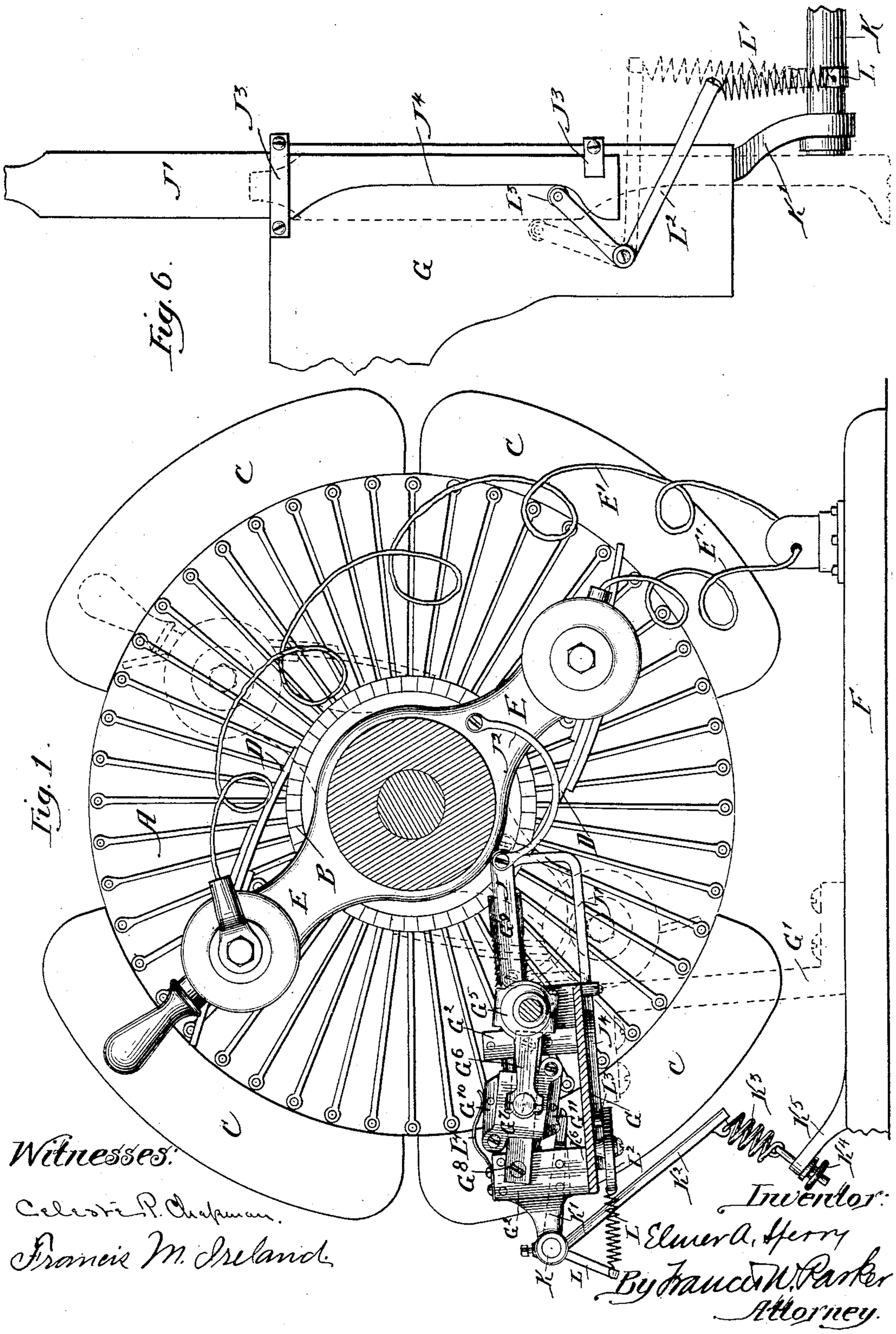
(No Model.) 3 Sheets—Sheet 1.

E. A. SPERRY.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 398,668. Patented Feb. 26, 1889.



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(No Model.) 3 Sheets—Sheet 2.

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Fig. 2.

