(No Model.) 4 Sheets—Sheet 1.

C. E. SCRIBNER.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 484,611. Patented Oct. 18, 1892.

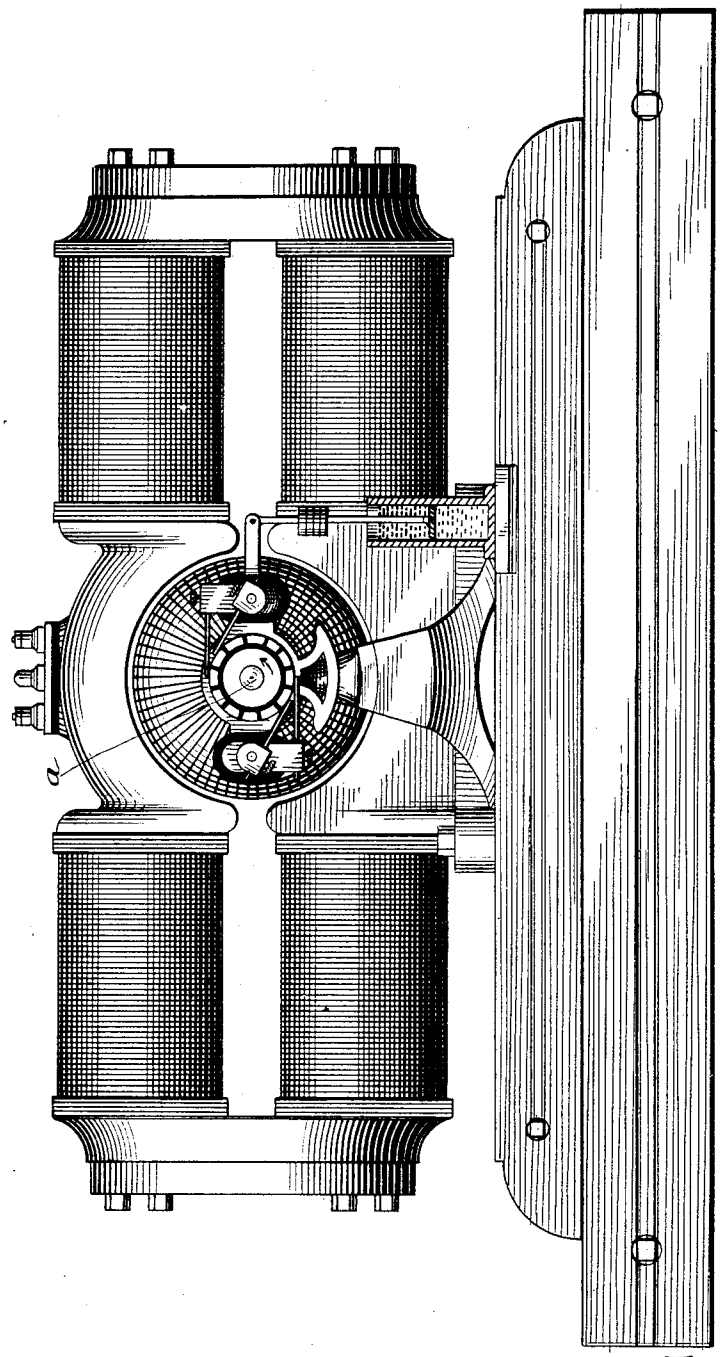

Fig. 1.

Witnesses:
Charles H. Hawley.
Ella Edler

Inventor.
Charles E. Scribner.
By George P. Barton
Attorney.

(No Model.) 4 Sheets—Sheet 2.

