(No Model.) 3 Sheets—Sheet 1.

C. J. VAN DEPOELE.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 401,230. Patented Apr. 9, 1889.

Fig. 1.

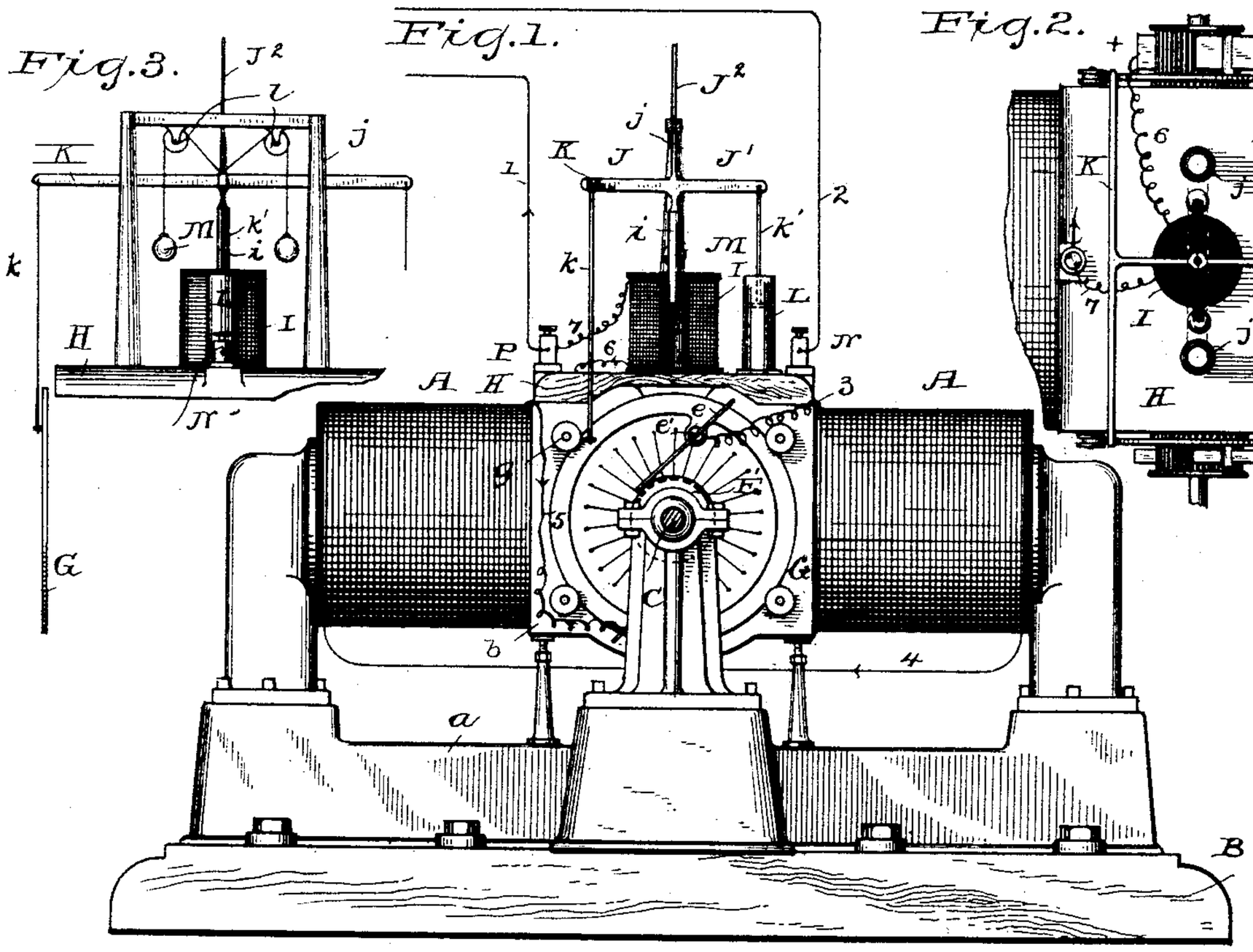
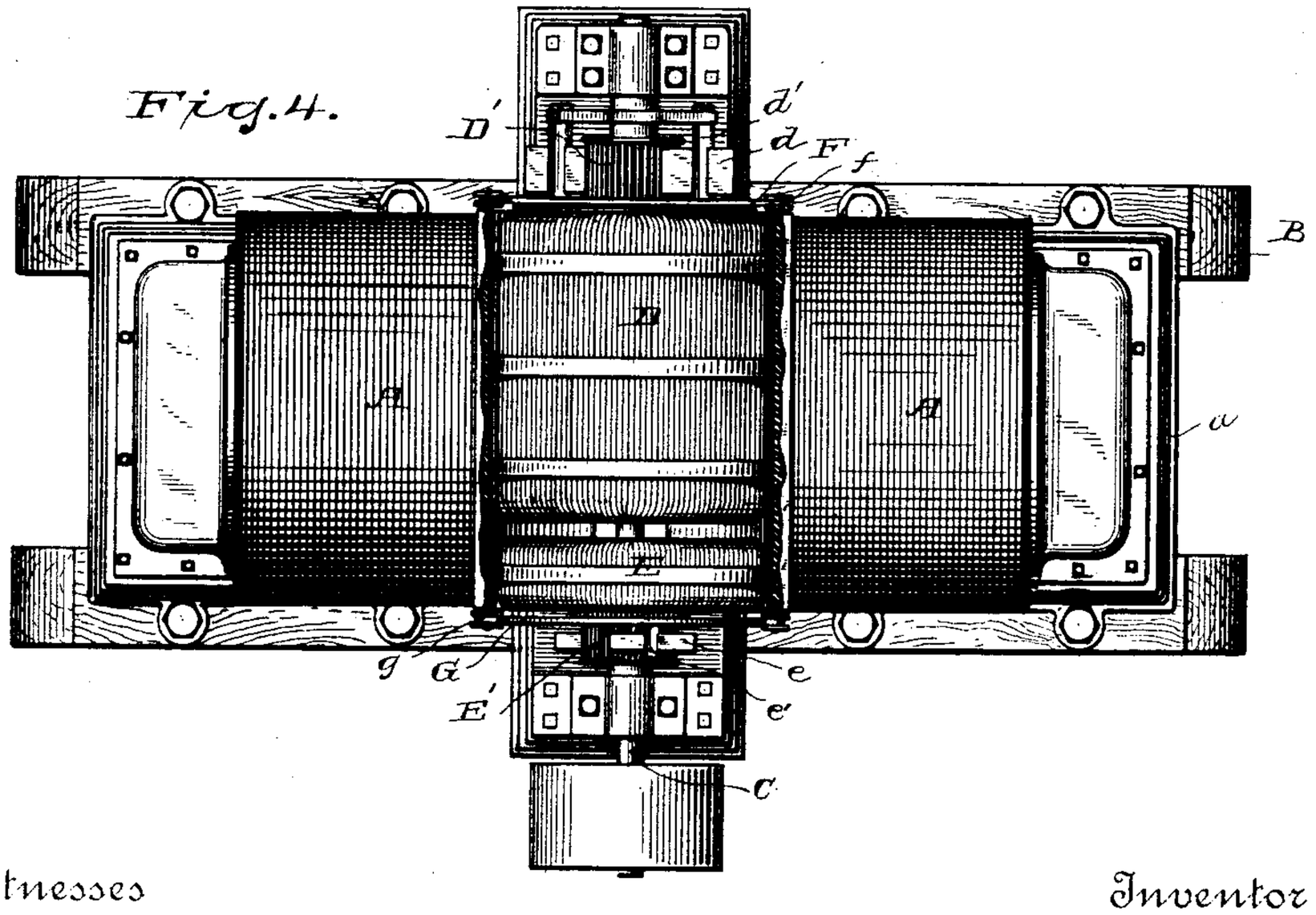


