(No Model.)

3 Sheets—Sheet 1.

E. THOMSON & E. W. RICE.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 339,079. Patented Mar. 30, 1886.

Fig. 1.

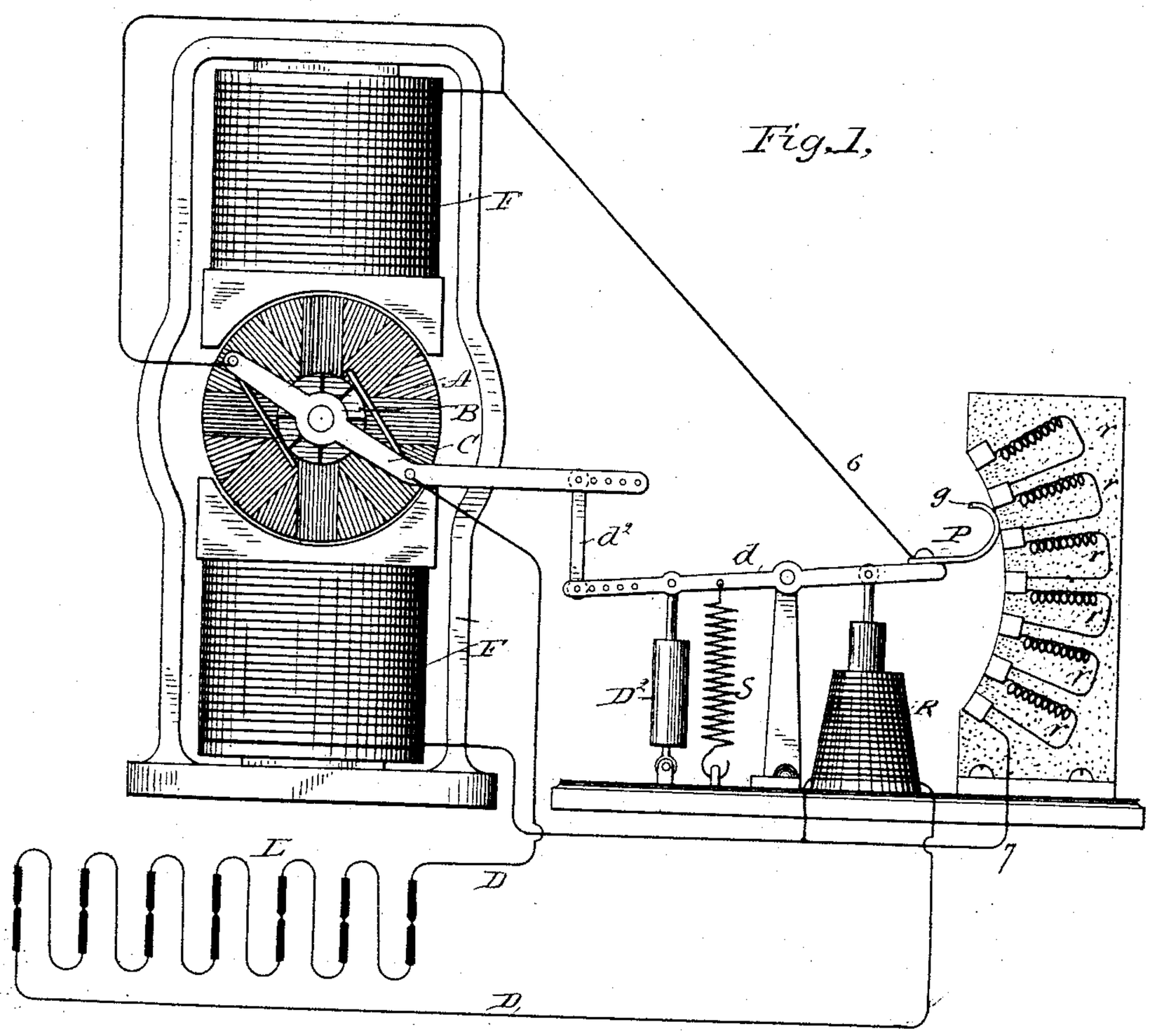


Fig. 2.

