(No Model.)

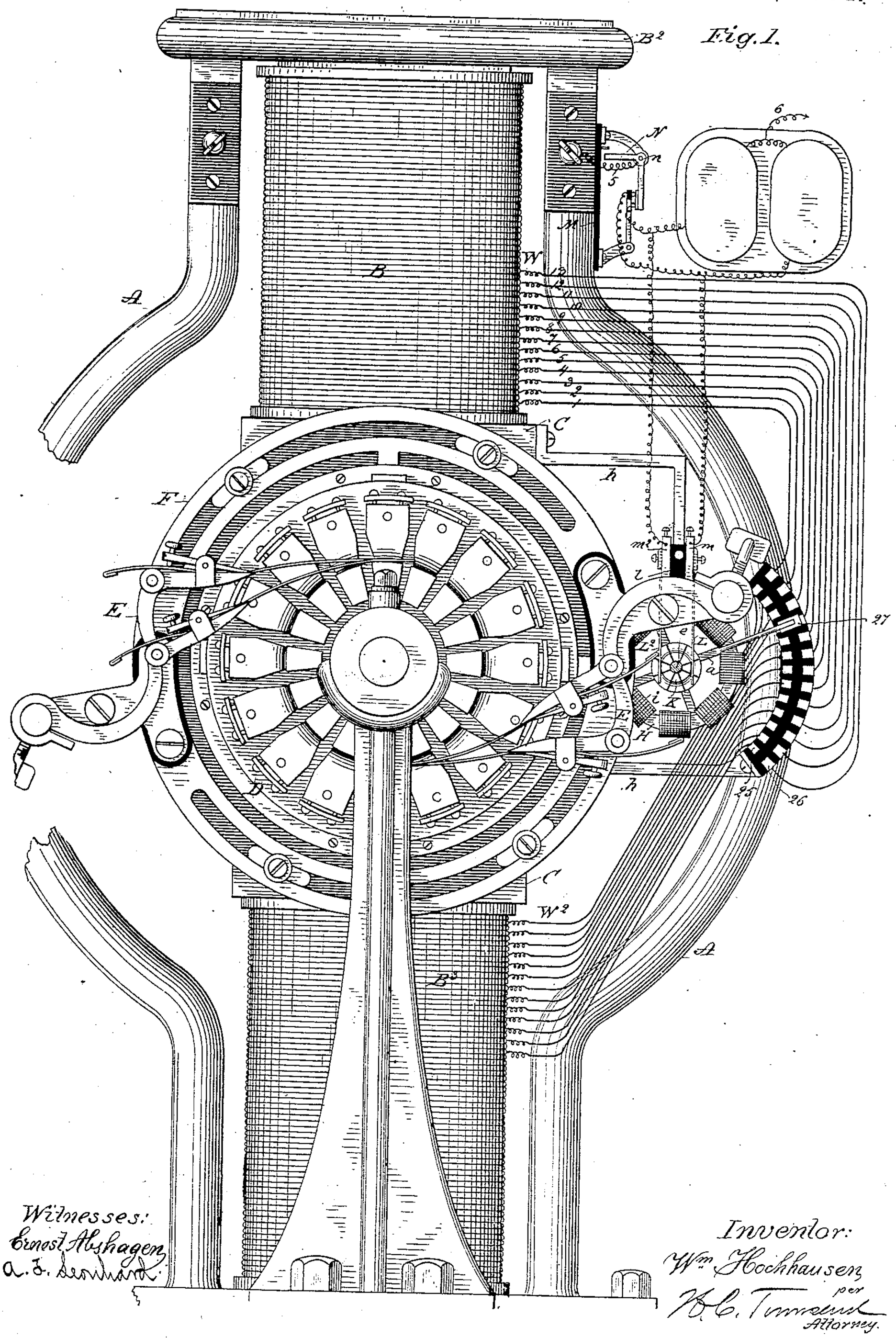
2 Sheets—Sheet 1.

W. HOCHHAUSEN.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 294,039. Patented Feb. 26, 1884.

Fig. 1.



Witnesses:
Ernest Abshagen
A. J. Leonhard.

Inventor:
Wm. Hochhausen
per
H. C. Townsend
Attorney.

