pole switch having two sets of movable and fixed contacts symmetrically arranged on opposite sides of the switch-center. The supply or line wires L L′ connect, respectively, to the two insulated movable contacts *c c′*, preferably through rubbing-contacts *l l′*. The movable contacts *c c′* also bear, respectively, on two series of insulated contacts *r r′*, which are connected together through two series of resistances R R′. The initial contacts of the two series of contacts *r r′* are connected together through field-magnet F of the motor and the final contacts are connected through the armature A.

In the position shown in Fig. 2 contact is broken between the switch-contacts *c c′* and resistance-contacts *r r′*, so that the line L L′ is cut off from the motor. On turning the switch-lever C in the direction of the arrow contact is made with the first of the contacts *r r′* and current flows from line L to line-contact *l*, movable contact *c*, resistance-contact *r*, and then divides, part going directly through wire *f*, field-magnet F, connection *f′*, contact *r*, and part going through all of the resistances R, connection *a*, armature A, connection *a′*, resistances R′ to contact *r′*, the combined currents then passing from contact *r′* to movable contact *c′*, line-contact *l′*, and line L′. The armature, which is just beginning to start and can oppose but little counter electro-motive force to the line-current, is protected from a dangerous rush of current by the resistance R R′, while the field-current, being unopposed by extra resistance, creates a strong field and a correspondingly-strong torque on the armature. The switch may then be advanced over the contacts *r r′* and at each step cuts an additional resistance on each side out of the armature-circuit and into the field-circuit. Thus the armature-current is strengthened and the field-current is weakened at the same time, and the speed of the motor is gradually increased. It will be seen that the same resistances serve to regulate both the armature and field-circuits. In some cases to prevent undue speeding of the motor when fully started final contacts r^2 r^3 may be provided, making connection with contacts *c c′* in their final position and connected so as to short-circuit (more or less) in the case shown all of the resistances from the field-magnet circuit. On turning back the switch-lever C it reverses the above-described operation, and finally breaks the connection with the line, leaving, however, a permanent and continuous path for the extra current from the field, the field-magnet, the armature, and resistances being connected in series in a permanently-closed circuit, which does not include any switch-contacts.

The same invention may be applied to a single-pole switch, the field-magnet and armature being at one end connected together and to the line by connections *d*. (Indicated in dotted lines.)

The other features of my invention are illustrated in Fig. 1, wherein E is an electro-magnet whose armature *e* controls a detent T, engaging with the controlling-lever C when in its final or "on" position, thereby holding it against the action of a spring *s*. This electro-magnet is in connection with the motor-circuit, preferably in the field-magnet branch.

When for any cause the current ceases in the line, the electro-magnet E releases its armature, which is then withdrawn by a suitable retractor from the controlling-lever. The spring *s* then throws said lever back over the series of resistances and brings it to its open position, so that when the current again passes the motor is in proper condition to receive it. In order to effect this release of the lever and the consequent stoppage of the motor from a distance, I provide switches *m*, connected to the circuit of the electro-magnet E, preferably in a shunt around the same, as indicated. This part of my invention may be carried out in many ways by providing a circuit energized in any suitable manner and including the magnet E and one or more switches or manual circuit-breakers *m*. The arrangement of the push-button or switch *m* in a shunt around the magnet E, so as not to interrupt the circuit including the magnet, is very desirable, especially when that circuit also includes the field-magnet circuit, as the push-button is then not subjected to the extra-current spark which would ensue on breaking the field-magnet circuit. Another advantage is that as the wires to the push-button do not have to carry the main field-current, but only to divert enough current to weaken magnet E, and being normally idle or open-circuited they are analogous to ordinary open push-button wires and may be carried to distant parts of the building with ordinary-sized wire without affecting the resistances of the field-magnet circuit or endangering the building through which they pass. This feature is also of importance as conducing to the permanence and reliability of the closed circuit for receiving the field-magnet discharge. It is also desirable that the motor-circuit should be interrupted whenever the machine is excessively overloaded. This I accomplish by a second electro-magnet or coil E′, acting reversely or differentially to magnet E and included directly in the motor-circuit, so that when the current in the armature exceeds the safe limit it neutralizes the effect of the shunt-current flowing through the coil E and the detent of the switch is released, allowing the switch-lever to be thrown to the open position. The magnet-coils E and E′ may be wound differentially on the same core, as shown in Fig. 5. The operation of this part of my invention simply requires two opposing coils controlling the switch, one coil being responsive to the armature-current by being included in the armature branch or a circuit including the same, as the main motor-circuit, and the other coil being, to a great extent at least, independent of the armature-current, as by being placed in a shunt across the mains or around the armature. Such a shunt in a shunt-wound motor is offered by the field-magnet branch, in which I prefer to place the coil E. It is not necessary that the magnet-coil E′ should act directly to neutralize the effect of the coil E. Thus it may act as a relay, as indicated in Fig. 7, to short-circuit coil E, and thus neutralize its effect and allow the switch to open when the current through coil E′ becomes excessive.