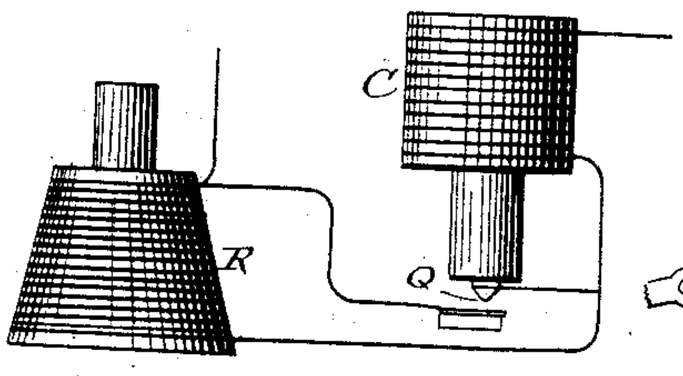
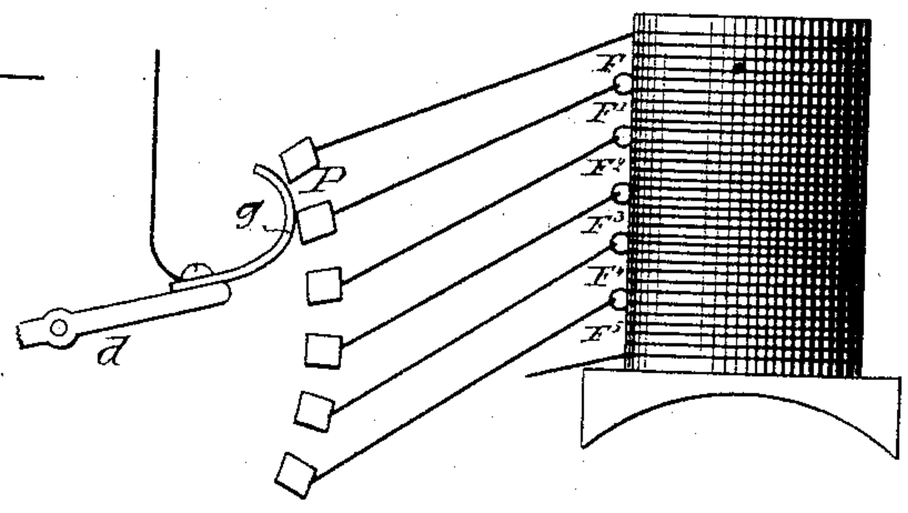


Fig. 3.



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By Their Attorney H. C. Townsend

(No Model.) 3 Sheets—Sheet 2.

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Fig. 4.