(No Model.)

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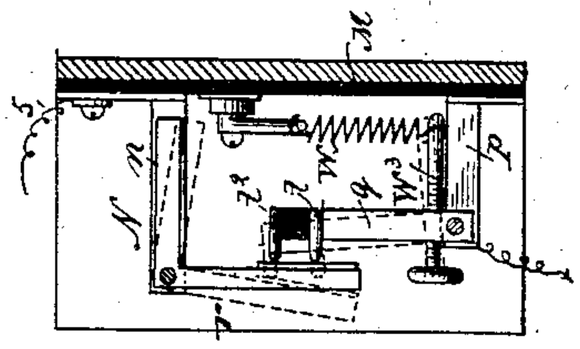

Fig. 5.

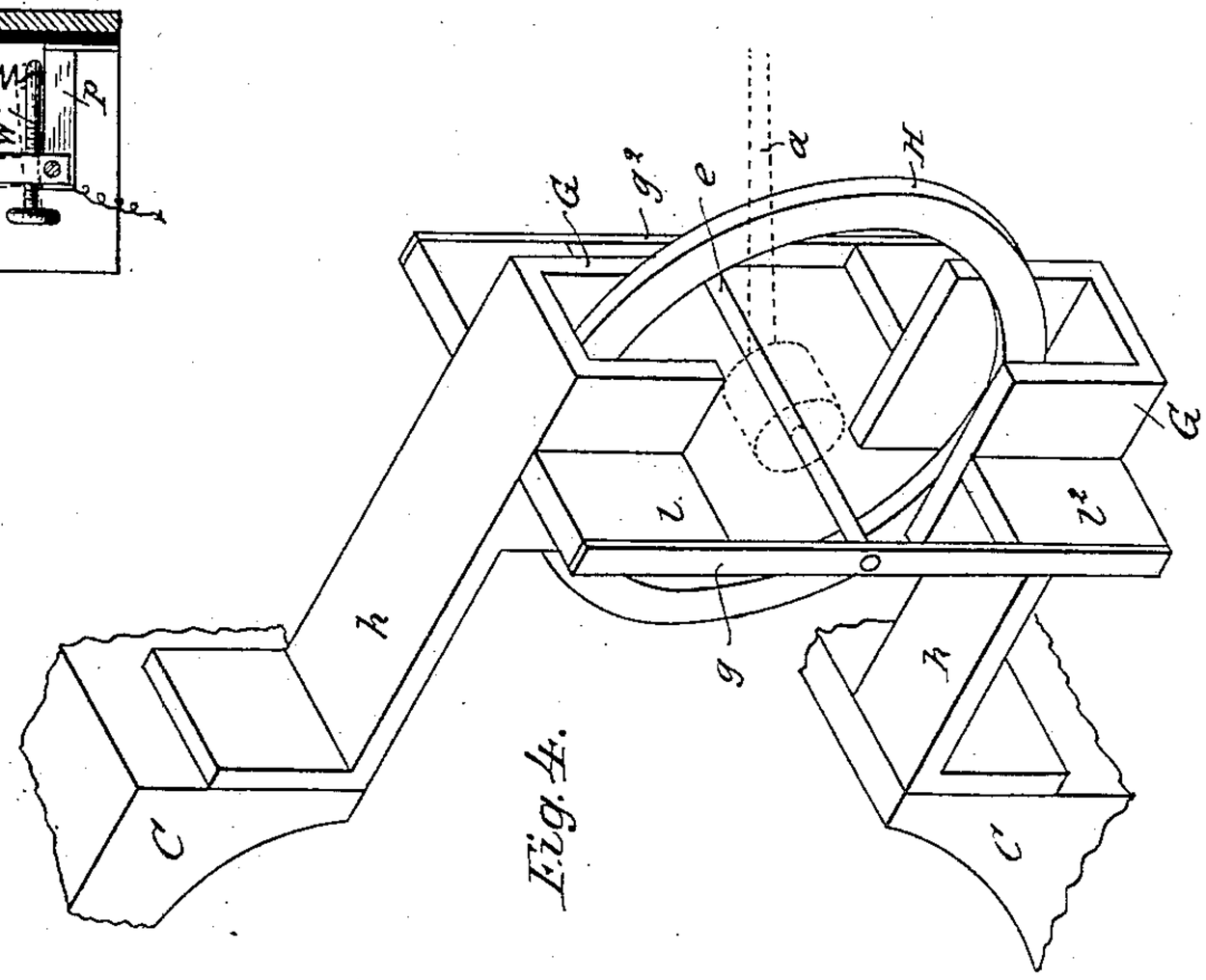

Fig. 4.

