(No Model.)

2 Sheets—Sheet 1.

# W. HOCHHAUSEN.

## REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 294,040. Patented Feb. 26, 1884.

*Fig. 1.*

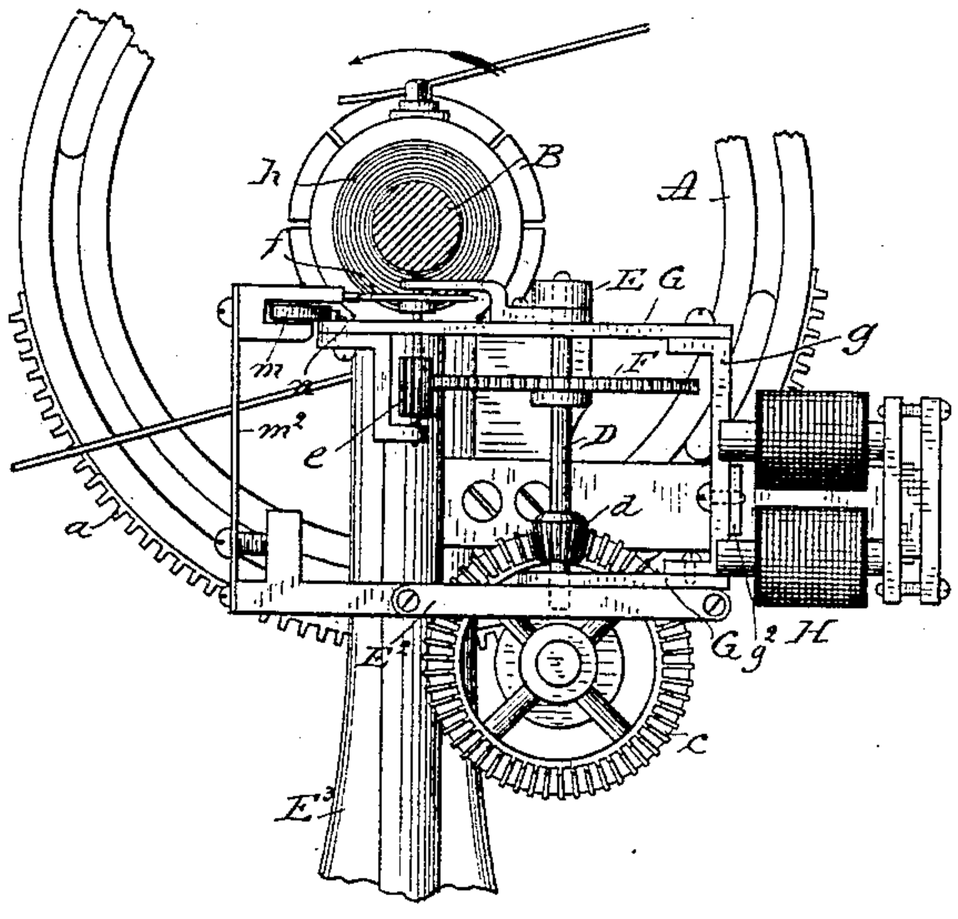
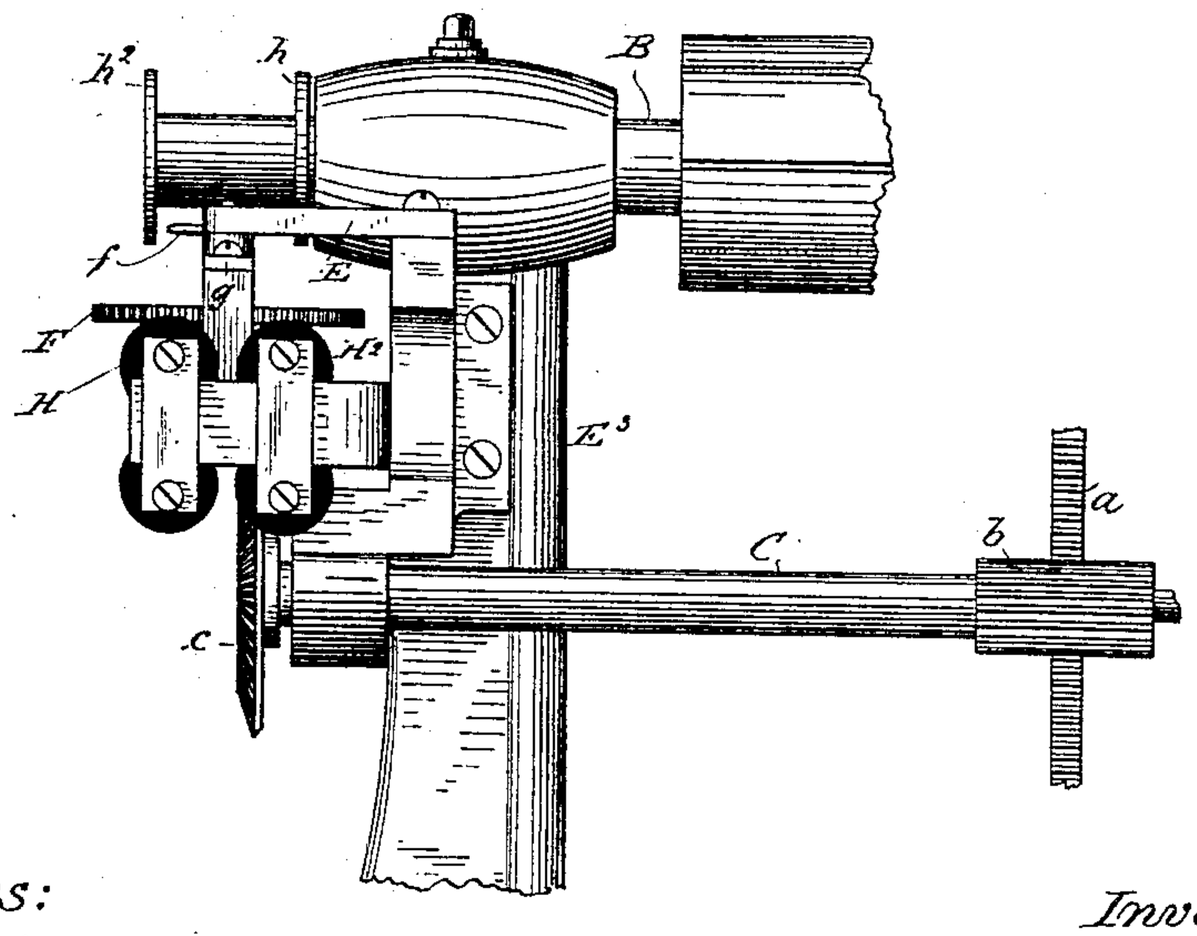