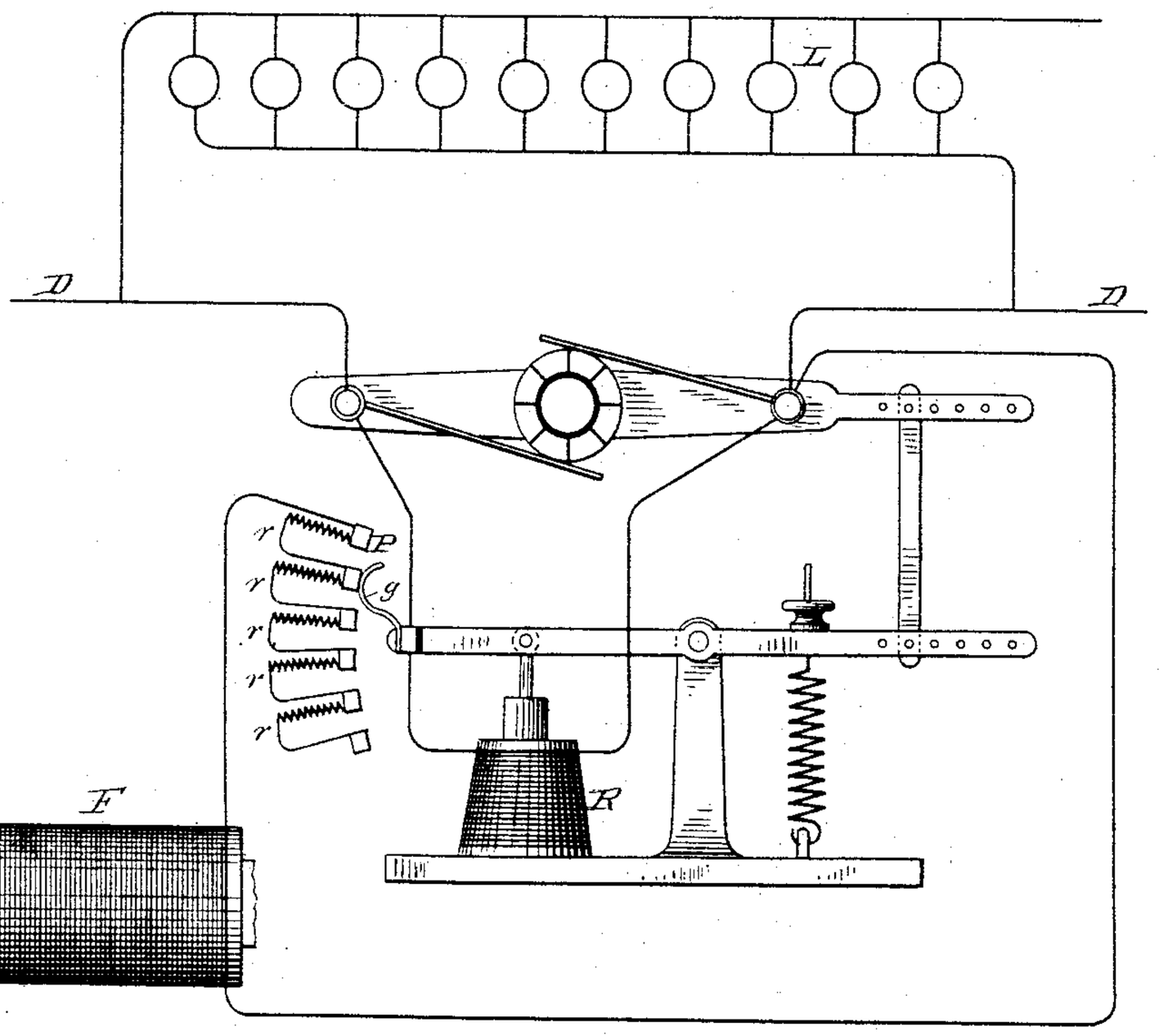
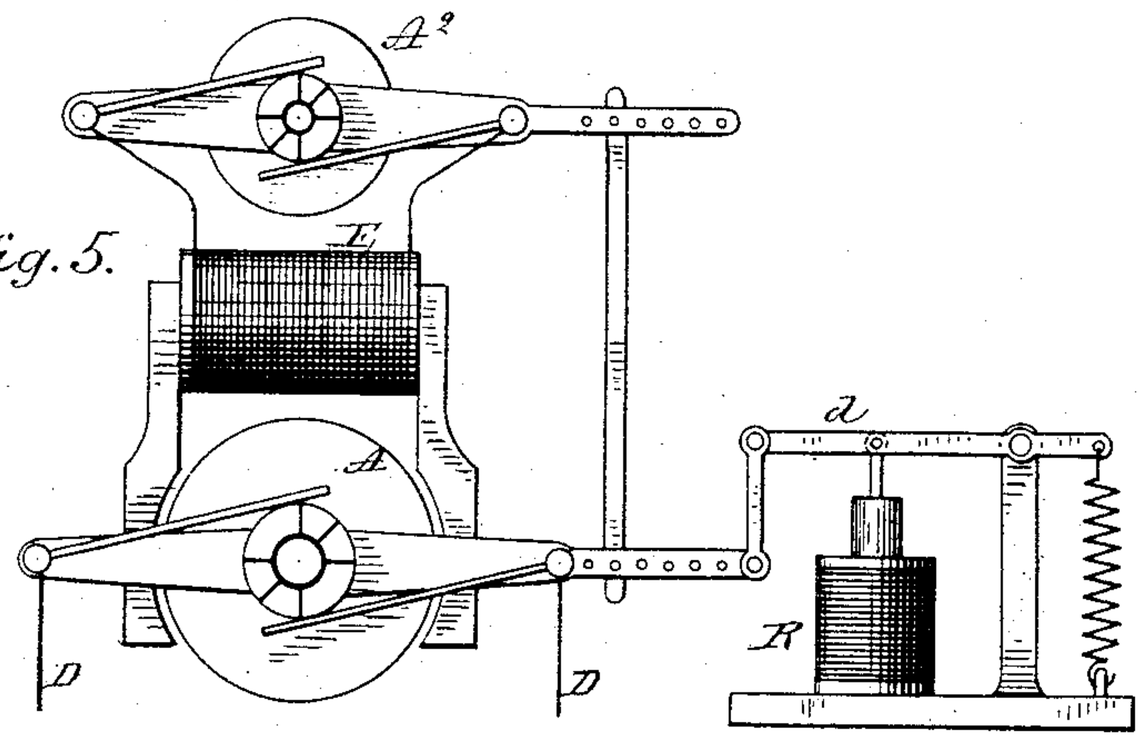