C. E. SCRIBNER.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 484,611. Patented Oct. 18, 1892.

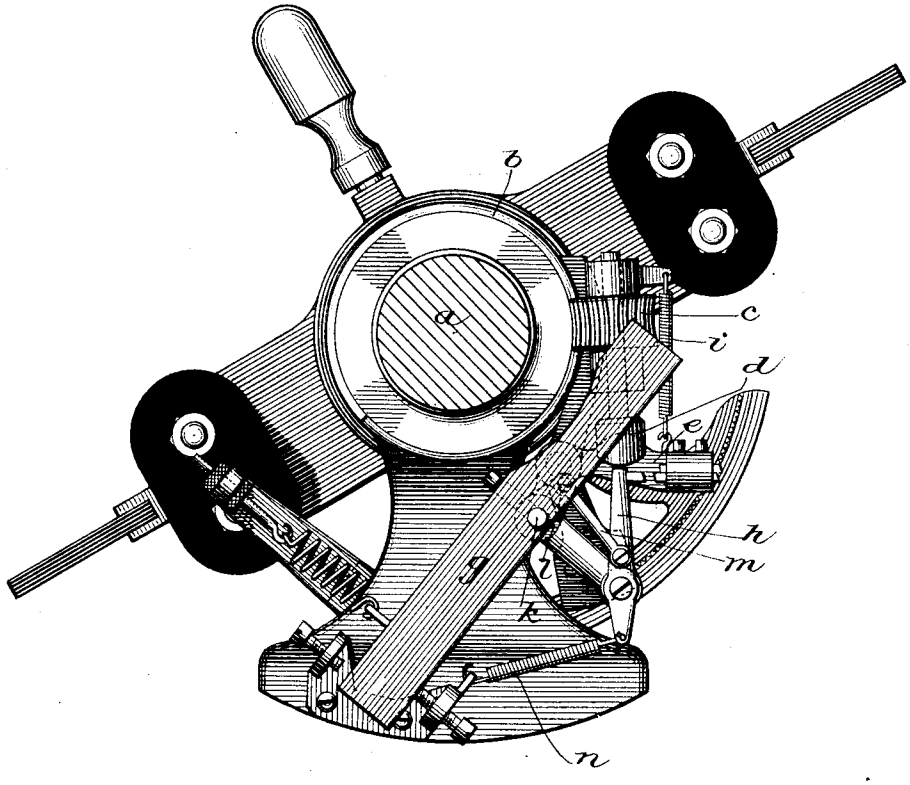

Fig. 2.

Witnesses:
Charles G. Hawley.
Ella Edler

Inventor:
Charles E. Scribner.
By George P. Barton
Attorney.

(No Model.) 4 Sheets—Sheet 3.

