(No Model.) 2 Sheets—Sheet 1.

E. THOMSON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 430,327. Patented June 17, 1890.

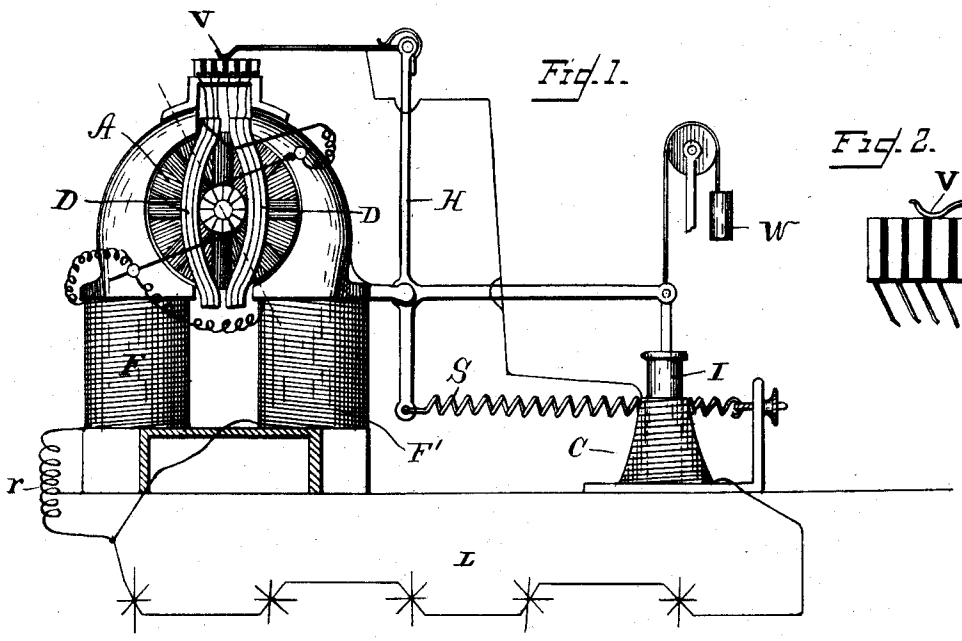


Fig. 1.

Fig. 2.

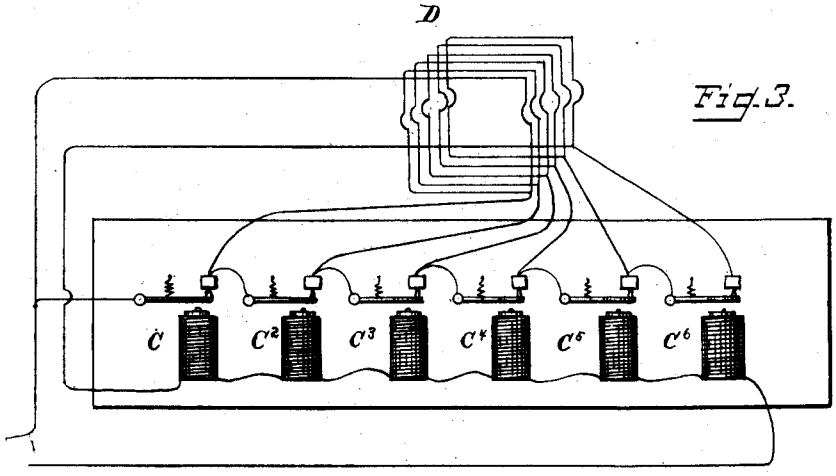


Fig. 3.

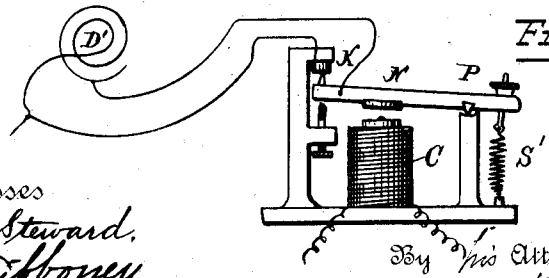


Fig. 4.

Witnesses
Ira R. Steward.
J. W. Gibboney

Inventor
Elihu Thomson
By his Attorneys
Townsend & MacArthur

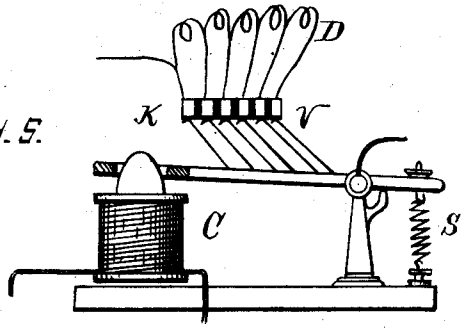
(No Model.) 2 Sheets—Sheet 2.