*Fig. 2.*

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By his Attorney:
H. C. Townsend

(No Model.)

2 Sheets—Sheet 2.

# W. HOCHHAUSEN.

## REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 294,040. Patented Feb. 26, 1884.

*Fig. 3.*

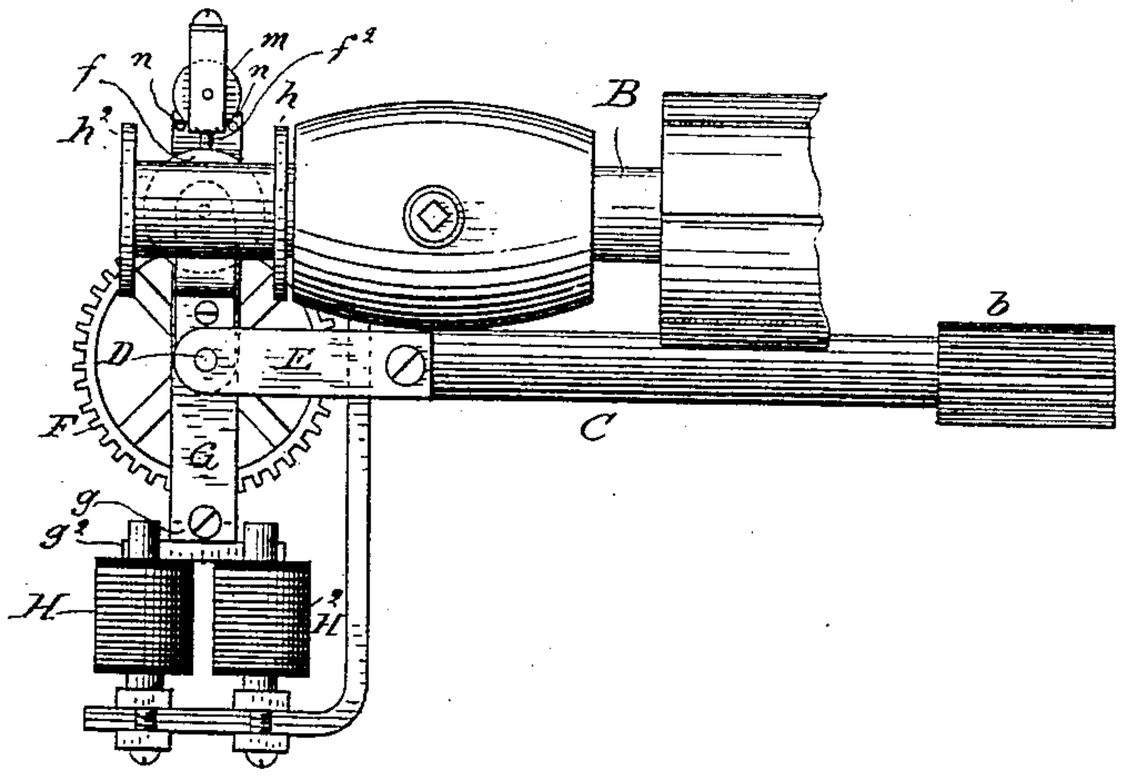



*Fig. 4.*

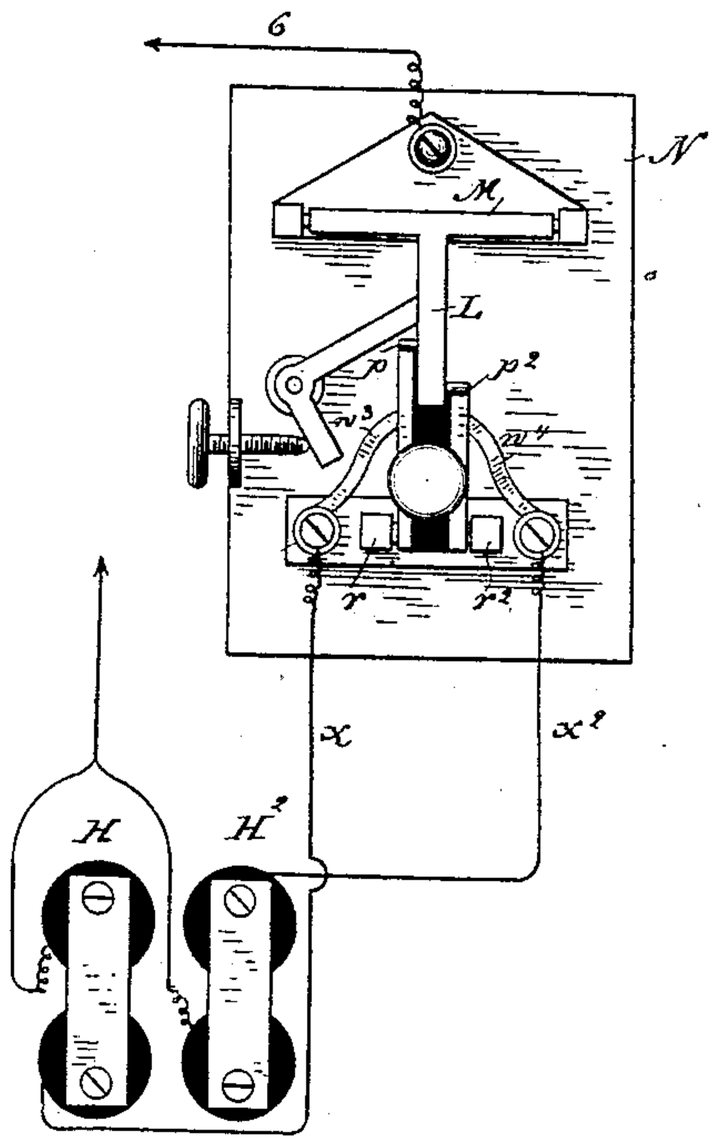
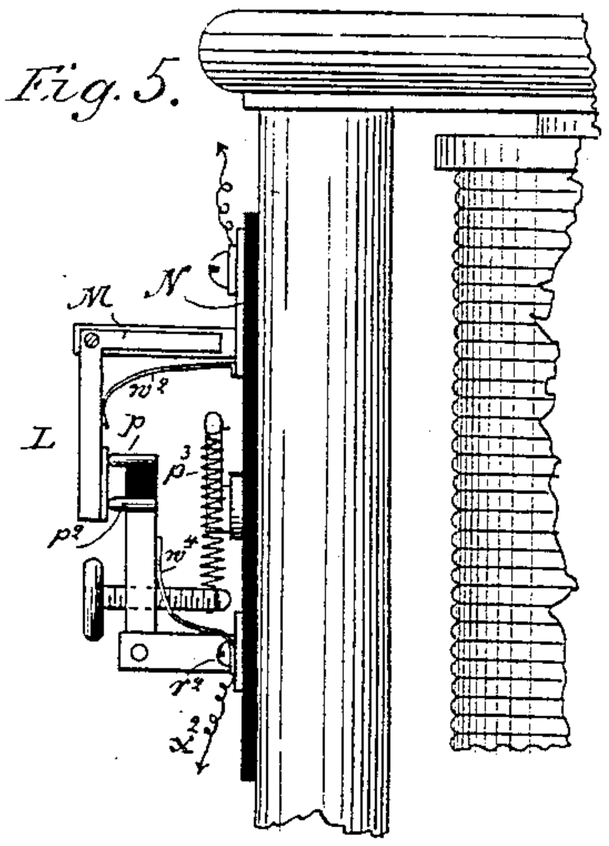