Fig. 2.

Fig. 3.

Fig. 4.



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(No Model.) 3 Sheets—Sheet 2.

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Fig. 5.

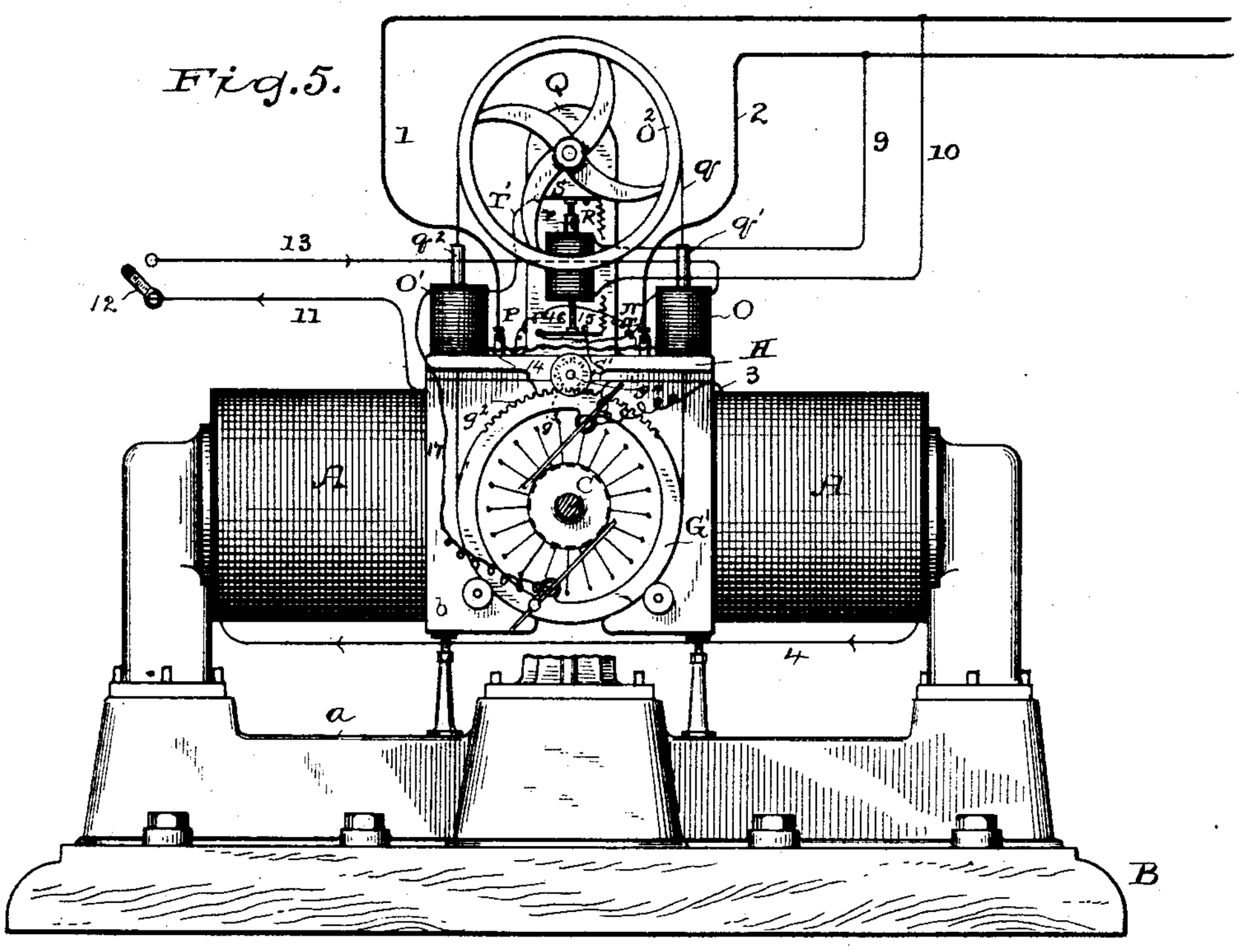
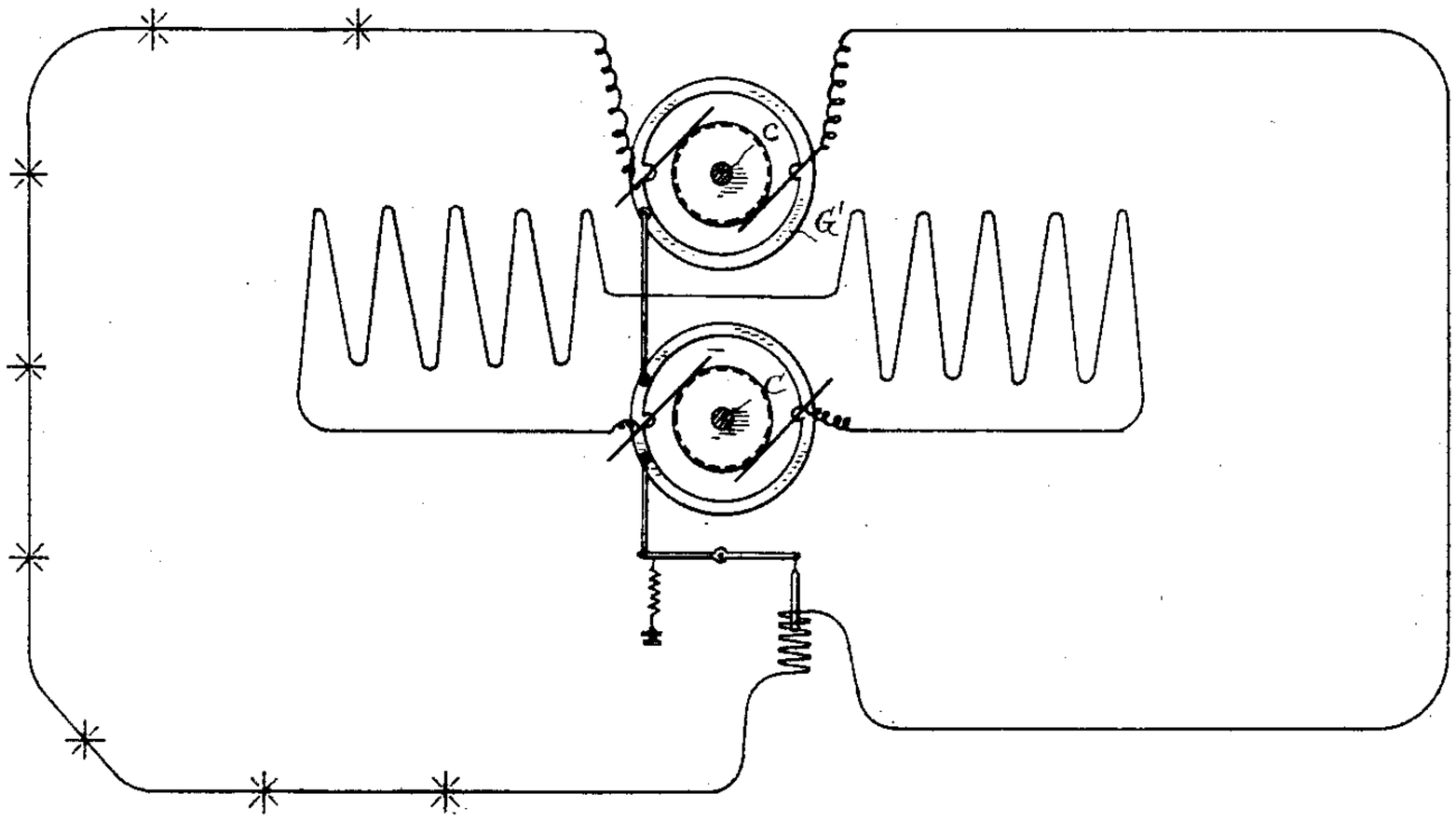


