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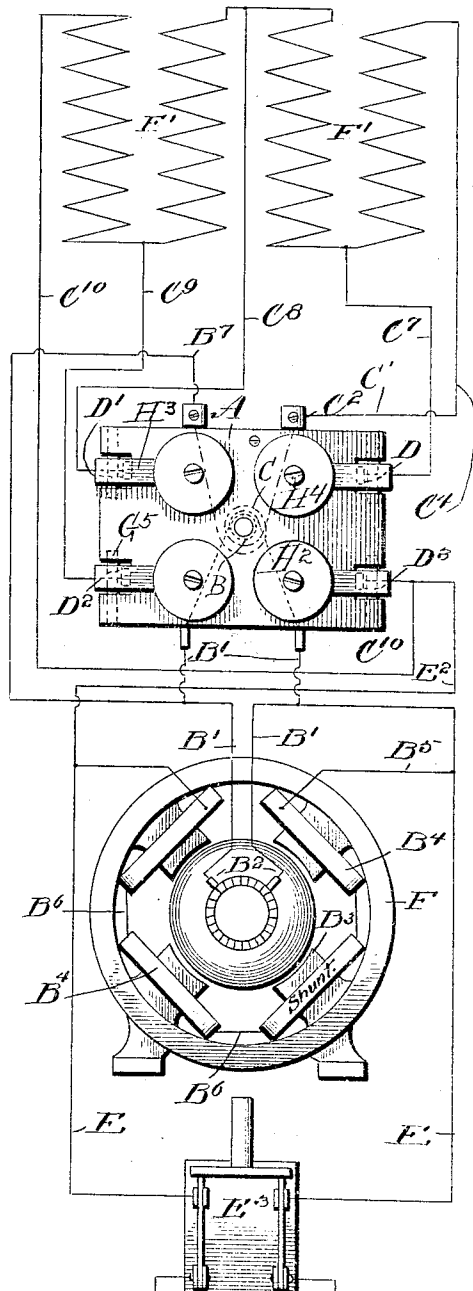
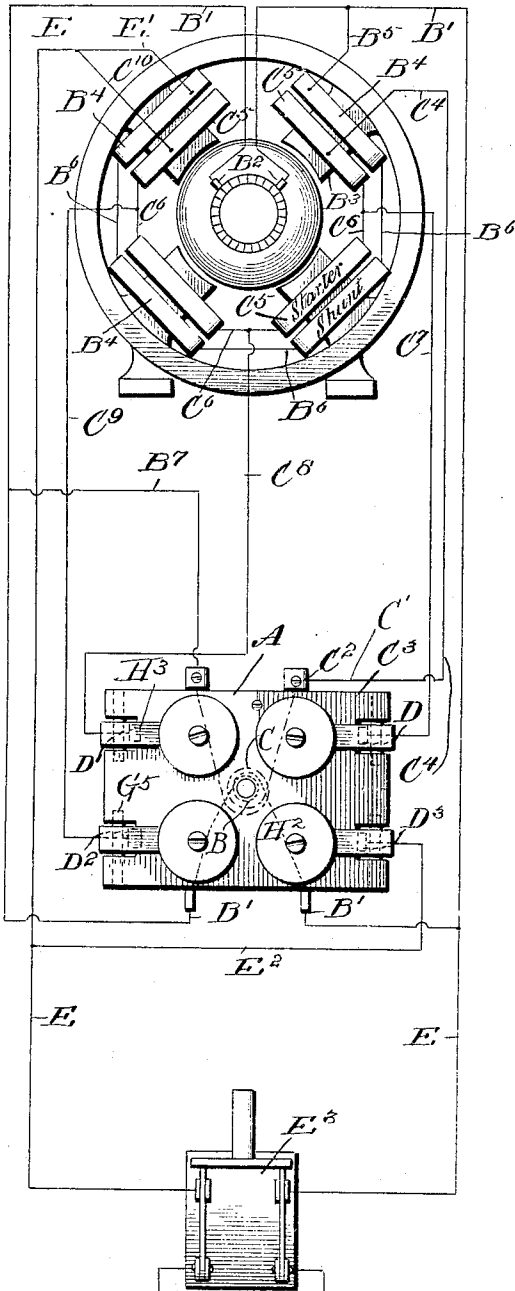
PATENTED AUG. 16, 1904.