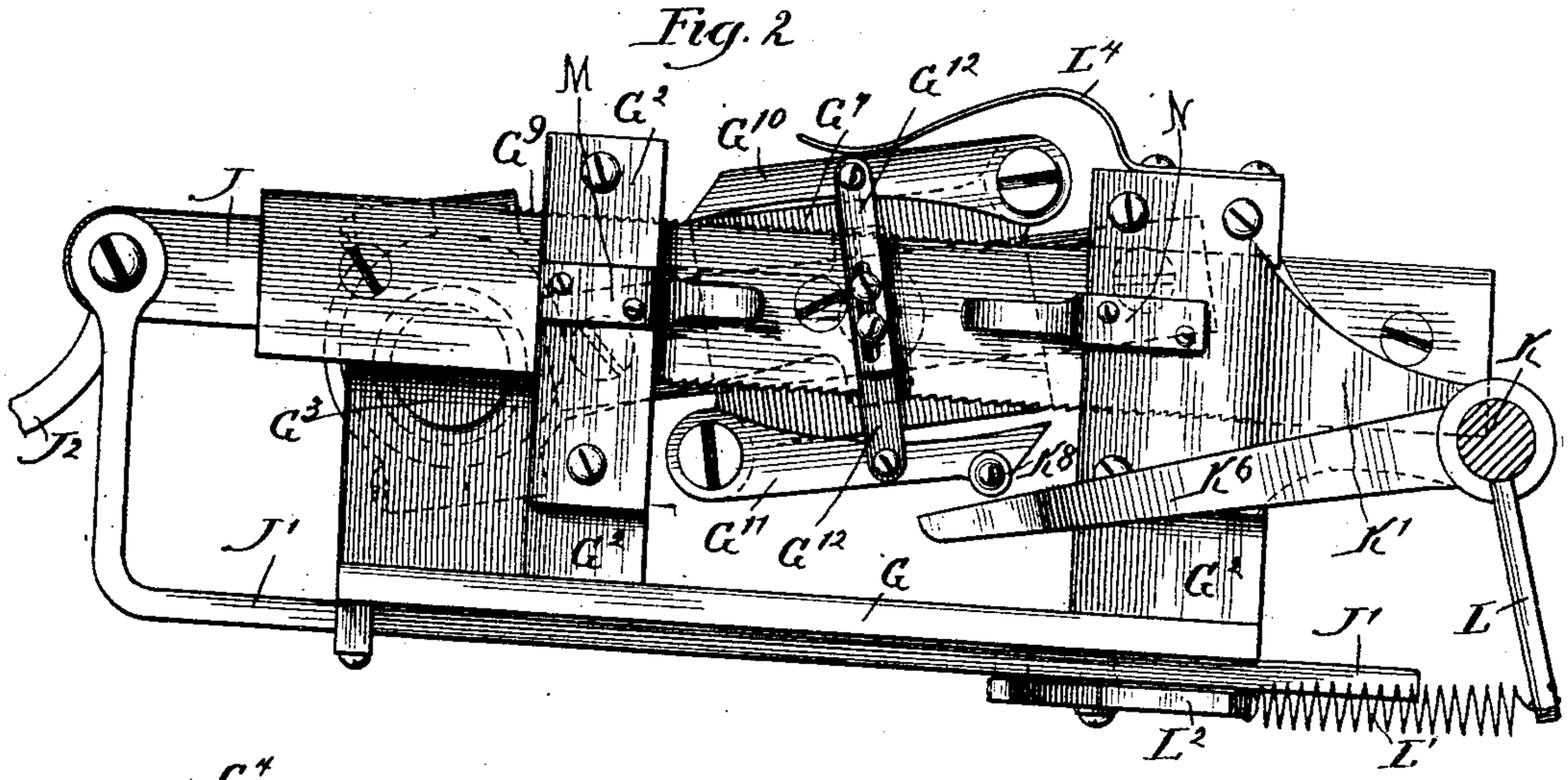

Fig. 3.