Fig. 7.



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(No Model.) 3 Sheets—Sheet 3.

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REGULATOR FOR DYNAMO ELECTRIC MACHINES.

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Fig. 8.

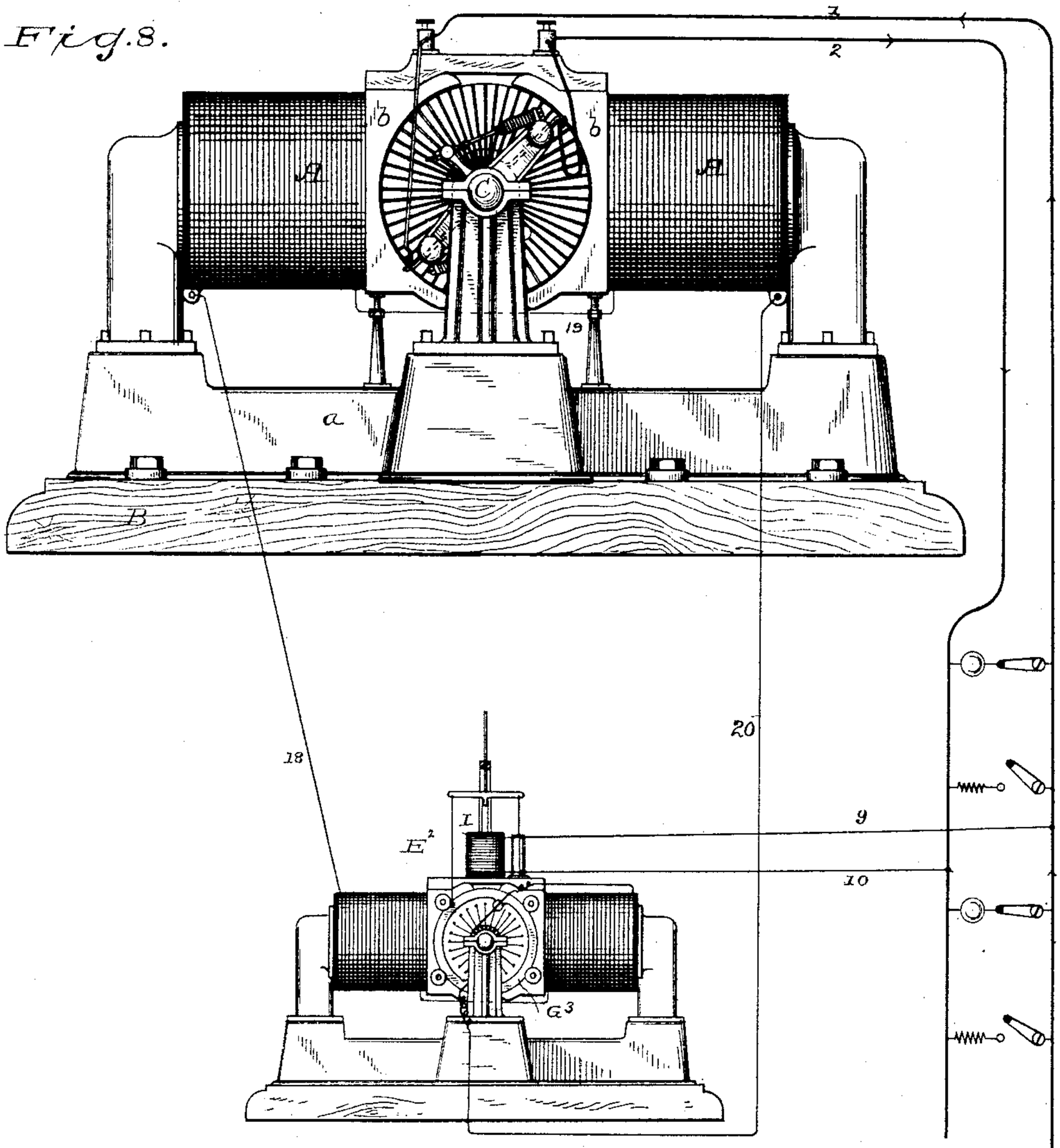
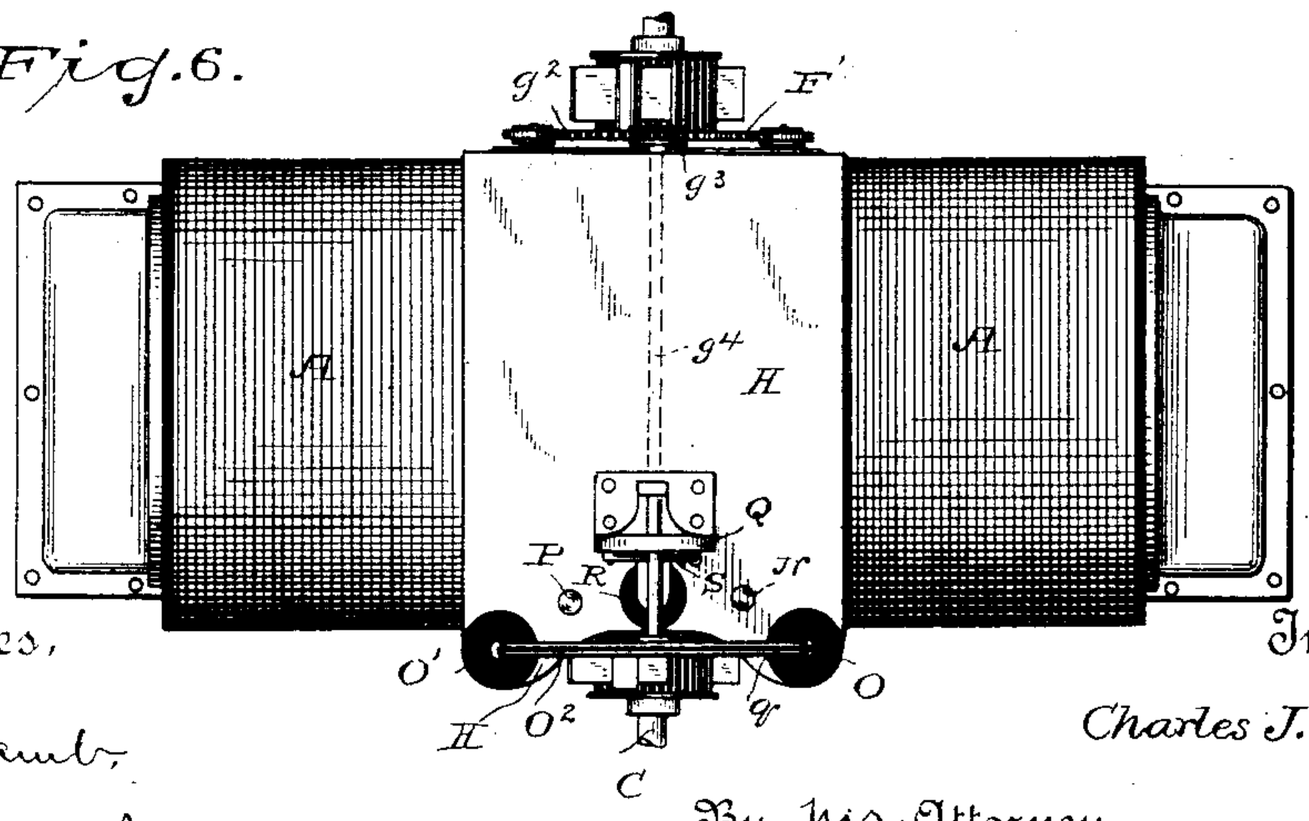


Fig. 6.



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UNITED STATES PATENT OFFICE.