It is obvious that any of the above magnets, instead of acting directly upon the detent, may act through well-known relay devices, and the push-buttons *m*, instead of being directly in the circuit of the magnet E, may control the same through a relay-magnet V in circuit with the push-buttons and a suitable source of electricity, as indicated in Fig. 6. The push-buttons may be placed in multiple or in series, as shown in Figs. 1 and 6, respectively, according to the nature of the circuit.

Any form of detent and actuating devices for the switch-lever C may be used; but I prefer the construction shown in Figs. 1 and 4. The hub H of the switch-lever is hollow and contains the spiral spring *s*, whose two ends are free, but embrace between them when the switch is in the open position two pins *b′ h′*, fixed, respectively, to the base B (see Fig. 4) and the lever C. Thus when the switch is turned to cut out resistance pin *h′* engages with the end of the spring and carries it around, while pin *b′* holds back the other end. When the switch-lever is released and flies back under the influence of the spring, the pin *h′* finally engages with the other end of the spring *s*, while the pin *b′* again holds back the opposite end of the spring, and the lever is thus stopped in a yielding or elastic manner. The same spring thus serves as a retractor and a buffer.

The lever C carries a roller h^2, engaging with a roller f^2 on the reciprocating rod T, operated by and preferably attached to the armature *e* of the magnet E. The roller h^2 rolls on a guide G, fixed on the base B, and by the nut *n* the position of this roller may be adjusted, so as to determine to a nicety the force required to release the rollers from engagement. This force is determined by the direction of pressure between the rollers, the retractive effect of a spring-retractor *f′*, and the rolling friction between the parts h^2 f^2 and f^2 G. This rolling friction is much more determinate than the sliding and pivot frictions found in most detent devices, and the degree of diminution of the pull on the armature which will suffice to let off the switch is thereby made capable of accurate adjustment. Instead of using the retracting-spring *f′* the detent may be reversed in position, so as to cause it to release by gravity.

While in the form I have shown the switch-lever breaks the connection of the entire motor with the line, it will be understood that so far as regards the automatic operation the switch may be used to break the connections of the armature-circuit only.

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

1. The combination of an electric motor, a resistance, a permanently-closed continuous

circuit including in series said resistance and the field-magnet and armature of the motor, and a rheostatic switch having connections to said resistance and motor.

2. The combination, with an electric motor, of a set of resistances having one end connected to the armature and the other end to the field of the motor and a switch-contact connected to the supply-line and passing over contacts connected to different points of said set of resistances, so that the same set of resistances and contacts serves for regulation of both field and armature.

3. The combination, with an electric motor having its field-magnet and armature in derivation, of resistances and contacts connected to the field-magnet and resistances and contacts connected to the armature and contacts co-operating with the aforesaid contacts, connected to the supply-lines and connected mechanically together, so as to simultaneously and reversely vary the resistances in the field-magnet and armature-circuits.

4. The combination, with an electric motor, of two electro-responsive devices, each controlling its operative connection with the circuit and connected, respectively, in circuit with the armature of the motor and in a branch independent of the armature-circuit.

5. The combination, with an electric motor, of a circuit-breaker for the connections of its armature and electro-responsive controlling means for the circuit-breaker, connected to the motor-circuit and responsive both to abnormal increase and to abnormal diminution of current in the motor connections.

6. The combination, with an electric motor having its armature and field-magnet in derivation, of a circuit-breaker in the connections from the armature to the line, an electro-magnetic device in a shunt around the armature and maintaining the circuit-breaker closed, and an electro-magnetic device included in circuit with the armature and operating to neutralize or oppose the action of the other electro-magnetic device, substantially as set forth.

7. The combination, with an electric motor having its armature and field-magnet in derivation, of a circuit-breaker in the connections from the armature to the line and two electro-magnetic devices oppositely controlling such circuit-breaker and connected, respectively, in the field branch and in circuit with the armature.

8. The combination, with an electric motor having its armature and field-magnet in derivation, of a circuit-breaker in the connections from the armature to the line, an actuator and a detent for such circuit-breaker, an electro-magnet acting on such detent to hold the circuit-breaker closed and included in the field-magnet circuit, and another electro-magnet acting on such detent oppositely to the other electro-magnet and included in circuit with the armature.

9. The combination, with an electric motor, of a circuit-breaker controlling the connections thereof, an actuator and a detent for said circuit-breaker, a magnet controlling said detent, a circuit connected to said magnet and to a source of electric current, and one or more circuit-controllers in said circuit.

10. The combination, with an electric motor having its field-magnet and armature in derivation, of a circuit-breaker controlling the connections of the armature, an electro-magnet maintaining such switch closed and included in the field-magnet branch, and a shunt around said field-magnet, and one or more circuit-closers in such shunt.

11. The combination, with the pivoted switch-lever, the base, and the retractor, of the detent consisting of a roller on the lever, a reciprocating detent part and a roller carried thereby, and a guide on the base, engaging with the detent-roller.

12. The combination, with an electric motor, of a circuit for its armature connections, a coil in shunt to the armature-circuit for maintaining said switch in its operative position, and a coil in connection with the armature-circuit, acting to release said switch upon the existence of abnormal current therein.

In witness whereof I have hereunto set my hand this 3d day of February, 1892.

JONATHAN P. B. FISKE.

Witnesses:

JOHN W. GIBBONEY,

BENJAMIN B. HULL.