C. E. SCRIBNER.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 484,611. Patented Oct. 18, 1892.

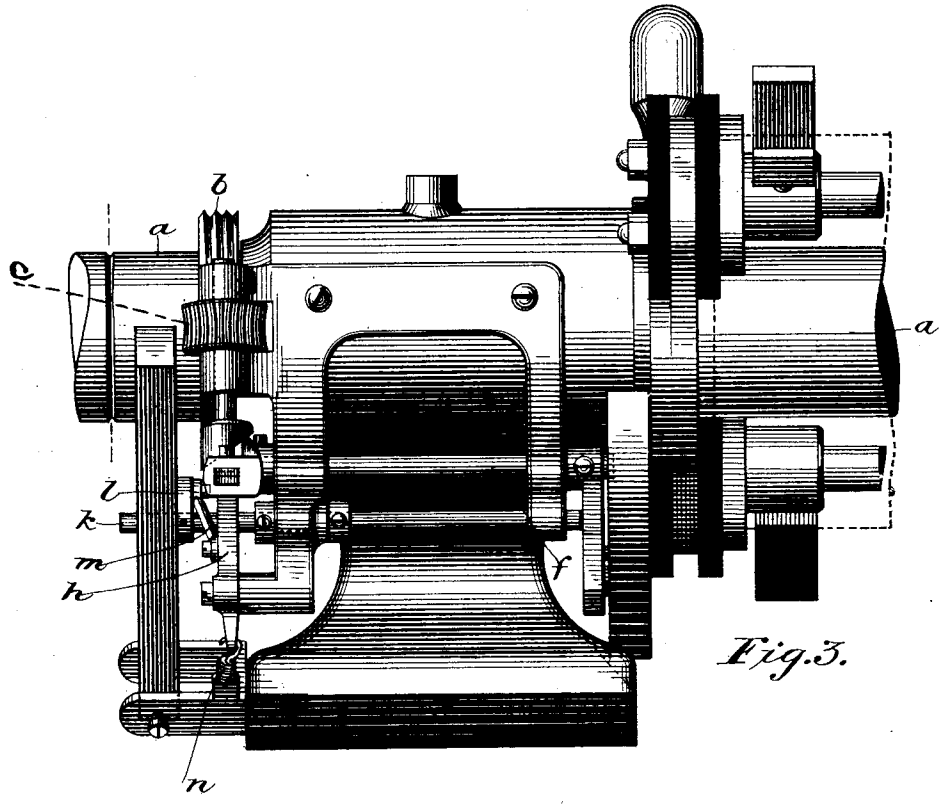

Fig. 3.

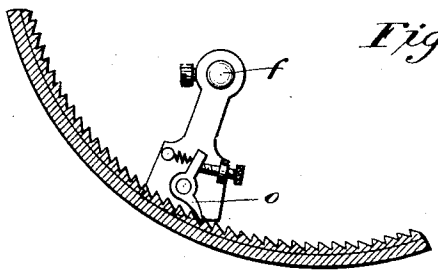

Fig. 4.

Witnesses:
Charles E. Hawley.
Ella Edler

Inventor:
Charles E. Scribner.
By George P. Barton
Attorney.

(No Model.) 4 Sheets—Sheet 4.

C. E. SCRIBNER.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 484,611. Patented Oct. 18, 1892.

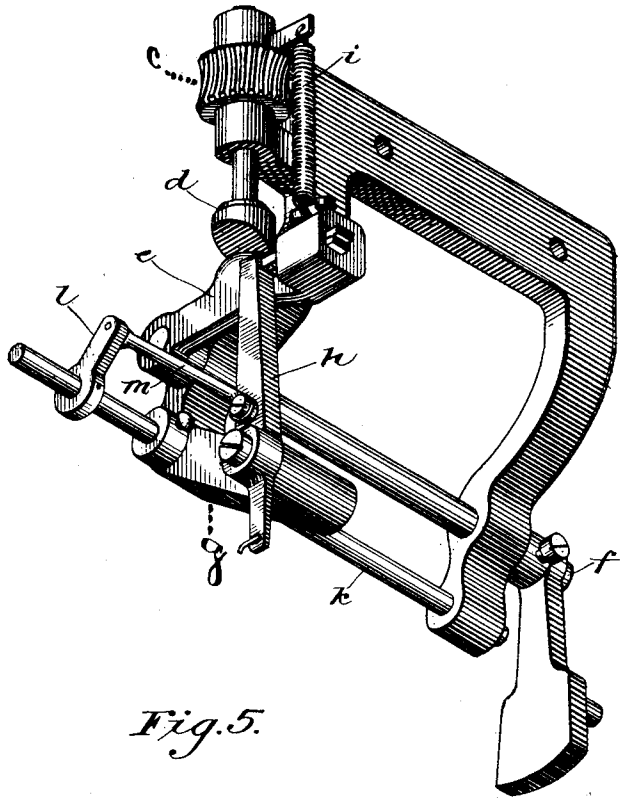

Fig. 5.

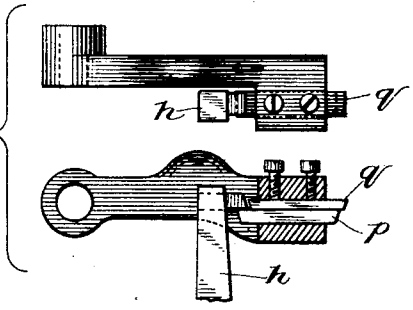

Fig. 6.

Witnesses:
Charles G. Hawley.
Ella Edler

Inventor
Charles E. Scribner.
By George P. Barton
Attorney.

UNITED STATES PATENT OFFICE.

CHARLES E. SCRIBNER, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY, OF SAME PLACE.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 484,611, dated October 18, 1892.

Application filed May 5, 1890. Serial No. 350,547. (No model.)