E. LEVISON.
AUTOMATIC ELECTRICAL REGULATOR.

APPLICATION FILED, JAN. 18, 1904.

NO MODEL.

2 SHEETS—SHEET 1.



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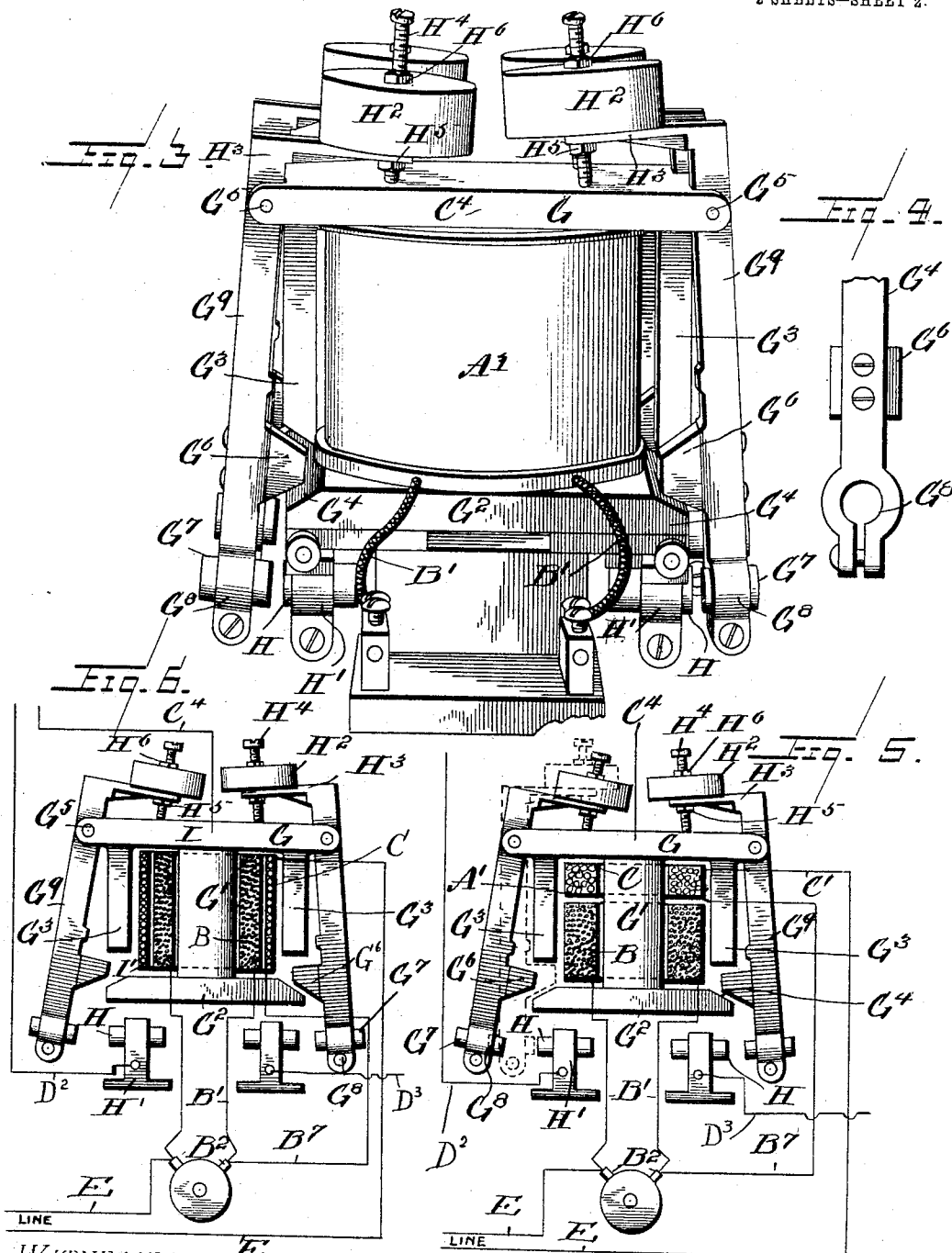
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WITNESSES:

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UNITED STATES PATENT OFFICE.