*Fig. 5.*




Witnesses:

Ernst Abshagen.

Thos. Dorney.

Inventor:

Wm. Hochhausen

By his Attorney: W. C. Townsend.

# UNITED STATES PATENT OFFICE.

WILLIAM HOCHHAUSEN, OF NEW YORK, N. Y.

## REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 294,040, dated February 26, 1884.

Application filed March 26, 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.

My invention is designed to furnish a simple and practical means whereby the strength of current upon a working-circuit supplied from a dynamo-electric machine may be kept uniform or constant despite any changes of resistance in said working-circuit. It is well known in the art that by shifting the commutator-brushes of a dynamo-electric machine upon the commutator-cylinder forward or backward with relation to the neutral line the electromotive force of the current taken off by said brushes may be varied; and it is by taking advantage of this fact, and by combining with such brushes certain novel appliances, to be herein described, for shifting the same in accordance with changes of current strength on the working-circuit, that I am enabled to accomplish the objects of my invention, and to keep the current on such circuit at its normal strength, although the resistance may vary.

My invention consists in certain novel devices and combinations of devices, that will be herein described, and then recited in the claims.

In the accompanying drawings, Figure 1 is a side view of an apparatus embodying my invention, showing the same applied to the commutator of a dynamo-electric machine. Fig. 2 is an end view of the apparatus. Fig. 3 is a top view of the same. Fig. 4 is a diagram of the circuit-connections of the controlling-magnets which serve to reverse the driving or actuating mechanism which acts on the support for the commutator-brushes. Fig. 5 is an edge view of the controlling-armature and circuit-closer supported on the field-magnet so as to be subjected to the magnetic attraction of the same.

In Fig. 1, A indicates the usual adjustable support by which the brushes bearing on the commutator-cylinder are supported and adjusted. The edge of said support is provided with a rack at *a*, with which gears the mechanism that serves to communicate movement thereto from the revolving armature-shaft B, Fig. 2, said shaft bearing the usual revolving armature of a dynamo-electric machine.

In practice I have applied my invention to machines of the Pacinotti or Gramme type, but do not limit myself to such application.