To all whom it may concern:

Be it known that I, CHARLES E. SCRIBNER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Current-Regulators for Dynamo-Electric Machines, (Case No. 217,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

Where dynamo-electric machines are used to supply a circuit under a variable load—as, for example, in arc-lighting, it being necessary to maintain the current strength practically uniform—automatic current-regulators are required.

Heretofore various forms of automatic regulators have been employed, their construction being such that any change in the load will be automatically compensated for by changing the electro-motive force, correspondingly increasing the electro-motive force automatically when the work is increased, and diminishing the electro-motive force when the work is lessened, as by cutting out a portion of the translating devices—as, for example, arc lamps.

My invention herein relates to that class of regulators in which the collecting-brushes are automatically shifted backward and forward to increase and decrease the electro-motive force.

When a dynamo-electric machine is in operation, its armature-shaft, being of iron, exerts two kinds of power, one power being mechanical and the other power being magnetic. The novel feature of my invention herein is making use of the variations in the magnetic power of the armature-shaft caused by variations in the current strength as the load is increased or diminished to automatically control the mechanical power acting upon the brushes, so that the brushes will be moved forward automatically when the load or resistance is decreased and backward when the load is increased, so as to hold the current practically uniform under such variations in the load. With this end in view I provide, in connection with the shaft, an armature connected by suitable mechanism with the mechanically-driven mechanism which acts upon the rotating brush-carrier to control the action of such mechanically-driven mechanism with respect to its engagement or action upon the brushes. Increase of magnetism of the armature-shaft changes the position of the armature of the regulating mechanism presented thereto to cause the brushes to be moved forward—that is, in a direction to diminish the current—while decrease of magnetic power of the armature-shaft permits the armature presented thereto to be moved by the force of its retractile spring, so as to cause the brushes to be moved backwardly or in a direction to increase the current.

In the drawings which are illustrative of my invention, Figure 1 is a front elevation of a dynamo-electric machine provided with my regulator. Fig. 2 is a view showing the armature-shaft in section, the brush-carrier mounted upon the machine in the position of maximum current and my automatic regulator for controlling the position of the brush-carrier responsively to variations in the magnetic force of the armature-shaft. Fig. 3 is a side elevation of my regulator applied to a dynamo-electric machine. Fig. 4 is a detailed view of the pawl-and-ratchet engagement between the regulator and the brush-carrier. Fig. 5 is an isometric view showing the operation of the tripping mechanism. Fig. 6 shows a top and side view of the adjustable catch mounted upon its arm in connection with the hook which controls the step-by-step movement of the regulator.

Like parts are indicated by similar letters of reference throughout the different figures.

The armature-shaft *a* of the dynamo-electric machine is driven in the direction indicated in Fig. 1.

We will consider the brushes, as shown in Fig. 1, in position to produce the electro-motive force required under ordinary conditions. Movement of the brushes backward increases the electro-motive force and movement of the brushes forward diminishes the electro-motive force, and thus, as is well known in this type of machines, the current may be maintained practically constant under a greater or less load by shifting the brushes in the proper direction.

As shown in Fig. 1, the brush-carrier is connected with a dash-pot and is weighted so as to tend to shift the brushes backward. Brush-carriers heretofore have been thus counterbal-

anced by a spring or weight, so as to tend to move in one direction, and a regulating device has been employed to act in opposition to the constant force tending to thus move the brush-carrier. It is by automatically varying or controlling the power which acts in opposition to this constant tendency of the brushes to move in one direction that the brushes are shifted to maintain constant-current strength. This I accomplish through the instrumentalities of an armature and tripping mechanism connected therewith, so arranged that increase of the magnetic force of the armature-shaft will cause the brushes to be moved in a direction to diminish the electro-motive force until the current, and consequently the magnetic force of the armature-shaft, is brought back to its normal.

A force opposing the constant force or tendency of the brushes to move in a given direction has been heretofore automatically controlled for the purpose of current-regulation. This, however, has not been accomplished through the influence or magnetism of the shaft of the machine acting upon a movable or pivoted armature, and I thereore do not limit my invention to the special mechanism herein described, but claim in connection therewith the method of utilizing the magnetic force of the shaft of the machine for the purpose of current-regulation. The force which is thus controlled may be obtained, as illustrated herein, from the shaft of the driven armature by any suitable mechanical means; but I do not limit my invention to any particular source of power in this regard.