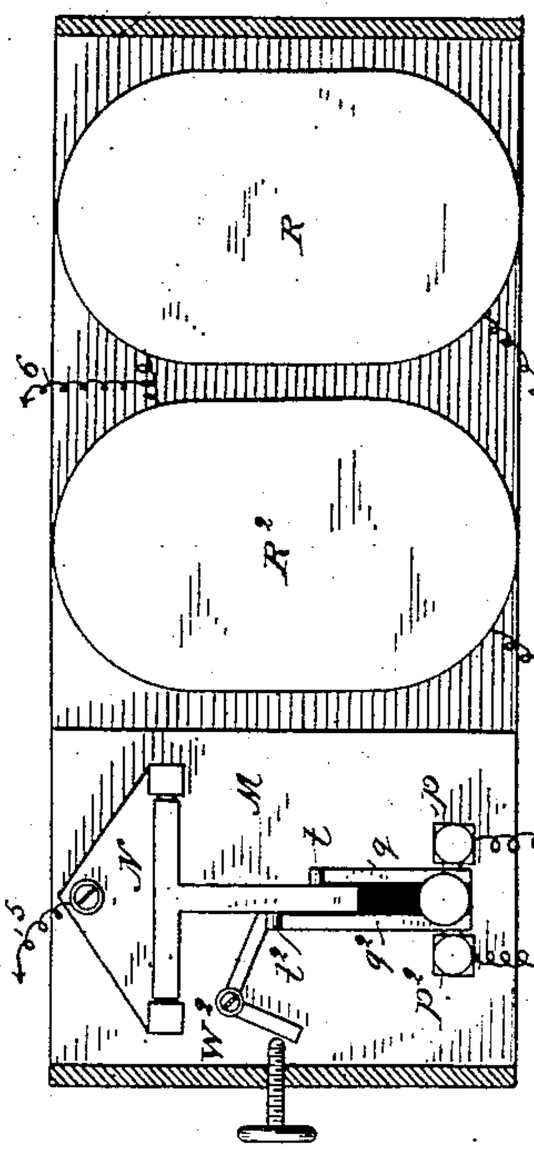

Fig. 3.