The mechanism which gears with the rack *a* is preferably of the following construction: C, Fig. 2, indicates a shaft or spindle mounted in a suitable bearing in the frame of the machine, or otherwise, and carrying at one end a pinion, *b*, which meshes with rack *a*, and at the other a bevel-wheel, *c*, engaging with a bevel-pinion, *d*, which latter is secured upon a vertical spindle, D, whose upper end is supported in an arm, E, suitably connected to the post $E^3$, Fig. 2, while its lower end has a bearing in a bar, $E^2$, also suitably supported from post $E^3$. The spindle D also carries a gear-wheel, F, which latter gears with a pinion, *e*, mounted in a horizontally-swinging frame, G, having connecting cross-piece *g*, which latter carries or constitutes the armature placed between two fixed electro-magnets, H $H^2$, Fig. 2. As here shown, the cross-piece *g* carries an armature, $g^2$, which is sufficiently narrow to pass between the poles of either magnet, H $H^2$. The armature $g^2$ is long enough to extend beyond the poles of either magnet when it is drawn to one side by such magnet, so that the attractive influence of such magnet upon the armature will not be so great as that of the other, to which latter the other end of the armature is properly presented, so that it will be attracted with sufficient force to draw the frame into the intermediate position. By this means the attractive power of the magnets is not affected by the position of the armature, as would ordinarily be the case if said armature were, when drawn over by one magnet, placed in a stronger field with relation to the same, but in a weaker field with relation to the magnet on the other side, so that the latter could not restore it to an intermediate position. The frame G *g* swings about spindle D as a center, and serves to throw a friction-wheel, *f*, mounted on the arbor of pinion *e*, into engagement with one or the other of two disks or plates, *h* $h^2$, revolving in a vertical plane, and secured to the armature-shaft B. The diameter of the wheel *f* is slightly less

than the distance between the revolving disks $h$ $h^2$, so that when it is in an intermediate position no movement will be communicated from the armature-shaft to the pinion $e$ and the connected train of wheels communicating with the commutator-brush support A. To hold the frame G and the wheel $f$ in such intermediate position, and to restore it to such position when magnets H and $H^2$ are acting oppositely upon the same, I provide a catch, $m$, consisting of a revoluble stud or disk, $m$, mounted on a fixed spring, $m^2$, which tends to force said disk into the space between two pins, $n$ $n$, on the frame G, with sufficient force to hold the frame firmly in an intermediate position, so long as the action of magnets H $H^2$ is balanced, but to nevertheless allow the frame to be swung, and thus bring wheel $f$ into contact with $h$ or $h^2$ when one magnet acts alone. When both magnets are energized, the frame G assumes an intermediate position, and the wheel $f$ is out of contact with both disks $h$ $h^2$, so that no movement is imparted therefrom to the commutator-brushes. A brake-pin, $f^2$, attached to the same support as catch $m$, is arranged so as to impinge against the edge of disk $f$, and bring it promptly to rest when the catch $m$ is forced into contact with both studs or pins $n$ $n$, and the wheel $f$ is drawn out of connection with a revolving disk, $h$ or $h^2$. If, however, magnet $H^2$, for instance, is alone energized, the energizing-current being withdrawn from H, the frame G will be swung so as to bring wheel $f$ into connection with disk $h^2$, so that if the direction of revolution of shaft B be in the direction indicated by the arrow, the wheel $h$ will be rotated, and movement will be communicated to the commutator-brush support A through the gearing described, in such a direction as to move the commutator-brushes forward in the direction of revolution of the armature of the machine. This movement will continue until the magnet H is again energized and frame G resumes its intermediate position. If, on the other hand, the frame be moved by the action of the magnet H, (magnet $H^2$ being in this case passive,) the wheel $f$ will be drawn against disk $h$, so that movement will be communicated to the commutator-brushes in an opposite direction—such movement continuing until magnet H again acts with $H^2$, but oppositely, when the action of spring $m^2$ will restore the frame to its intermediate position, and the adjustment backward of the commutator-brushes will cease.

In order to bring the magnets H $H^2$ into and out of action at the proper times, I prefer to employ an arrangement of circuits and circuit-controller, such as is shown in Figs. 4 and 5; but I do not limit myself to such arrangement, as when magnets H $H^2$ are used for operating the reversing devices of the operating mechanism between the armature-shaft and the brush-support, any suitable circuit-controller may be employed, provided it be properly arranged and actuated to respond to variations in the current strength in the circuit supplied by the machine, so as to allow one magnet to act while the current strength is above the normal, and to allow the other magnet to act while it is below the normal, and to also keep both magnets in or both out of circuit while the current strength in the general circuit supplied by the machine remains at normal.