A worm *b* upon the shaft is shown engaging with the pinion *c*, thus keeping the cam *d* in motion. It is the engagement of this cam with the bearing-surface of the arm *e* which communicates power to the brush-carrier to move the same, and by regulating the action of this cam upon the bearing-surface I control the position of the brushes, since this arm *e* is connected with the shaft *f* of the ratchet device. (For detail of a ratchet device see Fig. 4.) That is to say, as the arm *e* is moved a greater or less amount the ratchet engages with the brush-carrier to move the same forward or to simply hold the same and counterbalance its tendency to move backward, while in case the shaft *e* is held so far from the cam as not to be acted thereon the ratchet will be disengaged from the brush-carrier and permit the brush-carrier to moved backward. Thus it may be said there are three positions of the vibrating arm *e* with respect to the cam *d*. First, the arm *e* may be held without the range of the cam, so as to prevent the force derived from the cam from being exerted in any manner upon the brush-carrier; second, the arm may be within range of the cam, but only near enough to the same to receive a short stroke, in which case the force exerted upon the brush-carrier will be simply in the nature of a counterbalance force to hold the brushes in a given position, and this may be considered as the normal condition—that is, the current being established and the load remaining constant, the brushes should remain in the same position; third, the arm *e* may be in such proximity to the cam as to have a full stroke or vibration imparted thereto at each revolution of the cam. Such strokes will correspondingly move the shaft *f*, and the pawl of the ratchet will thus be moved correspondingly, so as to engage with the teeth of the rack, thus imparting positive movement to the brush-carrier to move the brushes forward.

I control the relation of the arm *e* to the cam *d* through the instrumentality of the pivoted armature *g* as acted upon by the magnetic force of the armature-shaft *a*, and thereby automatically regulate the strength of the current to maintain the same practically uniform.

The armature *g* is provided with or carries a hook or detent *h*. Now when this hook is entirely removed from the path of the catches of the vibrating arm *e* this arm *e* will be drawn up by the spring *i*, so as to receive its longest stroke or vibration. This condition is shown in Fig. 2. When the hook is in the condition shown most clearly in the lower view of Fig. 6, the arm will be given its short or intermediate stroke, and again when this hook *h* is carried into the path of the upper catch or upper step of the catch of arm *e* the said arm will be held down away from the cam *d*, so that no movement will be imparted to the shaft *f* and the ratchet will be disengaged from the brush-carrier and leave the brush-carrier free to move backward in response to the weight, or whatever the constant force may be.

The armature *g* is pivoted at *k* and is connected in any suitable manner with the hook or detent *h*, as shown. The pivot *k* of the armature *g* is in the form of a shaft, and upon this shaft is mounted the arm *l*, which is connected by the link *m* with the detent *h*. Any suitable medium of connection may be used between the armature *g* and the pivoted hook *h*, or whatever may be the trigger device employed to control and regulate the position of the arm. A retractile spring tends to hold the end of the armature *g* opposite the shaft *a* away from the same, and adjusting-screws are provided for limiting the stroke of the armature *g*. The hook *h* is adjusted to be brought into the path of the catch of arm *e* through the force of a spring *n* or otherwise. The rotation or movement of the armature *g* under the influence of the attractive force of armature-shaft *a* acts in opposition to the force of spring *n* to withdraw hook *h* from the path of the catch or catches provided upon arm *e*.