Fig. 5.



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3 Sheets—Sheet 3.

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Fig. 6.

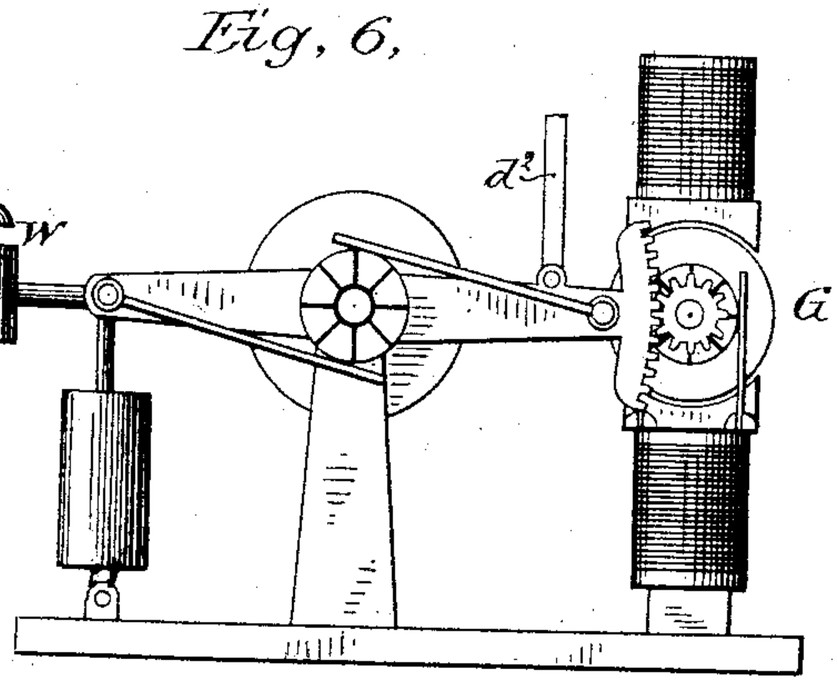


Fig. 7.

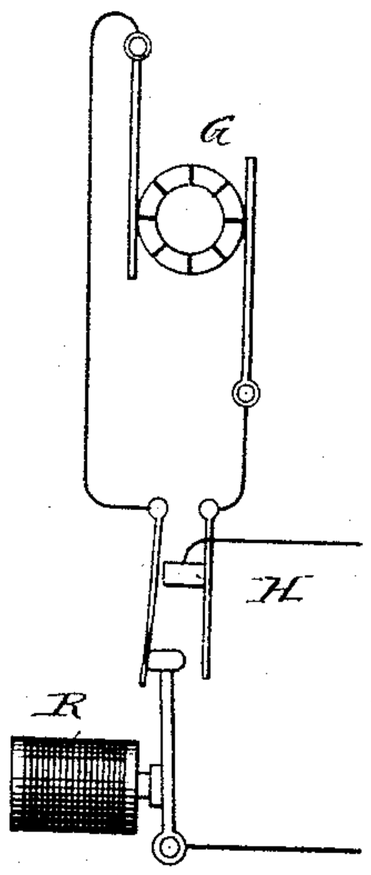


Fig. 8.