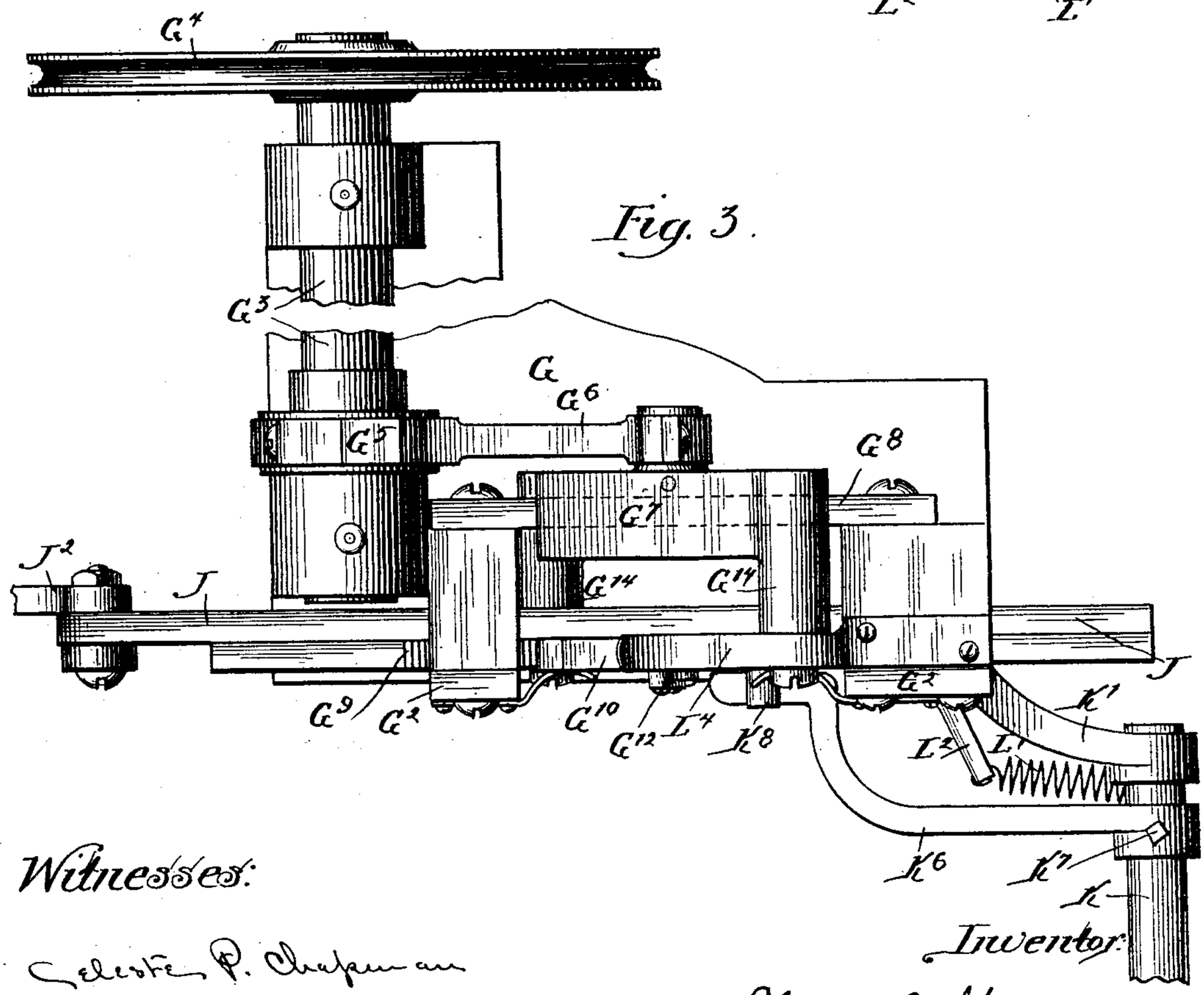

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Fig. 5.