In Figs. 2 and 3 the armature *g* is shown drawn toward the shaft *a*, thus removing the trigger device or detent *h* from the path of the arm *e*, and therefore said arm *e* is brought into such relation with the revolving cam *d*

as to be given its longest stroke at each revolution of the cam. In this manner the pawl *o*, as shown in Fig. 4, is caused to take the notches provided on the segment connected with the brush-carrier, and thus the brushes are carried forward step by step until the electro-motive force is reduced, so as to correspondingly lessen the magnetic force of the shaft *a* to permit the armature *g* to recede, say, until the hook *h* is carried to the position indicated in Figs. 5 and 6, or the intermediate or normal position, so as to be in the path of the lower catch *p*. When the hook *h* is in this position, the arm *e* is permitted to be drawn up to be within the range of the cam *d*, but so as to receive only about one-half the stroke or vibration, this being sufficient to work the ratchet, or whatever the means may be of communicating the power to the brush-carrier, sufficiently to simply counterbalance the tendency of the brush-carrier to carry the brushes back. In this manner the brushes are held in position by the two opposing forces, so as to maintain the current strength. Suppose now the load should be increased and the current cut down, so as to permit the armature *g* to recede still farther from its pole—that is, from the armature-shaft *a*. The hook *h* in this case would then, under the influence of its spring *n*, be carried back so as to be in the path of the upper step—that is, in the path of the upper portion *q* of the catch on arm *e*. The arm *e* will thus be prevented from rising far enough to be within the active range of the cam *d*. The pawl *o* will thus cease to engage with the notches provided therefor upon the brush-carrier and the brush-carrier will be free to move backward. This backward movement will continue until the electro-motive force is increased to bring the current to its normal strength, and consequently to bring the magnetism of the shaft *a* to its normal. When this is accomplished, the armature *g* will be moved so as to again bring the hook *h* to the position shown in Figs. 5 and 6. It will be observed that the steps or parts *p q* of the catch are made separately adjustable. The cam *d*, though driven by power derived from the shaft of the armature, it is evident that it might be driven by any other suitable mechanical means.

The different parts of the apparatus will be adjusted to the particular machine and to the particular conditions under which the machine is to be used.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. The combination, with the shaft of a dynamo electric machine, of an armature presented thereto and controlled by the magnetic force thereof, said armature being connected with a driven mechanical device and the brush-carrier, whereby the action of the driven mechanical device upon the brush-carrier is controlled by the movement of the said armature to maintain the current strength, substantially as and for the purpose specified.

2. The combination, with the shaft of the revolving armature of a dynamo-electric machine, of a mechanical device in engagement therewith and connected with the brush-carrier to impart a step-by-step movement to the brush-carrier, and an armature controlled by the magnetic force of said armature-shaft, said armature being connected with a device for controlling the action of the step-by-step acting mechanism upon the brush-carrier to maintain the current strength, substantially as and for the purpose specified.

3. The combination, with the driven armature-shaft of a dynamo-electric machine, of a worm provided thereon in engagement with a cam-rotating device, a ratchet device adapted to be reciprocated by said cam device, and an armature within the influence of the magnetic force of the revolving shaft, said armature controlling a catch or trigger device, whereby the current strength is maintained practically uniform in response to changes in the magnetic force of the armature-shaft.

4. A driven mechanism acting upon the brush-carrier in opposition to mechanism adapted to exert a constant force, said mechanism tending to move the brush-carrier backward, said driven mechanism being provided with adjustable stops *p q*, in combination with a magnetically-operated catch responding to changes in the magnetic force of the shaft of the armature, whereby the action of said driven mechanism upon the brush-carrier is caused to move the brush-carrier forward to counterbalance the force tending to move the brush-carrier backward or to disengage the driven mechanism from the brush-carrier to permit the same to be moved backward by said constant force, thereby maintaining practically uniform the current strength responsively to variations in the magnetic force of the shaft of the revolving armature.

5. The combination, with the brush-carrier, of the armature of a dynamo-electric machine, an armature-shaft presented thereto and tripping mechanism connected therewith, and mechanism whereby increase of the magnetic force of the armature-shaft will cause the brushes to be moved in a direction to diminish the electro-motive force, while decrease of the magnetic force of the armature-shaft will cause the brushes to be moved in a direction to increase the electro-motive force, whereby the strength of the current, and consequently the magnetic force of the armature-shaft, is maintained practically uniform, substantially as and for the purpose specified.

In witness whereof I hereunto subscribe my name this 27th day of March, A. D. 1890.

CHARLES E. SCRIBNER.

Witnesses:
GEORGE P. BARTON,
ELLA EDLER.