Referring to Figs. 4 and 5, M indicates an armature of soft iron, mounted on a plate, N, and L indicates a circuit-closing arm connected with said armature, and arranged to make contact with either or both of the contact-points $p$ $p^2$, insulated from one another, and connected, respectively, by separate conductors X $X^2$ with the electro-magnets H $H^2$. The contacts $p$ $p^2$ are formed, as shown on the ends, of separate conducting-pieces insulated from one another, but forming together a compound contact-lever swinging on supports $r$ $r^2$, also insulated from one another. A spring, $p^3$, adjustable by suitable devices, holds the contact-points of the lever against the arm L, and constitutes, in effect, the retractor of the armature M. Armature M is arranged within the attractive sphere of an electro-magnet in the circuit of the machine, or suitably connected to said circuit, so as to attract said armature with a force corresponding to the amount of current flowing in said circuit. In the present case the varying attraction is secured by pivoting the armature on the field-magnet of the machine below the head of the upper plate, so that the magnetism of the latter will tend to draw the armature upward. The retractor $p^3$ is so adjusted that when the current, and consequently the attraction, is normal, the armature will retain a horizontal position, and the arm L will make connection with both contacts $p$ $p^2$. If the attraction increase, the armature will be drawn up, and L will rock on $p$ $p^2$, breaking contact with the former, but retaining contact with the latter. If, when the armature is in a horizontal position, the attraction decrease, the upper end of the double contact-lever will move outward, and L will rock on $p$ $p^2$, so as to break contact with the latter, but preserve contact with the former.

The circuit-closing apparatus and the magnets H $H^2$ are in the present case placed in the general circuit, as indicated, the circuit being from field-magnet through wire 6, spring $w^2$ to L, contact $p$ or $p^2$, connecting-spring $w^3$ or $w^4$, wire X or $X^2$, and magnet H or $H^2$. After passing through the latter, the circuit reunites, as indicated, and is carried to the electric lamps or other working-resistance.

The general operation is as follows: If all of the working-resistance for which the machine is adapted is in circuit, and the commutator-brushes are in a proper position on the commutator to allow of the development and supply to the outside circuit of a current of the proper electro-motive force, then the current strength on such circuit will be of normal or proper amount, and the armature M will be

drawn up with just sufficient force, to cause the arm L to make connection with both contacts $p$ $p^2$, thus closing the circuits through both magnets H $H^2$. The frame G and wheel $f$ will therefore be in an intermediate position, so that no movement will be imparted to the commutator-brush support A, and will retain this position so long as the current remains of proper strength. If, now, the working-resistance diminish so that with the commutator-brushes in their original or normal position the electro-motive force, and consequently the strength of current, will increase, then the armature M will be drawn up with an increased force, causing L to rock on $p$ $p^2$, so as to break connection with $p$, while retaining it with $p^2$. Magnet H will thus be thrown out of circuit, and magnet $H^2$ will then act to swing the frame G, bring wheel $f$ into connection with disk $h^2$, so that the brush-support and the brushes will begin to move forward, and to thus cause a decrease in the electro-motive force of the current taken from the armature. The movement will continue until the electro-motive force falls to a point where the current upon the general circuit will be of the normal strength, at which point the strength of the field-magnet will become normal, and the armature M will resume the position in which connection is made with both contacts $p$ $p^2$, so as to bring magnet H into circuit again. When this happens, the frame G will resume its intermediate position, as already explained, and the adjustment forward of the commutator-brushes will cease. The brushes will retain this position so long as the current remains of normal strength. If, now, the resistance in the general circuit increase so as to diminish the strength of current and to require an increase in the electro-motive force, in order to keep the strength normal, the commutator-brushes will be drawn toward the point where the electro-motive force will be greater. This will be effected, because the armature M will be held up with less power when the resistance is introduced, and the connection with contact $p^2$ will be broken, the spring $p^3$ then forcing the upper end of the double contact-lever outward. By this means magnet $H^2$ is thrown out of circuit, and magnet H then pulls the wheel $f$ into connection with the disk $h$, so that the brushes begin to move backward on the commutator. This backward movement continues until the brushes reach a point where the electro-motive force is such as to produce a current of the normal strength, at which time the field-magnet becomes strong enough to draw the armature M into a position where both contacts $p$ $p^2$ are closed. The frame G then comes to a normal position, and the adjustment of the brushes ceases until another change in resistance and strength of current occurs. The magnets H $H^2$ may be energized from a current derived from any source, it not being necessary that the current of the machine should be used for this purpose, and the current may be admitted to them automatically by other arrangements of circuits, and of devices moving automatically in response to changes in the current strength. I do not, therefore, wish to be understood as limiting myself in these particulars to the special arrangements and devices herein shown.