CHARLES J. VAN DEPOELE, OF CHICAGO, ILLINOIS.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 401,230, dated April 9, 1889.

Application filed August 22, 1888. Serial No. 283,446. (No model.)

To all whom it may concern:

Be it known that I, CHARLES J. VAN DEPOELE, a citizen of the United States, residing at Chicago, in the county of Cook, State of Illinois, have invented certain new and useful Improvements in Combined Dynamo-Electric Generators and Automatic Exciters, of which the following is a description.

My invention relates to improvements in dynamo-electric generators of the class in which the main armature feeds directly into the main circuit, the field-magnets being energized by current from a separate source and known as "separately-excited" generators; and it comprises automatic motor devices for controlling the exciting-current, and thereby automatically adjusting the output of the main armature in accordance with the demands of the working-circuit. The motor device, by which the exciting-current is controlled, is shown and described in connection with an exciter in the form of a separate generator; but my invention also includes a novel construction in which main and exciting armatures are both mounted upon the same shaft and operated under the influence of the same field of force. In this part of my invention a single machine is operated with two armatures of unequal size, the smaller one being only capable of furnishing the current required to energize the field-magnets, all the remaining portion of the field of force being occupied by the larger armature, which is connected directly with and feeds the main or working circuit. The entire current of the smaller armature passes through the field-magnet coils, they constituting its working-circuit. The output of the smaller armature is caused to vary in accordance with the demand for current in the main circuit by a motor device which acts to raise or lower the commutator-brushes and thereby increase or decrease its efficiency. Movable commutator-brush-carrying devices are connected with the core or plunger of a solenoid included in the main circuit with the other translating devices in multiple arc or series, as the case may be, the said solenoid being connected in the working-circuit in similar relation to the other resistances, so that it will be directly affected by and respond to changes in the working conditions, and so regulate the production of current in the exciting-armature and by affecting the strength of the magnetic field similarly affecting the output of the main armature.

The details of arrangement and construction will be hereinafter pointed out, and referred to in the appended claims.

In the drawings illustrating my invention, Figure 1 is a view in elevation, showing a dynamo-electric generator embodying my invention. Fig. 2 is a fragmentary view showing the central top portion of the machine in Fig. 1. Fig. 3 is a view similar to Fig. 2 and on the line 3 3 thereof. Fig. 4 is a plan view of the machine, the central portion thereof being broken away to show both armatures. Fig. 5 is a view in elevation, showing another form of my improved brush-shifting-motor device. Fig. 6 is a plan view of the devices seen in elevation in Fig. 5. Fig. 7 is a theoretical diagram of the circuits and connections of the machine. Fig. 8 is a diagrammatic view showing the brush-shifting motor applied to a separately-constructed exciter. In this view the generator, exciter, and regulating devices are seen in elevation and the working-circuit in diagram.

Similar letters denote like parts throughout.

In the drawings, A A indicate the field-magnets of a dynamo-electric generator, said field-magnets being supported upon a strong iron frame, *a*, mounted upon a suitable base, B. The armature-shaft C is arranged transversely between the polar extensions *b b* of the magnets A A, and, as seen in Figs. 2, 4, 6, and 7, carries a comparatively large armature, D, and the relatively small armature E, the two armatures being arranged as close together as may be without interference or danger, and occupying the interpolar space, as does the single armature, Fig. 8. Separate commutators D′ E′ are provided for the respective armatures, the commutator-brushes *d e* being mounted in suitable positions on arms *d′ e′*, secured to metallic rings or disks F G, which are supported by grooved pulleys *f g*, secured to faces of the polar extensions *b*, or by any other similar or equivalent devices, whereby the commutator-brush-carrying frames are rotatably supported in positions

concentric with their respective armatures. The space between the upper edges of the polar extensions of the field-magnets is covered by a board, H, or other suitably-insulated support, upon which are mounted the main binding-posts P N, from which extend the main conductors 1 2. At about the center of the board H is placed a solenoid, I, which is provided with a vertically-moving iron plunger, *i*, formed with or attached to transverse arms J J′. A frame, *j*, is also mounted upon the base H and extends up and over or across the solenoid I, and being suitably apertured serves as a guide for the plunger *i*, which is provided with an upwardly-extending rod, J^2, passing therethrough. From the extremity of the arm J extends an arm, K, at right angles thereto. The arm K is somewhat longer than the width of the base H, and is at each end provided with a downwardly-extending connecting-rod, *k*, engaging the rotatable commutator-brush-carrying frames F G. From the extremity of the opposite arm J′ extends a piston-rod, *k′*, connected with the piston of a dash-pot, L. Counter-weights M are attached to the arm K, or other convenient part, and serve to raise the core and connected parts when the main current falls below a predetermined point. As the plunger *i* rises and falls, according to the influences of the solenoid I, or the weights M thereupon, the brush-carrying frames F G will be rotated to raise or lower both sets of commutator-brushes, and any sudden excessive or involuntary movement thereof is prevented by the piston and dash-pot L.