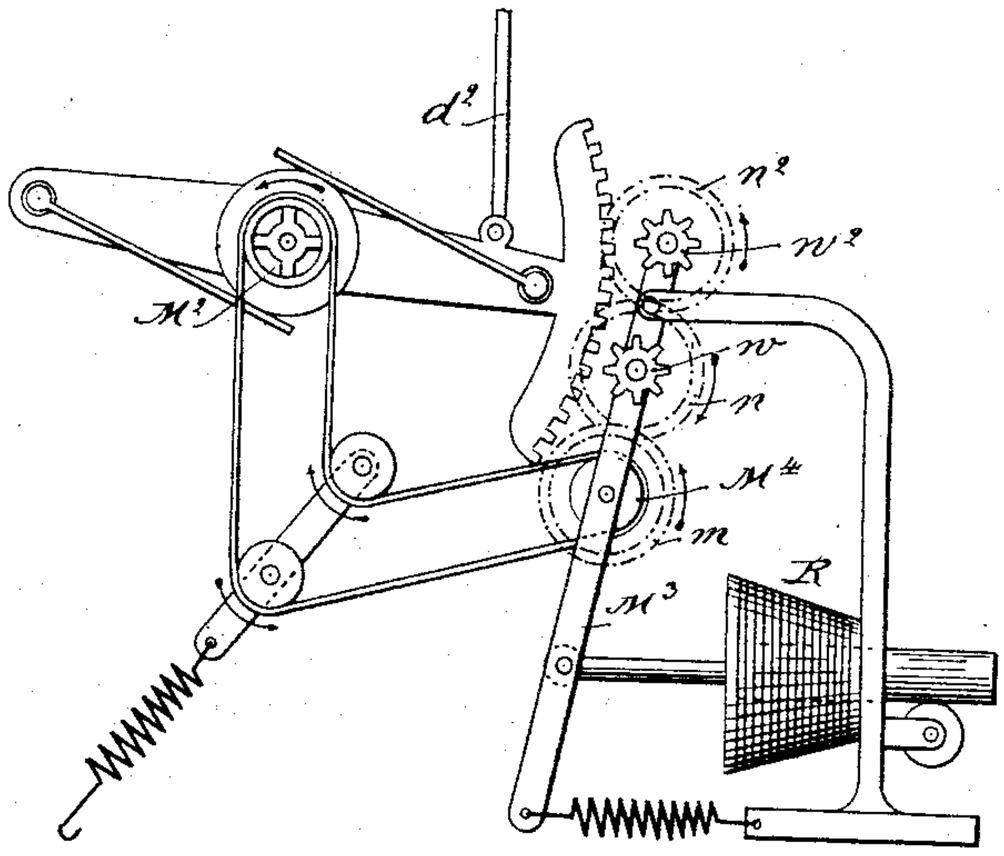
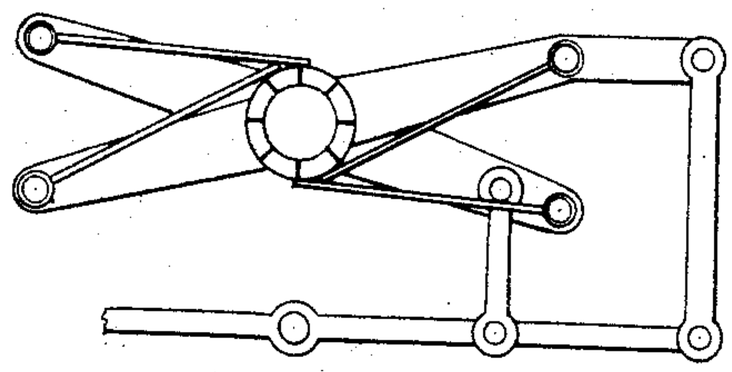


Fig. 9.



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Inventors:
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UNITED STATES PATENT OFFICE.

ELIHU THOMSON AND E. WILBUR RICE, OF LYNN, MASS., ASSIGNORS TO THE THOMSON-HOUSTON ELECTRIC COMPANY, OF CONNECTICUT.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 339,079, dated March 30, 1886.

Application filed January 28, 1884. Serial No. 118,996. (No model.)