I have described a commutator-adjustment which involves the moving of the commutator-brushes on the commutator-cylinder; but it is obvious that my invention is not limited to such special arrangement, the conditions requiring only a relative displacement of the points of contact of the brushes with relation to the neutral line. The arrangement of magnets H $H^2$, acting oppositely on the armature, a reversing mechanism, and the combination therewith of the circuits and circuit-controller, whereby either or both may be placed in circuit and made to operate the lever or frame G, as described, might be used with advantage in connection with other motors for reversing the movement of the brushes, or with other devices intended to regulate the electro-motive force of a dynamo-machine, and requiring a movement of the immediate regulating appliances in one or the other direction, and the stoppage of such appliances, while the current strength is normal.

It is also obvious that by my invention the armature-shaft of the machine might be used for communicating movement to regulating appliances working on other principles, provided the construction be such that the immediate regulating device requires to be moved in one direction or the other, according to the change in current, and to remain at rest while the current is normal.

What I claim as my invention is—

1. The combination, with the revolving armature or armature-shaft on a dynamo-electric machine, of an adjustable commutator for said armature, two revolving wheels actuated by said armature-shaft, an intermediate wheel gearing positively with the adjustable commutator, and an electro-magnet for bringing said intermediate wheel into connection with one or the other of the revolving wheels, said electro-magnet being energized by and varying in power with the current collected by said commutator.

2. The combination, with the armature-shaft, of adjustable commutator-brushes connected therewith by intermediate reversing mechanism, two electro-magnets acting in opposite directions on said reversing mechanism, so that when one actuates said reversing mechanism the commutator-brushes may be moved in one direction, and vice versa, and means for energizing one or the other of said magnets simultaneously with the rise or fall of the normal current strength.

3. The combination, with the armature-shaft, of two disks or wheels, $h$ $h^2$, on the armature-shaft, a wheel, $f$, through which movement may be communicated to the regulating

devices for changing the electro-motive force of the machine, and means for bringing said wheel into contact with one or the other of said disks or wheels $h$ $h^2$, according as the current strength rises or falls above or below normal.

4. The combination of the armature-shaft having the two disk wheels or surfaces $h$ $h^2$, the adjustable commutator-brushes or other device for regulating the electro-motive force of the machine, the intermediate actuating mechanism, wheel $f$, forming a portion of the same, and mounted on a swinging lever, and two electro-magnets acting on said lever in opposite directions, as and for the purpose described.

5. The combination, with the armature-shaft, of the adjustable commutator or other device by the adjustment of which the electro-motive force of the machine may be regulated, the intermediate actuating mechanism, the frame or support G, carrying wheel $f$, or other device whereby the mechanism may be run in either direction from the shaft, and two electro-magnets, H $H^2$, arranged to actuate the frame G in opposite directions, substantially as and for the purpose described.

6. The combination of the armature-shaft having driving-surfaces $h$ $h^2$, the adjustable commutator or its equivalent, the intermediate actuating mechanism provided with the movable driving-wheel $f$, the two electro-magnets controlling the position of said wheel, and suitable means whereby a current may be admitted to both or one of said magnets, according as the current strength is at normal or above or below normal.

7. The combination, with the armature-shaft having driving-surfaces $h$ $h^2$, of the wheel $f$, mounted on swinging frame G, magnets H $H^2$, brush-support A, having rack $a$, and the intermediate driving mechanism between said rack and wheel $f$.

8. The combination of support G, wheel $f$, gear F $d$ $c$, horizontal shaft C, pinion $b$, and rack $a$.

Signed at New York, in the county of New York and State of New York, this 22d day of March, A. D. 1883.

WILLIAM HOCHHAUSEN.

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

Correction in Letters Patent No. 294,040.

It is hereby certified that Letters Patent No. 294,040, 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. 294,040 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.*