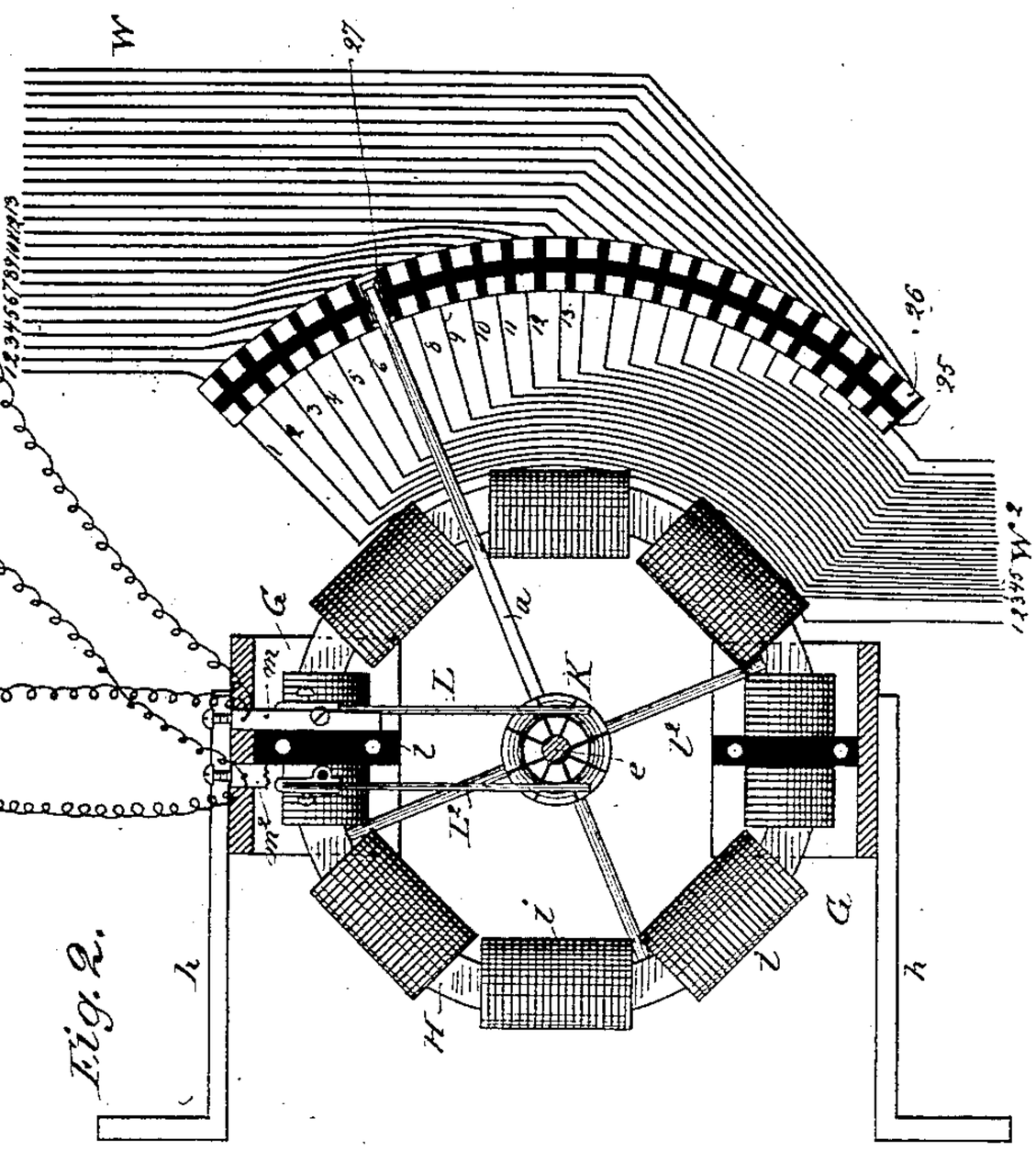

Fig. 2.

WITNESSES:

Ernest Abshagen

Albert G. Leonhard.

INVENTOR

Wm. Hochhausen

BY H. C. Townsend

ATTORNEY

UNITED STATES PATENT OFFICE.

WILLIAM HOCHHAUSEN, OF NEW YORK, N. Y.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 294,039, dated February 26, 1884.

Application filed March 22, 1883. (No model.)

To all whom it may concern:

Be it known that I, WM. HOCHHAUSEN, a citizen of the United States, and a resident of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Regulators for Dynamo-Electric Machines, of which the following is a specification.

The object of my invention is to automatically vary the electro-motive force of the current generated by a dynamo-electric machine in accordance with variations in the resistance of the working-circuit, so as to preserve a constant or uniform strength or volume of current. It is well known that the electro-motive force of the currents generated by a dynamo-machine varies with the strength of the magnetic field through which the armature moves. I take advantage of this well-known fact in carrying out my invention, and for the purposes thereof I propose to automatically vary the number of coils of the field-magnet through which an exciting-current is permitted to flow, said automatic variations being brought about by suitable circuit-closing devices that are under the control of an electric motor worked, preferably, by a current from the machine, said motor being reversed by the action of devices operated by an armature, which is arranged to be attracted by an electro-magnet excited by the current produced by the machine.

In the accompanying drawings, Figure 1 is an elevation of a machine showing my invention applied thereto. Fig. 2 is a side view of the electric-motor armature and its attachments, the fixed pole-pieces being removed. Fig. 3 is a face view of the circuit-controller, by which the motor is reversed. Fig. 4 is a perspective view, showing the manner in which the motor and its fixed pole-pieces may be attached to and supported by the pole-pieces of the dynamo-electric machine. Fig. 5 is a side view of the circuit-controller.