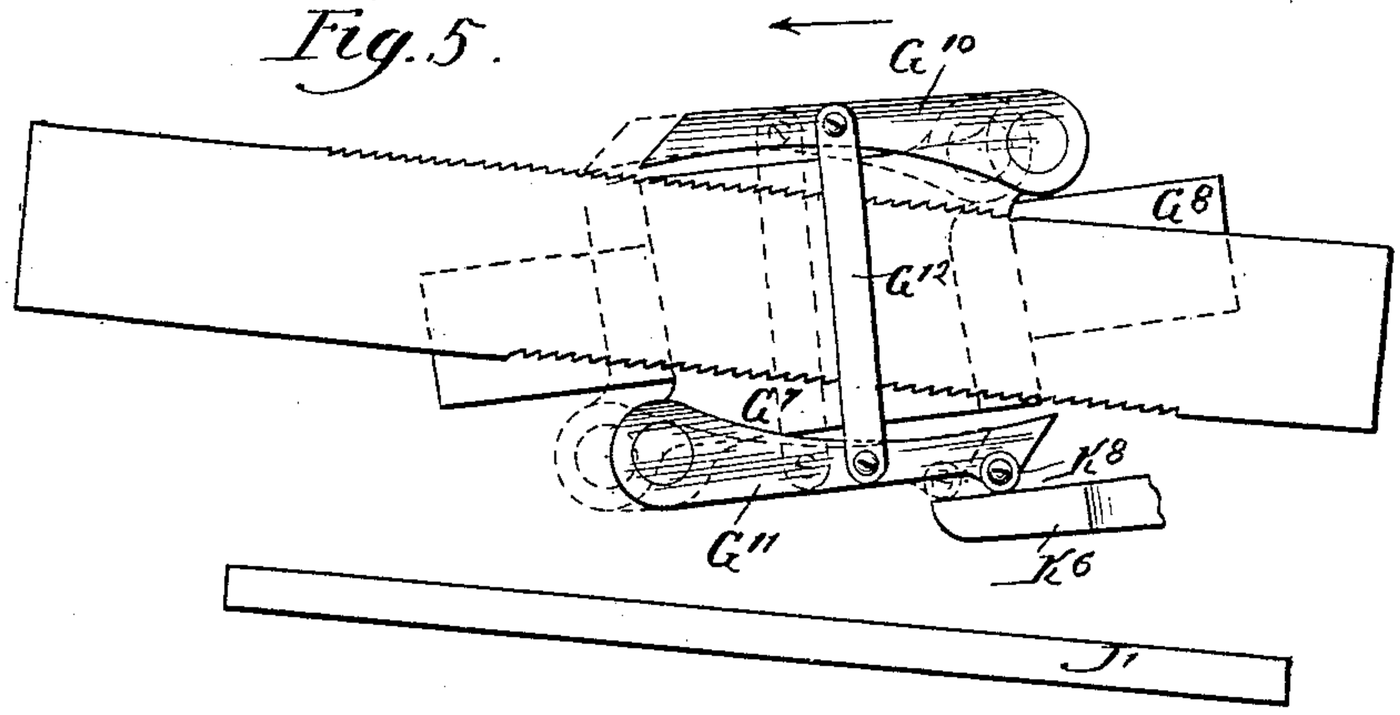
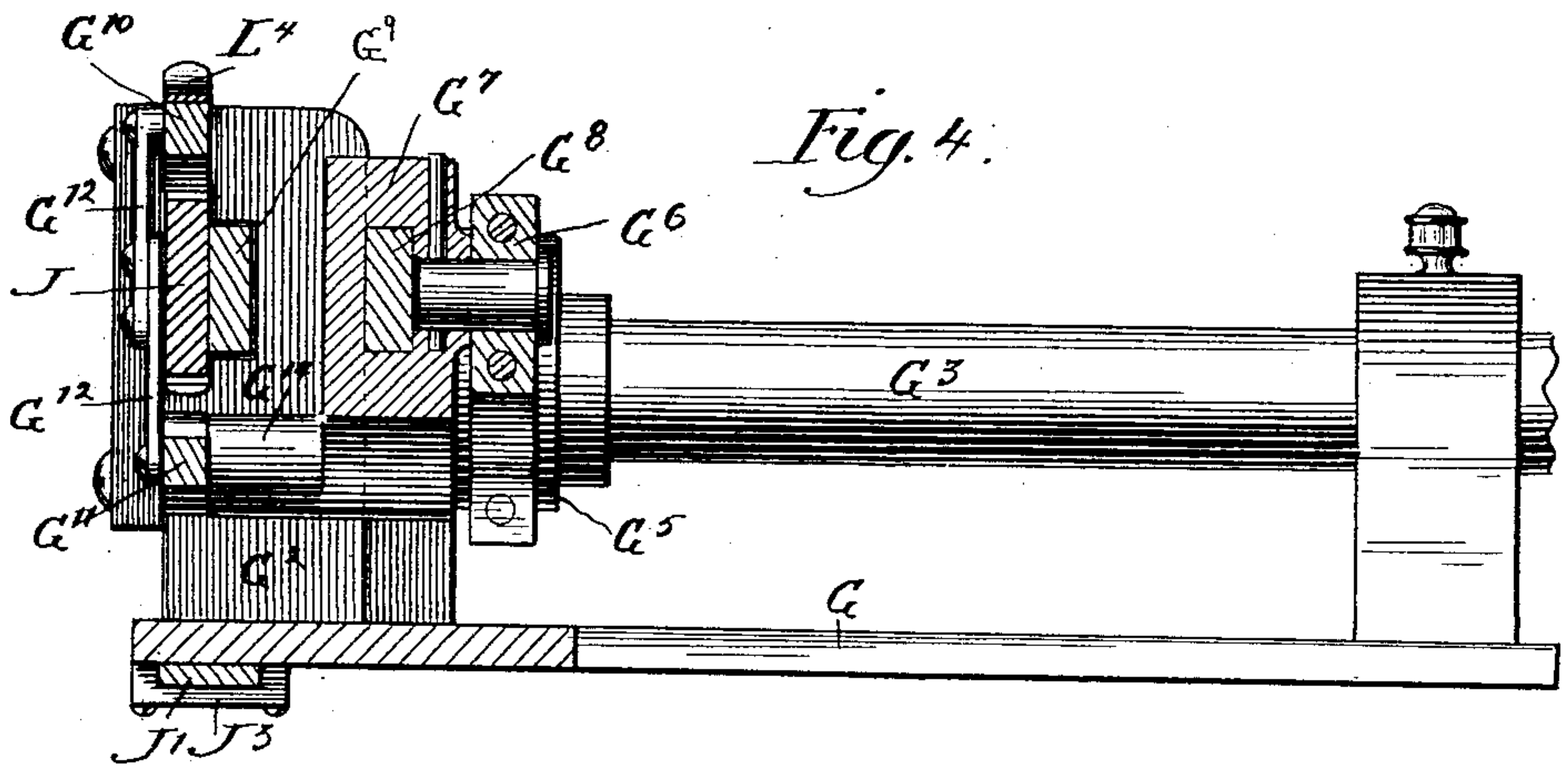


Fig. 4.