To all whom it may concern:

Be it known that we, ELIHU THOMSON and E. WILBUR RICE, citizens of the United States, and residents of Lynn, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Regulators for Dynamo-Electric Machines, of which the following is a specification.

Our invention relates to current-regulators for dynamo-electric machines, and its object is to provide a more efficient adjustment or regulation than is attained by the regulators or governors at present in use, and also to improve the class of governors in which the current strength is controlled by varying the strength of the magnetic field in which the armature of the machine revolves.

Our invention consists, broadly, in the combination of means for varying the strength of the magnetic field in which the armature revolves and means operating simultaneously to adjust the commutator.

In carrying out our invention any devices or means for varying the strength of the magnetic field may be employed, and the adjustment of the commutator may be either an adjustment of the commutator-cylinder or of the commutator-brushes. The adjustment may be of such nature as to cause the commutator-brushes to follow or be maintained in practical coincidence with the neutral point as the strength of the field is varied, or the simultaneous adjustment imparted to the commutator may be such that the variation of effect due to adjustment of commutator toward or away from the neutral point shall be superadded to the effect due to variation of magnetic field. Thus, for instance, if the commutator-brushes be set forward at the same time that the field is diminished, the adjustment forward may be such as to exceed the shifting of the neutral point caused by change in the magnetic field, so that the current will be diminished both by diminution in the strength of the magnetic field and also by reason of adjustment of commutator forward or beyond the new neutral point existing with the weakened field. If the commutator be adjusted so as to maintain the same relation to the neutral point that existed before the change in the strength of the field, the diminution of current will then be primarily due to change of field; but the disturbing effect due to changed relation of commutator to the neutral point that would ensue if the commutator remained unadjusted will be avoided.

An important feature of our invention is to make the commutator, when adjusted, follow the shifting neutral point due to variation of the strength of field, and to thus avoid the element of imperfection due in regulators working by change in the strength of the magnetic field to the fact that with a weak field the neutral point or point of change in the polarity of current on the armature is farther removed from the geometrical neutral point in the direction of rotation than is the case with a stronger field.

In regulators working by variations of the magnetic field a decrease in the strength of field carries the neutral point forward in the direction of rotation, leaving the commutator adjusted for the neutral point as it stood before the change. By providing a simultaneous automatic adjustment of the commutator to correspond with the change in position of the neutral point we avoid any difficulties or disadvantages arising from this cause.

In the accompanying drawings we have shown a commutator adjustment effected by moving the brushes forward or back on the commutator-cylinder, because that is the simplest adjustment, mechanically considered. We, however, contemplate employing any kind of commutator adjustment whereby a change in the current taken from the armature would be effected, or whereby the delivery-point of the current from the coils may be adjusted with relation to the actual neutral point or point at which the polarity of the current is set up as the armature changes.

Some of the various ways in which our invention may be carried out are illustrated diagrammatically in the accompanying drawings, in which—

Figure 1 shows the invention carried out in connection with a machine the strength of whose field is varied by variably shunting current from the field-magnet coils. Fig. 2 shows a modified detail of the magnetic ap-

paratus, whereby the desired adjustments are automatically effected. Fig. 3 illustrates another manner of varying the strength of the field-magnet. Fig. 4 illustrates another method of carrying out our invention. Figs. 5, 6, 7, 8, and 9 illustrate other modifications that will be described in detail further on.

Referring to Fig. 1, F F indicate the field-magnet coils for a dynamo-electric machine of any desired construction, and A the armature thereof, revolving in the magnetic field formed by the poles of the field-magnet. B indicates the commutator-cylinder, and C an adjustable yoke or other support of any ordinary or suitable description, carrying the commutator brushes and adapted to be turned about the commutator axis so as to shift the brushes forward or backward on the cylinder. D D indicate the working-circuit, containing electric-arc lights or other working resistances, L. The field-coils F and the armature are in this instance in circuit with one another and with the working resistances, as usual in the art, and as shown. In said circuit, or connected therewith, is a governing or regulating magnet, R, whose movable core is connected to a lever, *d*, that carries at one end a contact-spring, *g*, adapted to move over a series of contact-plates, P, each connected to a loop from a series of resistance-coils, *r*, all arranged in a manner well understood so that the amount of resistance in the circuit 7 6, connected to *g* and to one terminal of resistances *r*, and forming a branch around the field-coils, will be varied by the movement of lever *d* under the influence of magnet R. As the strength of R increases the lever *d* is moved so as to decrease the resistance in the branch 7, thus shunting more current from the field-coils and cutting down the strength of the field, while a contrary movement and an increase in the strength of the field results from a decrease in the strength of magnet R. Lever *d* is provided with a suitable retractor, S, acting in opposition to the magnet R, and with a dash-pot, D^2, to prevent sudden and over movements of the parts.