EMANUEL LEVISON, OF MANSFIELD, OHIO, ASSIGNOR TO THE PHOENIX ELECTRIC MANUFACTURING COMPANY, OF MANSFIELD, OHIO, A CORPORATION OF WEST VIRGINIA.

AUTOMATIC ELECTRICAL REGULATOR.

SPECIFICATION forming part of Letters Patent No. 767,703, dated August 16, 1904.

Application filed January 18, 1904. Serial No. 189,476. (No model.)

To all whom it may concern:

Be it known that I, EMANUEL LEVISON, a citizen of the United States, residing at Mansfield, in the county of Richland, State of Ohio, have invented certain new and useful Improvements in Automatic Electrical Regulators, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to an automatic electrical regulator, and particularly to means for cutting in or out electric circuits in starting a motor or generator.

The invention has for an object to provide a compound winding upon a magnet actuating a regulator having a shunt-coil in circuit with a motor and series coil in circuit with independent circuits or windings to be cut out and with a line-wire.

A further object of the invention is to provide an improved construction of the regulator or cut-out, whereby the compound winding thereon is adapted to actuate a series of armatures, so as to successively attract the same and establish a series of circuits.

Other and further objects and advantages will be hereinafter set forth and the novel features thereof specifically defined by the appended claims.

In the drawings, Figure 1 is a diagram showing a four-arm regulator with connection for cutting out coils in a self-starting motor. Fig. 2 is a similar view of a modified application of the invention for cutting out resistance on a plain shunt-motor. Fig. 3 is a perspective of the regulator or cut-out. Fig. 4 is a detail elevation of one of the armatures. Fig. 5 is a vertical section through the regulator, showing circuit connections; and Fig. 6 is a similar view showing a modified application of the compound winding.

Like letters of reference indicate like parts in the several figures of the drawings.

Referring to Fig. 1, letter A designates a cut-out or regulator which may be of any desired construction, but a preferred form thereof will be hereinafter described. This regu-

lator comprises an electromagnet A', having a compound winding comprising a shunt-coil B and a series coil C. This shunt-coil is connected by lines B' in the usual manner across the brushes B² of the motor. The shunt-coil is preferably formed of a large number of fine-wire windings, while the series coil is composed of a lesser number of heavier windings; but a number of small wires connected in parallel with one another, making an equivalent sectional area and connected in series with the armature-winding of the motor or other circuits to be cut out, would produce the same result as the series coil.

Referring to Fig. 1, it will be seen that the shunt-windings B¹ upon the poles B³ of the motor there shown are connected with one side of the shunt-line B' by a line B⁵ and in series with each other by connections B⁶, while the opposite shunt-line B' is connected with the regulator by a line B⁷. The series coil C is connected with the line-wires by a line C' and with the shunt-line by the line B⁷. In Figs. 1 and 2 this connection C' is shown as extending from a terminal post C² on the head-plate C³ of the magnet and by line C⁴ to the first of the series on starter-coils C⁵, carried by the armature of the motor, which are adapted to be cut out one by one. These coils are connected together by lines C⁶, and branch lines C⁷, C⁸, and C⁹ extend therefrom to the contact-posts D, D', and D² respectively. The circuit from the last starter-coil C⁵ is carried by a line C¹⁰ into the line-wire E, which is also connected by branch line E' with the last of the shunt-coils B⁴ on the motor. A line E² extends from the line-wire E to the contact-post D³. The service-line wires E extend thence through a suitable switch E³. In this arrangement as the switch is closed the current enters the armature of the motor, and as the difference of the potential is very low at the brushes or the point of connection of the shunt-winding of the regulator the latter takes very little current; but as the motor starts to rotate and generates a counter electromotive force the difference of potential increases at the brushes

and energizes the magnet in the regulator, so the armatures thereto are successively attracted according to the acceleration of speed. As each armature is attracted it makes connection 5 which controls a coil, as shown in Fig. 1, or a resistance, as shown in Fig. 2, as the motor speeds up. The series coil on the regulator-magnet is not energized to its full strength immediately upon closure of the circuit because of inductive reactions in the motor, and 10 so does not greatly affect the action of said magnet when the motor is started under light loads; but if the load upon the motor is heavy and the motor does not start immediately upon 15 the closure of the main switch on account of insufficiency of current the inductive reactions in the motor are not continued for any length of time and the series coil on the regulator-magnet becomes strong enough to pull in the 20 armatures one by one until sufficient current is admitted to the motor to cause it to start, and from this time on the action is as above described for light loads.