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UNITED STATES PATENT OFFICE.

ELMER A. SPERRY, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE SPERRY ELECTRIC COMPANY, OF SAME PLACE.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 398,668, dated February 26, 1889.

Application filed October 22, 1888. Serial No. 288,812. (No model.)

To all whom it may concern:

Be it known that I, ELMER A. SPERRY, a citizen of the United States, and a resident of Chicago, in the county of Cook and State of Illinois, have invented a new and useful Dynamo-Regulator, of which the following is a specification.

My invention relates to mechanism for regulating the current of dynamo-electric machines, and has for its object to provide a cheap and simple regulator.

My invention is illustrated in the accompanying drawings, wherein—

Figure 1 is an end view of a dynamo-electric machine with my device attached and parts removed. Fig. 2 is a side view of a portion of the driving mechanism. Fig. 3 is a plan view of the driving mechanism. Fig. 4 is a section thereof. Fig. 5 is a diagrammatic view of the driving-ratchet and dogs. Fig. 6 is a detail of the re-enforcing mechanism.

Like parts are indicated by the same letter in all the figures.

A is the armature; B, the commutator; C C, the field-magnets; D D, the brushes; E, the movable support therefor, which, together with the brushes, constitutes the movable current-collector; E′ E′, the conducting-wires, and F the bed-plate.

G is a plate supported on the standard G′ and bearing the vertical guides G^2 G^2.

G^3 is a shaft journaled on such frame and driven by means of the pulley G^4 from the end of the dynamo-shaft or other source of power.

G^5 is an eccentric, G^6 a pitman therefrom, and G^7 a block driven by such pitman. This block is supported so as to reciprocate on the guide-bar G^8, which is secured to the vertical guides G^2 G^2 at an angle to the reciprocating ratchet-bar G^9.

On the block G^7 are secured the dogs G^{10} G^{11}. These two dogs are adjustably secured to each other by the link-bars G^{12} G^{12}. The ratchet-bar is secured to the reciprocating frame, which consists of the upper bar, J, and lower bar, J′. This frame is connected by the spring or elastic connection J^2 with the current-collector. The bar J′ is guided by means of the cross-bars J^3 J^3 on the bottom of the plate G, and is provided with a cam, J^4, a portion of which may be composed of a parabolic curve and a portion of a straight line at an angle to the line of the motion of the bar. This angle is very slight. The angle and curve vary according to the inequality of action on the magnetic mass. The dogs are secured to the block G^7 by the lugs G^{11} G^{11}, and such block has an aperture to receive the guide-bar G^8.

K is a shaft journaled at one end to an arm from one of the field-magnets and at the other end to an arm, K′, from one of the standards G^2. Rigid to the shaft is the vibrator or magnetic mass K^2, adjustably and flexibly held at its lower end by means of the spring K^3 and thumb-nut K^4 to the arm K^5 from the bed-plate and in a position near one of the field-magnets C.

From the shaft projects the arm K^6, adjustably secured by the set-screw K^7, and receiving at its lower end a trunnion, K^8, journaled on the dog G^{11}. L is another arm from such shaft K; L′, a spiral spring therefrom; L^2, an elbow crank-lever pivoted on the bottom of the plate G, one arm secured to the spring L′ and the other carrying the trunnion L^3, which travels in the cam J^4.

L^4 is a spring which engages the dog G^{10}, and by the links G^{12} G^{12} opposes the upward movement of the arm K^6. The cam J^4 may be any shape as required and as above explained. The two springs M and N are shown impinging laterally against the reciprocating ratchet-bar G^9, and their office is to hold the reciprocating frame in any position to which it has been moved by the dogs, because of the spring-connection J^2, which tends to throw the frame back to its original position before inertia of the current-collector is overcome and motion imparted thereto.