Referring to Fig. 1, B B^3 indicate the field-magnets of a dynamo-electric machine, and A the connecting iron pieces for said magnets. C C indicate the pole-pieces, having the usual curved extensions, between which the armature of the machine rotates, and D a disk, upon which the commutator-segments are mounted, as described in my prior patent, No. 261,712. F is the ordinary circumferentially-adjustable ring or support for the commutator-brushes E E. From the upper field-magnet coils, B, run a series of independent wires or loop-connections, (indicated at W,) each of said wires leading from a separate convolution or set of convolutions of the magnet-coils, in a well-known manner, so that if, for instance, the circuit be closed through wire 1, all of the coils will be in circuit, while if it be closed through wire 2, a less number of coils will be in circuit, and so on up to the last wire, 13, when the number of coils will be decreased by the number included between the point at which 1 is connected and the point at which 13 is connected.

In practice the number of convolutions on A included between any two wires W may be of any desired number; but it is preferable to make the number small, in order to make the changes of magnetism in B gradual. It would be even possible to take the wires W from the convolutions in outside layer of wire in succession, so that the number of turns of wire included between 1 and 13 would be thirteen, and the changes in the number of coils carrying an energizing-current would be small and gradual. A similar set of wires, W^2, lead from the coils B^3 and terminate in a series of suitably supported and insulated contacts, 25, while the wires W terminate in a similar series, parallel to the first, and indicated at 26. The corresponding wires of the two series may be successively united by a contact spring or plate, 27, which rides over them, and is actuated automatically by any suitable means, governed in its movement by fluctuations in the current generated by the dynamo-machine. The width of the spring 27 is sufficient to allow the spring to make connection with one pair of contacts before breaking with the adjoining pair.

The circuit of the field-magnet coils is through the circuit-controller just described, which serves to unite the coils of one magnet to those of the other. As will be readily perceived, when wires 1 are united the number of field-magnet coils in circuit would be at the maximum, and the number would gradually decrease as the circuit-closer 27 moved from

one end to the other of the two series of contacts, with corresponding decrease in the strength of the field-magnet with the same strength of current. Contact 27 is carried by an arm, *a*, mounted on the shaft of a suitable actuating device, controlled automatically by variations in the current strength, due to changes of resistances, or is operated in any other suitable manner automatically and correspondingly with the changes in the working-resistance. In the present application I have shown how an electric motor may be employed for this purpose; but I do not, however, limit myself to any particular construction or form of this part of the apparatus, as my invention consists in the general combination of suitable agencies working together to automatically control the number of coils of the field-magnet through which a current shall pass in accordance with changes of working-resistance, and consequent changes in amount of current.

The construction of the electric motor and a means whereby said motor may be automatically reversed to move the spring 27 backward or forward, or may be kept at rest, are shown more in detail in Figs. 2, 3, 4, and 5.

G G indicate fixed poles of iron, between which the armature of the motor rotates. The poles G G are grooved, as shown, and are attached by means of brackets *h h*, Figs. 1 and 4, to the upper and lower poles of the field-magnet of the machine.

H is a ring-armature of the motor, carrying coils of wire *i*, which are connected to one another in endless series, and are provided with connections taken from points between the successive coils to the segments of a commutator, K, after the manner employed in the Pacinotti or Gramme machine.

L L^2 indicate the commutator-brushes of the motor, which are of the usual construction, and are mounted on opposite sides of a block, *l*, of insulating material, which is supported by a pole-piece, G. A brace, *g*, preferably of non-magnetic material, and a similar brace, g^2, also of non-magnetic material, and uniting the pole-pieces G G, serve as supports for the armature-shaft *e* of the motor. Connection is made with the electric motor through the conducting-blocks *m* m^2, from which the brushes L L^2 are respectively supported.