The same general arrangement of parts and 25 circuits are shown in Fig. 2 as have been described in connection with Fig. 1, with the exception that the motor F there shown is shunt-wound and has no starting-coils thereon, while instead of the latter a series of resistances F' 30 are provided and connected to the regulator, as described in connection with a series of starting-coils in Fig. 1.

The preferred form of the regulator or cut-out shown in Figs. 3, 5, and 6 comprises the 35 compound winding B and C, forming the magnet A', surrounding a core G', which is mounted upon a base G² and provided with a head G³. Depending from this head are a series of poles or arms G³, while at the opposite ends of the 40 base pole-faces G⁴ are provided. The head G may be formed of conducting material and is adapted to convey a current from the line C⁴ to the terminal C² of the series coil C and also to convey current through the series of armatures G⁹, which are pivotally mounted at the 45 sides of the head, as shown at G⁵, and provided with blocks or faces G⁶, adapted to be attracted toward the magnet-poles G³ and G⁴ when the coils are energized. The lower ends 50 of the armatures are provided with a contact-point G⁷, held in any desired manner—for instance, by means of the split clamp G⁸. This contact-point G⁷ on each armature is adapted to coöperate with a contact H, carried 55 by a post or clamp H', one of which is in circuit with each of the lines D, D', D², and D³, so that when the armature is attracted toward the magnet and contact made circuit will be established through these lines. For the purpose 60 of successively attracting these armatures relative to the increasing strength of the magnet they are disposed at different distances from the pole-face of the magnet, so that air-gaps of different lengths will be pro-

vided and the armatures adapted to respond 65 to different strengths of the actuating-magnet. For the purpose of restoring these armatures or retracting them from the magnet any desired means may be used. For instance, weights H² may be disposed upon the 70 inwardly-extending arms H³ of the armatures and the travel thereof determined by an adjusting-screw H⁴, held in position by lock-nuts H⁵ and H⁶.

In the modified form of the regulator shown 75 in Fig. 6 the parts are similar in construction to those described, with the exception that the shunt-winding I, of small wire, directly surrounds the core G', while the series winding I', of larger wire, extends circumferentially of the shunt-coil. In the present illustration of the regulator four armatures have 80 been shown; but it will be apparent that the number thereof may be varied in accordance with the number of circuits to be controlled 85 thereby.

The operation of the several parts of the invention will be clearly understood from the foregoing description, and it is only necessary to state that the action of the cut-out is 90 to cut out or make any desired electrical connection in a resistance-bank, the coils of a motor, or the circuits of the motor by which its speed is controlled. As the line-switch is closed the current from the service-line passes 95 through the motor; but owing to the difference of potential, which is very low at the brushes or point of connection of the shunt-winding for the regulator, the latter takes very little current. As the armature of the 100 motor starts to rotate it generates a counter electromotive force and the difference of potential at the brushes increases, so as to energize the magnet in the cut-out, which attracts its armatures in succession, according 105 to the acceleration of the speed of the motor. As each armature is attracted successively it establishes circuit by its contact, which thereby controls a resistance or coil and the motor thus increases in speed. The armatures are 110 set at different distances relative to the pole piece or pieces of the magnet, and each act accordingly as the air-gap is long or short and relative to the strength of the magnet. This produces an even starting of the motor 115 and protects same against careless handling, while the motor is sure to start regardless of the load and will carry heavy overloads with comparatively low voltage. It has been proven in tests to start four hundred and five 120 hundred per cent. overloads on normal voltage of the motor, bringing same up to speed by cutting in at successive steps. It has also been found that seventy-five per cent. overload may be started on voltage twenty-five 125 per cent. below normal. The compound winding controls the load as the latter is placed on the motor, and the series coil strengthens

the magnet as the load is placed on; so as to attract the armatures and cut out the desired circuits, thus preventing an overload on the motor by which the shunt-coil could not secure current owing to the failure of the armature of the motor to rotate, and thereby give the necessary counter electromotive force at the brushes to excite the shunt-coil for the purpose of cutting out the resistance or circuits.

The invention contemplates the cutting out not only of resistance-coils, but also any desired circuits or field-coils in the motor.