The use and operation of my invention are as follows: It is not necessary to describe the ordinary operation of the dynamo, or the peculiarities of the flow of current, or the peculiarities of the development of currents in the coils of the armature, or the variations of the magnetism of the field-magnets, or the ordinary shifting of the current-collector between the points of minimum and maximum current upon the commutator for purposes of regula-

tion. Assuming that the parts are in the position indicated in Fig. 1 and the line-resistance permanent, the magnetization of the field-magnet will be constant, and the vibrator or magnetic mass K^2 will be held at a practically uniform distance from the adjacent field-magnet. If, now, the resistance be suddenly diminished—as, for instance, by the extinguishment of some of the lamps on the main line—and it is desired that the current-collector should rotate over toward the position shown in dotted lines, this motion can be accomplished by the retraction of the bars J and J′ and the spring-connection J^2. This will only take place when the lower dog, G^{11}, is held against its adjacent ratchet-bar, and in that event the reciprocations of the block G^7 will cause the dog to feed the bar J, together with the bars J′ and J^2, toward the left in Fig. 1, thus carrying the current-collector about toward the position indicated in dotted lines; but this action only takes place when the arm K^6 bears upward against the dog G^{11} sufficiently to overcome the downward tendency of the spring L^4. This motion the arm K^6 will have when the vibrator or magnetic mass K^2 is drawn with sufficient force toward the field-magnet C. The field-magnet C will draw this vibrator or magnetic mass to itself proportionately to the increase of magnetism in the field-magnet C, so long as the same is unaffected by the currents in the armature, and this increase takes place as the resistance in the line is diminished by the extinguishment of lamps or by other causes. The vibrator or magnetic mass K^2 is drawn closer to its magnet C, the arm K^6 forces the dog G^{11} into engagement with its ratchet, and the bars J, J′, and J^2 are moved step by step toward the left in Fig. 1 to rotate the current-collector toward the position indicated in dotted lines. This operation continues until the current-collector has reached a position where the current is again normal. It is found that as the current-collector moves toward the position indicated in the dotted lines the position of the neutral point of the armature so changes with reference to the field-magnet C, adjacent to the vibrator or magnetic mass K^2, that the resultant of the magnetism of the field-magnet C and the currents in the armature, which resultant affects the vibrator or magnetic mass, cannot sufficiently affect the vibrator or magnetic mass K^2, and I have therefore supplied the compensating motor, which is operated by cam J^4, so located on the bar J′ that as the neutral point approaches such described position the roller or trunnion L^3 travels along such cam J^4, and by means of the spring or motor L′ and arm L assists in holding the vibrator or magnetic mass K^2 toward its field-magnet. Generally the variation of the assistance during the greater part of this movement is not great; but as the collector nearly approaches the position indicated and the described resultant rapidly loses its power to affect the vibrator or magnetic mass K^2 the curved or parabolic portion of the cam J^4 receives the trunnion L^3, rapidly swings the elbow-lever L^2, and thus increases the power of the compensating motor or spring to force the vibrator or magnetic mass into that position which it must occupy to continue the excursion of the bar J toward the left in Fig. 1, and which position the magnetism of the field-magnet or the currents of the armature or the resultant of the magnetism and the currents of the armature are powerless to make it assume, and which position it must occupy to maintain the normal current in the exterior circuit traversed by the perfected or generated current.

The spiral spring, which is connected with the arm on the rock-shaft to which the magnetic mass is secured, operates as a compensating motor. Of course many other kinds of motors could be used in this position to reenforce or resist the action of the magnetic mass in compensation for its change of power incident to the variation in the magnetization of the field-magnet at the point near which such magnetic mass is placed, or, in other words, to the variation in the resultant of the magnetization of the field-magnet and the currents in the armature.

The shifting device or shifter for the movable current-collector consists, substantially, of the reciprocating bar, though of course other shifters might be used. This bar I call the "shifter." The block and pitman which are driven from the shaft of the dynamo I term the "driving-motor," since they co-operate to reciprocate the shifter. Great variations in this form of the device could be made, it being probable that even rotary motion could be employed.

The parts described as connections and so alluded to in the claims consist, essentially, of power-transmitting pieces or connections, the object being to communicate power or motion from one part to another. In the form of device shown the operation of the magnetic mass, aided at certain parts of the excursion of the shifter by the re-enforcing motor, which is controlled and set in operation by the cam, is primarily to apply the driving-motor to the shifter in such manner as to secure the proper motion of the shifter.

The magnetic mass may be of any shape or character and supported in any manner, and may even be of other than magnetic material, provided only its character is such as to make it respond as would the magnetic mass, as shown in the drawings—such, for example, as a solenoid.