The current generated by the small armature E passes through the coils of the field-magnets, flowing through conductor 3 into one coil of the field-magnet, issuing thence by conductor 4 to the opposite coil of said field-magnets, and from there by conductor 5 to the other commutator-brush of the exciting-armature, thereby completing a working-circuit therefor. The main current flows from the main armature D by conductor 6 into the solenoid I, passing therefrom through conductor 7 to binding-post P and to line, returning through binding-post N and by conductor 8 to the negative commutator-brush of said armature. The solenoid is directly in the main circuit, and must, therefore, be affected by any changes in the working conditions therein. An increase of working devices in the circuit will, by lowering the current-strength, weaken the effect of the solenoid upon the core *i*, permitting the counter-weights M to exert their influence and raise the said plunger, thereby turning the commutator-brush-carrying frames in the direction to raise the commutator-brushes and increase the output of both armatures to meet the additional demand, and so on up to the capacity of the machine.

When working-resistances are cut out of the main circuit, the increased current passing in the solenoid will draw down the plunger and rotate the commutator-brush frames in the opposite direction, and thereby decrease the production of current in accordance with the demands of the circuit.

It will be readily understood that, the object being to include the solenoid I, in the same manner as in other working-resistances, the apparatus may be operated either in multiple arc or in series without any other changes than that necessary to connect the solenoid in multiple arc between the main conductors instead of in series therewith, as shown.

In Fig. 5 I have shown a somewhat different construction of the regulating apparatus. As there shown, a pair of solenoids, O O′, are placed at opposite corners of the support H, directly over the vertical line of the periphery of one of the brush-carrying frames. A suitable band-wheel, O^2, is mounted upon an upwardly-extending post, Q, its periphery being also in the same vertical line as that of the brush-carrying frame referred to. A light steel or other band, *q*, extends about the peripheries of the wheel O^2 and the brush-carrying frame G′, said band passing through both solenoids and being affixed to the iron cores $q′\ q^2$ thereof, so that with this form of construction I am enabled to entirely dispense with springs or counter-weights, as one core is pulled by the other going downward, serving to place themselves and the brush-carrying frames in the desired positions. In addition to the solenoids O O′ a third solenoid, R, is provided, the said solenoid being in a derivation spanning the main conductors by conductors 9 10, and having no electrical connection with the solenoids O O′. The solenoid R is provided with a plunger, *r*, tipped with carbon or other non-fusible material at each end and normally bearing against spring-held contacts S S′. The field-magnet circuits of the machine under description are as follows: From one commutator-brush by conductor 3 into field-magnet coil out through conductor 4 and to the opposite field-magnet coil, thence by conductor 11 through switch 12 and conductor 13 to solenoid O from the opposite end of the coils of solenoid O by conductor 14 to solenoid O′, and from the opposite end of the coils thereof by conductor 17 to the negative commutator-brush, completing the exciter-circuit. Short-circuit connections T T′ extend from the upper coils of the solenoids O O′, and when the circuit is completed through either one thereof no appreciable current will pass through said solenoids. Bridge-wires 15 16 extend from the conductor 14 to the lower portion of the plunger *r*.

The operation in this form of my invention is as follows: Supposing the switch 12 to be closed, the exciting-current would normally enter the solenoid O, flow down through the short-circuit conductor T, thence through spring-contact S′, plunger *r*, spring-contact S, short-circuit conductor T′, the upper coil of the solenoid O, and by conductor 17 to the

negative commutator-brush of the armature E. Assuming, however, that there is an increased demand for current in the main working-circuit, the solenoid R will be energized, and by lifting its plunger *r* will move it away from the spring-contact S′, opening the short circuit at that point and compelling the exciting-current to flow through the coils of the solenoid O, issuing thence by conductor 14, passing through bridge-wire 15 to plunger *r*, thence through plunger *r* to spring-contact S, short-circuit conductor T′, through the upper coil of the solenoid O′, and by conductor 17 to the negative commutator-brush, thus energizing the solenoid O, which then draws in its plunger, draws down the band *q*, and turns the commutator-brush-carrying arms in the direction to raise the brushes and increase the output of current in both the exciting and main generating armatures.