E. THOMSON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 430,327. Patented June 17, 1890.

Fig. 5.



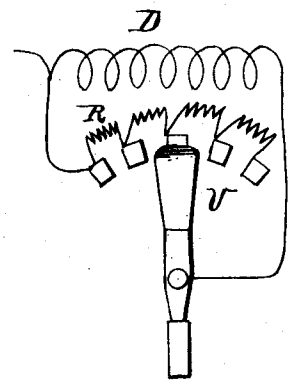


Fig. 6.

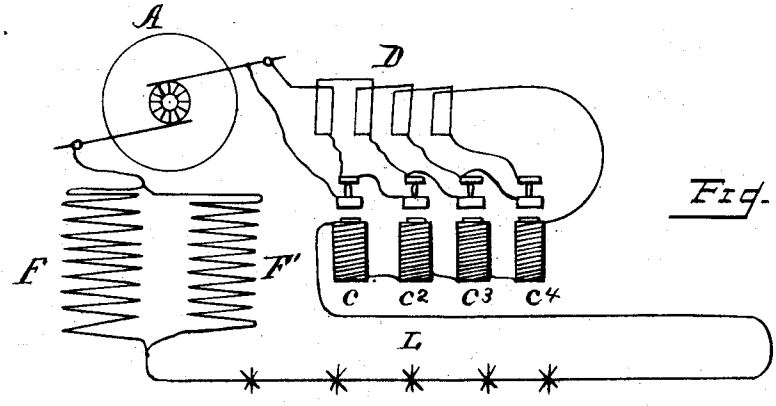


Fig. 7.

Witnesses
Ira R. Steward.
F. H. Gibboney

Inventor
Elihu Thomson
By his Attorneys
Townsend & MacArthur

UNITED STATES PATENT OFFICE.

ELIHU THOMSON, OF LYNN, MASSACHUSETTS.

REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 430,327, dated June 17, 1890.

Application filed March 8, 1888. Serial No. 266,639. (No model.)

To all whom it may concern:

Be it known that I, ELIHU THOMSON, a citizen of the United States, and a resident of Lynn, in the county of Essex and State of Massachusetts, have invented a certain new and useful Dynamo-Electric Machine, of which the following is a specification.

My present invention relates to an improvement in dynamo-electric machines whereby economy of material is obtained with high output in those machines which are to be used for constant-current purposes, and especially in arc-lighting machines.

I apply in my invention a set of demagnetizing or opposing coils around the armature of the machine, as in my Patent No. 333,573, dated January 5, 1886, and arrange means for varying the current which traverses the demagnetizing coil or coils over the armature or for varying the number of convolutions through which the current passes at any time. The object is to cause a great falling off of electro-motive force of the armature when the current increases slightly above the normal current, as when a fall of resistance occurs in the circuit either suddenly or gradually, or, in other words, the characteristic curve of the machine is made to descend or droop rapidly after a position on the curve is passed at which the normal current is yielded, or the current will be produced with an electro-motive force which is falling when the current increases and rising when the current decreases from the normal value.

In the accompanying drawings, Figure 1 shows in side elevation a dynamo-electric machine with my invention in one of its forms applied thereto. Fig. 2 shows a detail of the apparatus illustrated in Fig. 1. Fig. 3 illustrates an arrangement in which instead of the single controlling-magnet responsive to the changes of current a series of magnets is employed for the purpose of obtaining a more sensitive action. Fig. 4 illustrates in detail one of the magnets of Fig. 3. Fig. 5 shows an arrangement that might be employed for producing the same changes in the circuit as are produced by the series of magnets, Fig. 3. Fig. 6 illustrates an equivalent way of changing the effect of the demagnetizing-coils by shunting current variably from them instead of by varying the number of convolutions through which the current may pass. Fig. 7 is a diagram of the connections of the machines.

In Fig. 1, A indicates the armature of the machine, which armature is wound after the Gramme, Siemens, or other fashion, and is mounted in any suitable manner for revolving between the pole-pieces of a suitable field-magnet. The core of the armature contains so much iron as not to become saturated magnetically when the machine is at work. Upon the field-magnets coils F F′ are wound for magnetizing them strongly—as, for instance, nearly or quite to saturation. These coils are preferably wound and connected in multiple arc and placed in the main circuit of the machine, although other means of getting a strong field, even by shunt field-coils or by separate excitation, may be used. I prefer, however, the disposition shown.