The object is to transmit the force or power existing in the place where such mass is located into motion or power to be applied directly or indirectly to shifting the current-collectors or to connect the driving-motor with a device to shift such collectors. When the magnetic mass is located as shown, and the lamps are being turned on, the action of a compensating motor is to gradually decrease

the action which it exercises toward such mass. It might be possible to so place the magnetic mass as that this action would be reversed and the power of the magnetic mass would be in the first instance too great, and would require a diminishing resisting influence from the motor instead of an increasing aiding influence, as in the form herein described. In either case the result would be the same—namely, the compensation by such motor of the inequality of influence exercised over the magnetic mass by the field-magnet—and hence we call this the "compensating motor." The varying heights at which the dogs are held with respect to the ratchets by the lever K^6 permits them to skip a greater or less number of ratchet-teeth in successive excursions, and thus to engage the ratchets at varying points along their travel, as shown in Fig. 5. Thus each successive excursion of the dogs may cause the ratchets to travel unequal distances, owing to the angular arrangement of such ratchet-bar with reference to the travel of the dogs.

The ratchet-bar may be called a "shifter" when considered independent from the motor, or if regarded as fixed thereto it may be regarded as a part of such motor.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is as follows:

1. In a current-regulator for dynamo-electric machines, the combination of a vibrating magnetic mass in proximity to the field-magnet with a movable current-collector and an elastic connection between the two.

2. In a current-regulator for dynamo-electric machines, the combination of a vibrating magnetic mass pivoted in proximity to the field-magnet with a movable current-collector and an elastic connection between the two.

3. In a current-regulator for dynamo-electric machines, the combination of a magnetic mass responsive to the resultant of the magnetism of the field-magnet and the currents of the armature with a movable current-collector and a power-transmitting connection between the collector and the mass.

4. In a current-regulator for dynamo-electric machines, the combination of a magnetic mass in proximity to the field-magnet with a movable current-collector, connections between the two, a compensating motor, and power-transmitting connections therefrom to the collector.

5. In a current-regulator for dynamo-electric machines, the combination of a magnetic mass in proximity to the field-magnet with a movable current-collector, connections between the two, a compensating motor, and power-transmitting connections therefrom to the mass and thence to the collector.

6. In a current-regulator for dynamo-electric machines, the combination of a magnetic mass in proximity to the field-magnet with a movable current-collector and an elastic connection between the two, and a compensating motor and connections therefrom to the mass.

7. In a current-regulator for dynamo-electric machines, the combination of a magnetic mass in proximity to the field-magnet, a movable current-collector, a shifter therefor connected therewith, and power-transmitting connections between such mass and shifter.

8. In a current-regulator for dynamo-electric machines, the combination of a magnetic mass in proximity to the field-magnet, a movable current-collector, a shifter therefor connected therewith by an elastic connection, and power-transmitting connections between such mass and shifter.

9. In a current-regulator for dynamo-electric machines, the combination of a magnetic mass in proximity to the field-magnet, a movable current-collector, a shifter therefor connected therewith, a compensating motor connected with such mass, and power-transmitting connections between the shifter and mass.

10. In a current-regulator for dynamo-electric machines, the combination of a magnetic mass in proximity to the field-magnet, a movable current-collector, a shifter therefor connected therewith by an elastic connection, a compensating motor connected with such mass, and power-transmitting connections between the shifter and mass.

11. In a current-regulator for dynamo-electric machines, the combination of a magnetic mass responsive to the resultant of the magnetism in the field-magnet and the currents in the armature with a movable current-collector, connections between the two, a compensating motor connected with the mass, and a controller for such motor moving with the collector, so as at a certain point in the motion thereof to apply the said motor.

12. In a current-regulator for dynamo-electric machines, the combination of a movable current-collector with a shifter therefor, a driving-motor for such shifter, a magnetic mass in proximity to the field-magnet, and mechanical connections from the mass to the motor to control the application of the latter to the shifter.

13. In a current-regulator for dynamo-electric machines, the combination of a movable current-collector with a shifter therefor, an elastic connection from such shifter to such collector, a driving-motor for such shifter, a magnetic mass in proximity to the field-magnets, and connections from the mass to the motor to control the application of the latter to the shifter.

14. In a current-regulator for dynamo-electric machines, the combination of a movable current-collector with a shifter therefor, the two connected by an elastic connection, and a driving-motor for such shifter.

15. In a current-regulator for dynamo-electric machines, the combination of a movable current-collector with a shifter therefor, a driving-motor for such shifter, a magnetic mass in proximity to the field-magnet, a compensating motor, and connections for such

magnetic mass and re-enforcing motor to the driving-motor to control the application of the driving-motor to the shifter.