The means for reversing the direction of rotation of the motor are in this case electrical, and consist of an arrangement of circuits and circuit-controller, whereby the direction of the current through the motor is reversed. The devices whereby this is accomplished are shown in Figs. 1, 3, and 5. M indicates a block, preferably of insulating material, upon which the parts are supported, and which is attached to the frame of the machine, as shown in Fig. 1, at a point below the upper head of magnet B. Supported in brackets *n* is an armature, N, which is free to swing upward in a vertical plane under the influence of the magnetic attraction exerted by the top plate, B^2. An arm, *r*, attached to said armature, swings with it and in a horizontal line, and acts as a circuit-closer to complete the circuit between the wire 5, connected to the supports *n*, and one or both of two circuit-closing points, *t* t^2, which are formed on the ends of conducting-bars *q* q^2, connected by an insulating-block, as shown, and forming together a lever pivoted in conducting-supports *p* p^2, also insulated from one another, and in electrical connection, respectively, through the bars with the points *t* t^2. A spring, *w*, constitutes the retractor for the armature and compound contact-lever *q* q^2, one end of said spring being attached to a lever, w^2, for adjusting its tension, and the other end to a screw, w^3, passing through the compound lever, and adjustable out and in to vary the distance of the end of the spring from the fulcrum of lever *q* q^2, and thus vary the action of the spring in its function of retracting the parts.

The circuits and connections are as follows: Contact *t* is connected through *q*, *p*, and *m*, with motor-brush L, and contact t^2 similarly with brush L^2. The brushes L L^2 are each connected with a wire, 6, through artificial resistances R R^2, respectively, so that the motor is virtually in a bridge between two branch wires, one of which, starting from lever *r*, would include *t*, *q*, *p*, and R, while the other would include t^2, q^2, p^2, and R^2. The amount of the resistances R R^2 is determined by the resistance of the motor, and is to be sufficient to cause a proper amount of current to be diverted through said motor for operating the same. Wires 5 and 6 are connected in the circuits of the machine in any proper way, so that current generated by the same will pass through the circuit-controller and the artificial resistances R R^2.

The operation would be as follows: Normally—that is, when the machine is generating a current of proper strength adapted to the amount of working-resistance—the armature N (the retractor being suitably adjusted with this end in view) will be attracted with sufficient force to hold the circuit-closing arm *r* in vertical position, or against both contacts *t* t^2, so that the current passing through the parts will pass through both branches, including the equal resistances R R^2, and no current will pass through the motor, it being in a bridge-wire whose terminals are connected to the branches at points of equal potential. Said motor and circuit-controller 27 will therefore be at rest. If, however, the resistance in the main circuit of the machine should decrease, thus increasing the volume of current, and requiring a corresponding decrease in the strength of the field-magnet, so as to bring the current generated down to normal, the armature N will be drawn up, owing to the increased attraction of the field-magnet, thus causing *r* to rock on the compound contact-lever, and breaking the circuit through t^2, while

retaining that through *t*. The current will then pass to point *m*, where it will divide, a portion passing the resistance R to 6, another portion being diverted through L, the motor L^2, and resistance R^2 to 6, thus causing the motor to revolve in a proper direction to shift the brush 27, so as to reduce the number of field-magnet coils through which the energizing-current may flow, and correspondingly decreasing the strength of the magnetic field in which the armature revolves. This movement of the spring 27, and the attendant disconnection or cutting out of field-magnet coils, will continue until the current generated resumes its normal strength, when the armature N will resume its normal position, so that both contacts t t^2 will be closed, and the motor will come to rest, the current ceasing to flow through the same. The amount of current diverted through the motor in this instance will of course depend upon the resistance of R. If R and R^2 be made each equal in resistance to the motor, one-third of the current would go through the motor, the resistance of the motor and R^2 being twice that of R. If, now, the resistance on the main circuit should increase, thus weakening the magnetism by which N is held up against the stress of spring *w*, and require an increase in the strength of the field-magnet, the upper end of the compound circuit-closer would be drawn outward by the spring *w*, causing *r* to rock on the same, and to break contact with *t*, while preserving contact with t^2. The current will then flow to m^2 instead of *m*, as in the second case, and will at that point divide, a portion passing through the motor (but in a reverse direction) to L, resistance R and 6, and another portion through R^2 to 6. The motor will thus be caused to rotate in an opposite direction, and to move the circuit-closing spring 27 backward until the current resumes its normal strength and the armature is attracted with the normal force required to hold *r* in contact with both *t* and t^2, at which point the adjustment will cease, because the motor will come to rest.

Any other desired form of electric motor may be used, and any proper means for reversing the same may be employed. The devices for this purpose herein described are claimed by me in another application for patent, and are therefore, so far as this application is concerned, disclaimed.