It will be obvious that changes may be made in the details of construction and configuration without departing from the spirit of the invention as defined by the appended claims.

Having described my invention and set forth its merits, what I desire to claim and secure by Letters Patent is—

1. A compound-wound regulator-magnet having a coil in shunt to a motor-armature and a coil in series with said armature and with a series of resistances, and a plurality of magnet-armatures controlling said resistances.

2. The combination with a motor having shunt-coils and series starter-coils thereon, of a regulator-magnet having a coil in shunt to the armature of the motor, and a series coil in circuit with the series starter-coils of the motor.

3. The combination with a motor having shunt-coils and series starter-coils thereon, of a regulator-magnet having a coil in shunt to the armature of the motor and a series coil in circuit with the series starter-coils of the motor, and means controlled by said magnet for controlling each of said starter-coils.

4. The combination with a motor, of a series circuit comprising a plurality of parts to control the starting thereof, a regulator-magnet having a coil in shunt to said motor and series coil in circuit with said starting-circuit, and means controlled by said magnet for independently controlling each part of the series starter-circuit.

5. A regulator-magnet comprising a core having a shunt-coil thereon, an independent series coil coöperating with the shunt-coil, a plurality of armatures carried by one pole of said magnet, and a plurality of pole-faces to attract said armatures.

6. A regulator-magnet having a compound winding, a head-plate carried by the pole of said magnet, a plurality of armatures pivoted to said plate, and a circuit-contact carried by each of said armatures.

7. A regulator-magnet having a compound winding, a head-plate carried by the pole of said magnet, a plurality of armatures pivoted to said plate, a circuit-contact carried by each of said armatures, and a pole-piece carried by the magnet from which the armatures are at different distances.

8. A regulator-magnet having a compound winding, a head-plate carried by the pole of said magnet, a plurality of armatures pivoted to said plate, a circuit-contact carried by each of said armatures, a pole-piece carried by the magnet from which the armatures are at different distances, and means carried by the armatures for adjusting the same relative to the magnet-poles.

9. A regulator-magnet having a compound winding, a head-plate carried by the pole of said magnet, a plurality of armatures pivoted to said plate, a circuit-contact carried by each of said armatures, a pole-piece carried by the magnet from which the armatures are at different distances, means carried by the armatures for adjusting the same relative to the magnet-poles, and means for restoring said armatures to their position away from said poles.

10. A regulator-magnet having a compound winding, a head-plate carried by the pole of said magnet, a plurality of armatures pivoted to said plate, a circuit-contact carried by each of said armatures, a pole-piece carried by the magnet from which the armatures are at different distances, means carried by the armatures for adjusting the same relative to the magnet-poles, means for restoring said armatures to their positions away from said poles, a resistance to be controlled by said armatures, and posts connected to points in said resistance to be controlled and adapted to contact with the armatures when the latter are attracted by the magnet.

11. A regulator-magnet having a compound shunt and series winding about its core, a head-plate carried by said core and having depending pole-pieces therefrom, a base carried by the core and provided with pole-pieces at opposite sides, armatures pivotally mounted upon said head-plate and provided with blocks opposite said pole-pieces, and circuit-contacts carried by said armatures.

12. A regulator-magnet having a compound shunt and series winding about its core, a head-plate carried by said core and having depending pole-pieces therefrom, a base carried by the core and provided with pole-pieces at opposite sides, armatures pivotally mounted upon said head-plate and provided with blocks opposite said pole-pieces, circuit-contacts carried by said armatures, arms carried by the upper ends of said armatures and extending above the head-plate, and adjusting-screws mounted in said arms to vary the distance of the armatures from the pole-pieces.

13. A regulator-magnet having a compound shunt and series winding about its core, a head-plate carried by said core and having depending pole-pieces therefrom, a base carried by the core and provided with pole-pieces at opposite sides, armatures pivotally mounted upon said head-plate and provided with blocks

opposite said pole-pieces, circuit-contacts carried by said armatures, arms carried by the upper ends of said armatures and extending above the head-plate, adjusting-screws mounted in said arms to vary the distance of the armatures from the pole-pieces, and restoring-weights carried by said armature-arms.

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

EMANUEL LEVISON.

Witnesses:

HOYT FORD,
JACOB R. RYDER.