In order to prevent, as far as possible, sudden changes in the magnetism of the field-magnet or sudden fluctuations occurring, I propose to make the field magnetism the resultant of the magnetizing effect of two or more field-magnet coils, which form or are placed in separate branches or circuits having different self-induction. On sudden increase of current the current will reach its maximum in one coil, after that in the other, owing to this difference of self-induction, and the disturbance will be distributed in point of time through an interval, so that the change will be less sudden than if the current reached its maximum in both of the coils at once. As the field magnetism is the sum of the effects of the two coils, it is obvious that the effect of this arrangement will be to make the change less sudden and marked than if the fluctuation or sudden increase of current took place in one single field-magnet coil only. The difference of self-induction in the two coils of branches may be obtained in obvious manner, as by giving a different number of turns to the coil. The current which passes in the two coils may be made equal by having their resistances equal, or by adding resistance to the coil branch which has the least resistance, as at *r*. Over the armature is placed or wound a stationary set of coils

D D, which, when in circuit, convey current in a direction to neutralize or tend to neutralize the induced magnetism of the armature as produced by the field-magnets. It is only requisite that this opposing action have a value such that under any conditions the machine yields its normal current and an electro-motive force just sufficient to maintain that normal current. A moving contact-arm V slides over a set of contact-pieces connected with the sections or successive turns of the coils D D, as shown, and this contact-arm V is controlled by a lever H, actuated by a magnet-core I of coil C against the counteraction of a balance-weight W and spring S. The coil C is made responsive to the variation of main current, and may therefore be put into the main circuit, as shown. The connections are such that when the current in the circuit of lights L increases above the normal the contact at V is shifted to bring into action the turns of D, traversed by current to oppose the magnetism of the field upon the armature A and cut down the electro-motive force, and when the current decreases from the normal to increase the said force by cutting out turns of coils D D. This gives stability of current strength under varied conditions, either with all the lights in circuit or with a lessened number.

It is obvious that any other form of magnet or any other arrangement of controller magnet and motor mechanism, such as are ordinarily used with electric regulators, might be employed in place of the magnet shown, and likewise that the switch-arm H might be moved by any other desired means, as by hand.

Fig. 2 simply shows the relation of the contact-arm V to the contacts. It is well to have it short-circuit a section or a few sections of coils D D in passing from one point to another to avoid spark.

The arrangement shown in Figs. 3 and 4 is designed to secure the greatest possible promptness of action and sensitiveness of the controlling main circuit in putting into the circuit the portions of the coils D of Fig. 1. A series of electro-magnets C C^2 C^3 C^4 C^5 C^6 are connected in series or in parallel in the main circuit, being wound accordingly, and their independent armatures are independently adjusted each to open a shunt-contact around a section of the coil D when a very slight departure from normal current takes place, and to close such shunts on a slight lowering of current. It will of course be understood that in this case the retractors for the different armatures are differently adjusted, so that they will be drawn down in succession as the amount increases from normal, a slightly-greater current being required to bring down each successive armature of the set. The armatures and magnets are preferably constructed as shown in Fig. 4, though any sensitive arrangement will suffice. The armature N, Fig. 4, is mounted on a lever with knife-edge pivots at P, and has a retractile spring S′, delicately poising the armature at normal current in coil C. The contact K is a shunt around D′, a section of coil D, Fig. 1, and this contact is opened and closed in consequence of slight variations of current in coil C. The armature is given a very limited range or play. The action is far more sensitive and prompt than is the case with Fig. 1, and under normal conditions a constant play of the armatures and contacts takes place.

In Fig. 5 the magnet C operates to open a group of shunt-contacts at K V around sections of coil D, and it may supplant apparatus of Fig. 3. The contacts are arranged to open in rapid succession, and not simultaneously, in which case the magnet C is given by construction a somewhat longer range without variation of pull with a given current.

The variation of power in coils D may, as indicated in Fig. 6, be secured by varying a shunt resistance R around D by a moving contact V, passing over a succession of fixed contacts, as usual in such cases. This plan is less economical of current energy.

In Fig. 7 the circuit-connections of Fig. 3, taken as a type, are displayed in complete form, although they might be variously modified.

What I claim as my invention is—

1. The combination, in a dynamo-electric machine, of a demagnetizing-coil or set of coils wound over the armature, and means responsive to current changes in the circuit supplied by the machine for varying the current in or the number of turns of said coil or set of coils, as and for the purpose described.

2. In a dynamo-electric machine, the combination, with a series of controlling-magnets connected to the circuit of the machine, of a demagnetizing-coil wound in sections over the armature of the machine, and circuits from said individual sections to switch contacts individually controlled by the magnets, as and for the purpose described.

3. In a dynamo-electric machine, two field-magnet coils arranged in separate branches or circuits having different self-induction, and an artificial resistance in one of said circuits adjusted, as described, so as to distribute the current in a manner to cause the current to be distributed equally in the two coils.

Signed at Lynn, in the county of Essex and State of Massachusetts, this 23d day of February, A. D. 1888.

ELIHU THOMSON.

Witnesses:
OTIS K. STUART,
F. W. WEBSTER.