16. In a current-regulator for dynamo-electric machines, the combination of a movable current-collector with a shifter therefor having oppositely-faced ratchets, a driving-motor carrying oppositely-acting dogs to engage such ratchets, a magnetic mass in proximity to the field-magnet, and connections therefrom to the driving-motor to control the application of the driving-motor to the shifter.

17. In a current-regulator for dynamo-electric machines, the combination of a movable current-collector with a shifter therefor having oppositely-faced ratchets, a driving-motor carrying oppositely-acting dogs to engage such ratchets, a magnetic mass in proximity to the field-magnet, a compensating motor and connections from such mass and re-enforcing motor to the driving-motor to control its application to the shifter.

18. In a current-regulator for dynamo-electric machines, the combination of a movable current-collector with a shifter therefor having oppositely-faced ratchets, and a driving-motor for the shifter having oppositely-acting dogs to engage such ratchets, said dogs movable in a line at an angle to said ratchets.

19. In a current-regulator for dynamo-electric machines, the combination of a movable current-collector with a shifter therefor having oppositely-faced ratchets, a driving-motor for the shifter having oppositely-acting dogs to engage such ratchets, said dogs movable in a line at an angle to said ratchets, a magnetic mass in proximity to the field-magnet, and connections therefrom to the driving-motor to control its application to the shifter.

20. In a current-regulator for dynamo-electric machines, the combination of a movable current-collector with a shifter therefor, a driving-motor for such shifter, a pivoted magnetic mass in proximity to the field-magnet, and an arm therefrom to the driving-motor to control its application to the shifter.

21. In a current-regulator for dynamo-electric machines, the combination of a movable current-collector with a shifter therefor, a driving-motor for such shifter, oppositely-faced ratchets on the shifter and oppositely-acting dogs on the motor, said dogs movable in a line at an angle to the line of the ratchets, a magnetic mass in proximity to the field-magnet, a compensating motor and connections from the mass, and the re-enforcing motor to the driving-motor to control its application to the shifter.

22. In a current-regulator for dynamo-electric machines, the combination of a movable current-collector with a shifter therefor connected therewith by a spring-connection and having oppositely-faced ratchets, with a motor having oppositely-acting dogs to engage such ratchets, said dogs movable in a line at an angle to the line of the ratchets.

23. In a current-regulator for dynamo-electric machines, the combination of a movable current-collector with a shifter therefor, a constantly-moving motor to intermittently drive the same, severable connections between the motor and shifter, and a magnetic mass in proximity to the field-magnet, and connections therefrom to such severable connections to control the application of the driving-motor to the shifter.

24. In a current-regulator for dynamo-electric machines, the combination of a movable current-collector with a driving-motor for such collector, a magnetic mass in proximity to the field-magnet, and mechanical connection from the mass to the motor to control the application of the latter to the collector.

25. In a current-regulator for dynamo-electric machines, the combination of a movable current-collector, a driving-motor for such collector, a magnetic mass in proximity to the field-magnet, a compensating motor, and connections from such magnetic mass and compensating motor to the driving-motor to control the application of the driving-motor to the collector.

26. In a current-regulator for dynamo-electric machines, the combination of a movable current-collector with a driving-motor therefor having oppositely-faced ratchets and carrying oppositely-acting dogs to engage such ratchets, a magnetic mass in proximity to the field-magnet, and connections therefrom to the driving-motor to control the application of the driving-motor to the collector.

27. In a current-regulator for dynamo-electric machines, the combination of a movable current-collector with a driving-motor therefor having oppositely-faced ratchets and carrying oppositely-acting dogs to engage such ratchets, a magnetic mass in proximity to the field-magnet, a compensating motor, and connections from such mass and compensating motor to the driving-motor to control its application to the collector.

28. In a current-regulator for dynamo-electric machines, the combination of a movable current-collector with a driving-motor therefor having oppositely-faced ratchets and oppositely-acting dogs to engage such ratchets, said dogs movable in a line at an angle to said ratchets.

29. In a current-regulator for dynamo-electric machines, the combination of a movable current-collector with a driving-motor therefor, a pivoted magnetic mass in proximity to the field-magnet, and an arm therefrom to the driving-motor to control its application to the collector.

30. In a current-regulator for dynamo-electric machines, the combination of a movable current-collector with a shifter therefor, a constantly-moving motor to intermittently drive the same and adapted to be connected therewith, a magnetic mass in proximity to the field-magnet, and connections therefrom to such motor to control the application thereof to the shifter.

31. In a current-regulator for dynamo-electric machines, the combination of a movable current-collector, a shifter therefor, a driving-motor for said shifter, connecting parts between the shifter and motor and attached to one and adapted to engage the other at varying intervals, a magnetic mass in proximity to the field-magnet, and connections therefrom to the motor to control its application to the shifter.

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