The devices so far as described act to regulate the current upon the circuit containing the working resistances by varying or governing the strength of the magnetic field in which the armature moves. In addition, there is a simultaneous adjustment of the commutator, brushes, either to follow or to exceed the shifting neutral point produced by changes in the strength of the field, such adjustment being made in the present case to take place correspondently with the variation of the resistance in the shunt 7, by the simple expedient of connecting the yoke C with the lever *d* by a link, d^2, so that as the strength of the field decreases by the adjustment of the resistance, and the neutral point consequently shifts forward in the direction of revolution, the commutator-brushes will be made to follow or move in the same direction, and to either retain the same adjustment with relation to the neutral point, or, if it be desired, to move beyond the point necessary to maintain the same adjustment. Such excess of commutator adjustment may be effected by any desired mechanical arrangement or relation of the parts. The magnet R is preferably of such construction as to have a uniform pull upon its armature or core in all positions of the latter with the same strength of current. This may be effected by giving to the coil a larger number of turns near its bottom, or in any other desired way.

The magnet R may, if desired, be governed by a second magnet, C, as indicated in Fig. 2, which magnet may be in a derived circuit, or in the main circuit, as indicated, and may govern contacts Q, that complete a shunt around magnet R when the power of coil C to hold up its core decreases to a predetermined extent. The contacts Q are preferably carbon contacts, or other variable-resistance device whose shunting capacity will decrease with increase of lifting power of magnet C.

Fig. 3 simply illustrates how the strength of the field may be varied in the well-known way by varying the number of field-magnet coils in circuit. The field-magnet coil is divided into sections F F′ F^2 F^3, &c., to which contacts P are connected, as indicated. Contact-spring *g* moves over contacts P, and keeps a greater or less number of coils in circuit, according to the necessities of the case. The coils are placed in any circuit, and energized by a current from any source. This device may be substituted for the expedient shown in Fig. 1 for varying the strength of the magnetic field for the armature.

In Fig. 4 the main circuit D supplies current to a group of incandescent lamps in multiple arc, and the field-magnet coils are in a derived circuit which passes through an adjustable resistance formed by coils *r* and contacts P *g*, governed by armature-lever *d*. Magnet R is in a derived circuit of high resistances around the working-resistances, and its power increases with a diminution in the number of working-resistances, as incandescent lamps calling for a decrease of current to prevent injury to those remaining in operation. As the strength of R increases the resistance in the circuit of field-magnet F is increased, cutting down the magnetic field. The commutator-brushes are simultaneously and automatically adjusted. The parts may obviously be so adjusted or proportioned that the brushes shall be set forward beyond the new neutral point, so as to assist in diminishing the current taken off from the armature.

In Fig. 5 is illustrated an arrangement in which the strength of the field for the machine that supplies current to circuit D is varied by shifting the brushes of the commutator A^2 for an auxiliary machine whose duty is to supply the energizing-current that flows in coils F. The commutator A^2 has brushes mounted on

an adjustable yoke connected to lever *d*, so that, as will be obvious, a movement forward of the brushes of A^2, to decrease the strength of the field-magnet F, will, as in Fig. 1, be accompanied by a simultaneous adjustment of the brushes for commutator B to follow the shifting neutral point.