On the presence of an abnormal current or a decrease of demand for current in the main line the action is reversed, the plunger *r* being drawn down by excess of power in the solenoid R, in which event the short circuit T′ is broken at the upper contact, S, and the energizing-current caused to flow through all the coils of the solenoid O′ by way of the short-circuit conductor T, spring-contact S′, the lower portion of the plunger *r*, bridge-wire 16, and the conductor 14, which connects with the lower coil of the solenoid O′, causing said solenoid to draw down its plunger and to move the commutator-brush-carrying frames in the direction to lower the brushes and decrease the output of the machine. It will thus be seen that the two actions of raising and lowering the commutator-brushes are with this construction separately brought about and without in any manner interfering each with the other. It will also be obvious that this arrangement is equally applicable to either series or multiple-arc working-circuits, in the present instance the actuating-solenoid R being shown as connected in multiple arc between the working-conductors 1 and 2.

In the foregoing but one commutator-brush-carrying frame has been referred to. The solenoids O O′ may be centrally located with respect to the brush-carrying frames and connecting thereto by transverse bars K K, as shown and described with reference to Fig. 1. If the band and carrying-wheel arrangement is preferred, a single set thereof will be sufficient, the frames being connected by any simple mechanical contrivance, for example, as seen in Figs. 5 and 6. The periphery of rotating frames G′ F′ are formed with rack-teeth g^2 g^2, which mesh with pinions g^3, carried upon the extremities of the shaft g^4. If preferred, a double set of solenoids and connections, may, however, be used.

In Fig. 8 is shown a form of embodiment of my invention, in which the generator is provided with but a single armature, which is connected directly with the main-circuit conductors 1 2, which for the sake of illustration only are shown in multiple arc. The exciter E^2 is shown as a separate machine, the circuit of which includes the field-magnets of the generator through conductors 18, 19, and 20. The commutator-brush carrier G^3 of the exciter E^2 is rotatably mounted, as before described, and either form of commutator-brush-controlling motor device is attached.

The brush-shifting motor shown is that seen in Figs. 1, 2, and 3 of the drawings. The solenoid I is connected in the main circuit by conductors 9 and 10, and its operation in raising and lowering the brushes of the exciting-armature is precisely the same as though the exciting and generating armatures were both located in the same field of force. With this latter arrangement, however, it is not necessary that the brushes of the main armature be shifted in accordance with those of the armature furnishing the exciting-current.

It will be entirely obvious to those skilled in the art to which the invention relates that various minor modifications may be made therein without departing from the spirit of the invention.

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

1. The combination of a generator having two armatures within its field of force, one supplying the main working-circuit, the other being in circuit with and supplying current to the field-magnet coils of the generator, and a motor for automatically adjusting the commutator-brushes of both armatures and arranged to raise or lower said commutator-brushes, and thereby increase or diminish the output of the armature supplying the field-magnet circuit, according to the rise or fall of potential in the main circuit, and prevent sparking in the brushes of the main armature, substantially as described.

2. The combination of a generator having two armatures, one of which is included in the main working-circuit, the other in circuit with the field-magnets of the generator, and a motor for adjusting the commutator-brushes of both armatures, comprising a solenoid included in the main circuit and arranged to lower or raise the said commutator-brushes, according to the rise or fall of potential arising from increased or diminished demand for current in the main circuit, substantially as described.

3. In combination with the field-magnets of an electric generator, two armatures, one in the main circuit and the other acting as an exciter and in circuit with the field-magnets of the generator, and a motor for adjusting the brushes of both armatures, comprising a solenoid or solenoids included in the main circuit and a plunger or plungers influenced thereby and arranged to lower or raise the commutator-brushes according to the flow of current in the main circuit, substantially as described.

4. The combination, with the field-magnets

of an electric generator, of two armatures, the commutator-brushes of both of which are rotatively mounted, and a motor actuated by the main current and arranged to shift all the brushes at once, according to the flow of current in the main circuit, substantially as described.

5. In an electric generator, the combination, with suitable supports thereon, of movable commutator-brush-carrying frames, a solenoid included in the main circuit, an iron plunger for said solenoid, a frame secured to and extending from said plunger and connected to the brush-carrying frame, a guiding-frame extending over the plunger, and counter-weights suspended from said guiding-frame and arranged to raise the plunger and its connections when less than the predetermined current is passing in the solenoid, substantially as described.

6. In an electric generator, the combination, with suitable supports thereon, of movable commutator-brush-carrying frames, solenoids adapted to be put in circuit with the coils of the field-magnets and having iron plungers mechanicallyconnected to the movable frames to move said frames in the desired direction, a solenoid included in the main circuit and having an iron plunger, and circuit-connections extending from the commutator-brush-actuating solenoids and into the path of the plunger of the solenoid in the main circuit, whereby one or the other of said solenoids will be actuated in accordance with the increase or decrease of demand for current in the main circuit, substantialfy as set forth.

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

CHARLES J. VAN DEPOELE.

Witnesses:
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JOHN EASON.