If an electric motor be used for working the circuit-closer 27, or its equivalent, it may be energized by a current derived from any desired source.

The circuit closing or controlling devices for governing the number of coils that shall be in circuit, or that shall carry an energizing-current, may be infinitely varied without departing from the spirit of my invention. Their number might be increased or diminished above or below the number herein shown, and the length of wire on the field-magnet coils between any two loop-connections may be as desired. It is generally preferable, however, to make the length small, so that the changes of magnetism attendant upon the movement of the circuit-closing devices may be very gradual. The field-magnets may be placed in either a direct or a derived circuit without departing from the invention, and the governing-armature N may be attracted by a magnet placed in any proper connection with the main circuit, so that fluctuations of current on the latter, due to variations of resistance or other cause, will be attended by variations in the strength of said magnet.

It is obvious that my invention is not limited to the employment of electro-magnets, and the magnetizing effects of the current for giving motion to the controlling devices that shall respond to the fluctuations; and I might employ the current in other ways, so as to give movement to the reversing appliances for the motor, or to other controlling mechanism.

I am aware that it is not new to shift the circuit-closing arm for the field-magnet coils by means of two electric motors; but in such case no reversing appliances are used with either motor, and the function of each is confined to moving the arm in one direction only, the required motion of the arm in one direction or the other being obtained by energizing one or the other of said motors according to the direction in which it is desired to move the arm.

What I claim as my invention is—

1. The combination, with a series of loop-connections from the field-coils in a dynamo-electric machine, of a circuit closer and breaker, a motor operating the same, and automatic reversing devices for causing said motor to move in one direction or the other, so as to vary the number of field-coils through which the exciting-current shall flow.

2. The combination, with the field-magnet coils in a dynamo-electric machine, of a circuit-closer and loop-connections from the coils, whereby an exciting-current may be caused to flow through a greater or less number of said coils, an electric motor for operating said circuit-closer, and means for automatically reversing said motor in accordance with a rise or fall of the current generated by the machine.

3. The combination, with the field-magnet coils, of a circuit-closer and connections, whereby a greater or less number of said coils may be included in circuit, a rotary electric motor for operating said circuit-closer, and devices whereby the direction of the current through said motor may be automatically reversed in accordance with variations in the working-resistance.

4. The combination, with the field-magnet coils, of a circuit-closer and connections, whereby a greater or less number of coils may be included in the circuit, an actuating electric motor for said circuit-closer in a bridge-

wire between two branches, each including a resistance, and a circuit-closer for admitting the current to one or the other branch singly, or to both together.

5. The combination, with the rotary electric motor, of the contact-arm secured to the armature-shaft thereof, and means for automatically reversing said motor as the main-current strength rises or falls above or below normal.

6. The combination, with the two field-magnets, of the two intermediate series of insulated contacts forming the terminals of loops from the magnet-coils, and a circuit-closer for connecting said insulated contacts in succession, as described.

Signed at New York, in the county of New York and State of New York, this 16th day of March, A. D. 1883.

WILLIAM HOCHHAUSEN.

Witnesses:
THOS. TOOMEY,
GEO. C. COFFIN.

Correction in Letters Patent No. 294,039.

It is hereby certified that Letters Patent No. 294,039, granted February 26, 1884, upon the application of William Hochhausen, of New York, New York, for an improvement in "Regulators for Dynamo-Electric Machines," should have contained the following clause, setting forth certain foreign patents which had been obtained by the said William Hochhausen, viz: "Subject to the limitation prescribed by section 4887 of the Revised Statutes, by reason of English patent No. 2,058, dated April 23, 1883; French patent No. 155,988, dated June 12, 1883; and Canadian patent No. 17,408, dated July 26, 1883."

It is further certified that the United States Letters Patent No. 294,039 should be read with this clause inserted in the grant thereof, thereby limiting its term, and to make it conform to the files and records pertaining to the case in the Patent Office.

Signed, countersigned, and sealed this 25th day of March, A. D. 1884.

[SEAL.]

M. L. JOSLYN,
Acting Secretary of the Interior.

Countersigned:

BENJ. BUTTERWORTH,
Commissioner of Patents.