Figs. 6 and 7 illustrate how a rotary electric motor may be used to produce the desired adjustments. G indicates a rotary electric motor, of any desired description, geared to a segment upon the adjustable yoke that carries the commutator-brushes. Said motor may be supplied with current from any source, and its movement forward or back may be produced by a current-reverser, H, Fig. 7, constructed on the principle well known in telegraphy or in any other well-known manner, and operated by magnet R or other means in such way that when R increases in strength current will flow in one direction through G and cause an adjustment of the current-regulating mechanism in one direction to be produced, while on a reverse movement of the armature for R, due to weakening of R, a current will flow through G in a reverse direction and produce an opposite adjustment. While the magnet R is of the proper or adjusted strength the current-reverser H retains a central position and the motor remains at rest, practically no current flowing through it.

In Fig. 8 we have shown how the armature-shaft or other revolving power-driven shaft may, through the means of reversing mechanism controlled by R, be made to produce the desired movement of the parts. The shaft M^2 is belted to a wheel, M^4, upon a lever, M^3, connected to the core of R, and carrying on opposite sides of its fulcrum the wheels n n^2, gearing with one another and with a wheel, *m*, rotating with M^4. Moving respectively with the wheels n n^2 are the pinions w w^2, adapted to gear separately with the segment upon the rocker-arm that carries the commutator-brushes. In one position of the core of R the upper pinion, w^2, gears with the segment, thus shifting the adjusting mechanism in one direction. In the opposite position of the core for R the lower pinion, w, engages with the segment and produces an opposite adjustment. In the normal or intermediate position of the core neither pinion is in engagement with the segment, and the commutator-shifting and field-varying devices remain at rest and unaffected.

Instead of adjusting the two single brushes of a commutator, we may shift two sets of brushes, as indicated in Fig. 9. In this case each collecting-brush (positive and negative) is made up of two single brushes connected together electrically and shifted together in such way as to vary their collecting extent simultaneously with the forward or backward movement.

Other commutator adjustments may be used in place of those described.

We do not limit ourselves in this respect, the invention consisting, broadly, in combining an adjustable commutator of any kind with means for varying the strength of the magnetic field in such way that an adjustment of the latter shall be accompanied by or effect directly or indirectly an adjustment of the commutator.

The connection of the adjusting devices may be mechanical or of any desired nature, such that a movement of one shall be accompanied by a movement of the other.

We do not in any respect limit ourselves to the kinds of commutator adjustment described, nor to the means of varying the magnetic field. Where the adjustment is an automatic one, any controlling magnet or other device that will respond to variations of current may be employed, and may be placed in any desired position or relation to the machine or its circuits, so as to be affected by changes in the current of the machine.

What we claim as our invention is—

1. In a regulator for dynamo-electric machines, the combination of means for adjusting the commutator, and means for varying at the same time the strength of the magnetic field independently of any variation in strength that would be produced by an adjustment of the commutator, as and for the purpose described.

2. In a dynamo-electric machine, the combination of an adjustable commutator, means for varying the strength of the field, and automatic regulating devices governed by the current of said machine for effecting a simultaneous movement of the commutator-adjusting and field varying devices.

3. In a dynamo-electric machine, the combination of means for varying the strength of the magnetic field, an adjustable commutator, and a governing electro magnet or magnets excited by the current of said machine for governing the devices, whereby the strength of the field and the adjustment of the commutator are determined.

4. The combination, in a dynamo-electric machine, of means for varying the strength of the magnetic field, an adjustable commutator, and devices for imparting movement thereto at the same time, whereby an adjustment of the commutator is made to accompany a variation of the strength of the magnetic field.

5. In a dynamo-electric machine, the combination, with means for varying the strength of the magnetic field, of an adjustable commutator, and means for causing the same to follow the shifting neutral point as it shifts with the change in the field strength.

6. The combination, in a dynamo-electric machine, of a regulating magnet or magnets with mechanism controlling the position of the commutator and the strength of the magnetic field.

7. The combination, with a magnet, of a

lever actuated thereby in opposition to a suitable retractor, a movable commutator-brush support connected with said lever, and devices for varying the strength of the magnetic field connected with the same lever, as and for the purpose described.

Signed at Lynn, in the county of Essex and State of Massachusetts, this 22d day of January, A. D. 1884.

ELIHU THOMSON.
E. WILBUR RICE.

Witnesses:
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E. B. DOEN.