

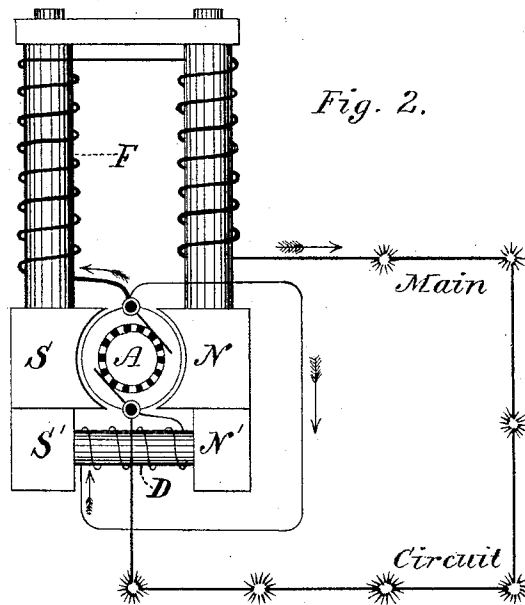
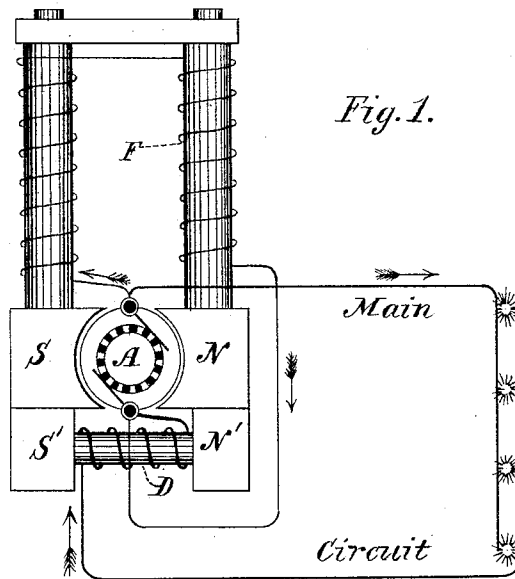
(No Model.)

R. H. MATHER.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 337,778.

Patented Mar. 9, 1886.



Witnesses:

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# UNITED STATES PATENT OFFICE.

RICHARD H. MATHER, OF WINDSOR, CONNECTICUT.

## REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 337,778, dated March 9, 1886.

Application filed May 21, 1884. Serial No. 132,231. (No model.)

*To all whom it may concern:*

Be it known that I, RICHARD H. MATHER, a citizen of the United States, residing in the town of Windsor, county of Hartford, and State of Connecticut, have invented certain new and useful Improvements in Regulators for Dynamo-Electric Machines, of which the following is a full, clear, and exact description, whereby a person skilled in the art to which it appertains can make and use the same, reference being had to the accompanying drawings.

My invention is an automatic regulator for dynamo-electric machines. The latter term is here used in a broad sense, including all machines for converting energy in the form of dynamical power into energy in the form of electric currents by the operation of causing conductors—usually in the form of copper wire—to rotate in a magnetic field.

The object of my invention is so to regulate a dynamo-electric machine that the same shall produce a standard or uniform electro-motive force or current, as the case may be, regardless of variations of resistance in the external circuit, a result which is particularly desirable in electric lighting and in the electric deposition of metals. My device for accomplishing this object is a variable magnetic switch or shunt consisting of an electro-magnetic armature of the field-magnet, and may for convenience be termed a "detractor."

I proceed to point out the best mode of applying my invention to different types of dynamos.

In the drawings, Figure 1 is a diagrammatic representation of my invention as applied to a shunt-dynamo with the detractor in the main circuit. Fig. 2 is a diagrammatic representation of my invention as applied to a series dynamo, with detractor in a special shunt-circuit.

In these drawings, F is the field-magnet, whose particular form is unimportant in this connection. The north and the south poles of the field-magnet, which are lettered, respectively, N and S, should, however, be of convenient form for the juxtaposition of the detractor, as hereinafter described.

A is the revolving armature, provided with brushes and commutator in the usual manner, as shown.

D is the detractor, which is a core of soft

iron wound as an electro-magnet and having north and south poles or pole-pieces lettered, respectively, N' and S', and of any convenient form for contact with N and S, before mentioned, as shown.

The field-magnet and detractor are fixed with their like poles together, as shown, and may conveniently be bolted together.

The amount of winding of the detractor should be such as to produce the same intensity of magnetization therein as exists in the field-magnet.

In order that both the magnetic conductivity of the detractor, as dependent upon the quantity of iron utilized therein as a shunt, and the electro-magnetic power of the detractor-helix, as dependent upon the quantity of wire composing the same, may be properly proportioned relatively to each other in the case of a machine which is to be regulated for constant electro-motive force, (see Fig. 1,) I proceed in the construction of such machine in the following manner: Having completed the machine in the usual manner as to all parts thereof, except the detractor, I ascertain by experiment what quantity of wire of the size which is selected for the purpose is necessary to produce in the detractor, when wound thereon and placed in circuit, the same intensity of magnetization as is produced in the field-magnet by the field-magnet coil in the normal operation of the machine. The size of the wire which is selected for this purpose should be as large as convenient in order that the same may not reduce the efficiency of the machine by unnecessarily increasing the resistance of the circuit. Next I introduce the wire so selected and determined into the circuit which contains the lamps or other resistances representing the work to be done. Then, having placed in circuit the maximum number of lamps which the machine is designed to operate, I run the machine at such speed as will bring all the lamps to the desired degree of brilliancy. This is the normal speed of the machine. Next, before winding the detractor, I place the same unwound in its position of contact with the field-magnet, as shown in the drawings, and as described above. At the same time, and while the wire before selected remains in circuit, I turn out all the

lights in the circuit except one, and observe the result. If the single remaining light is too bright, I increase the mass of the detractor, and if too dim I remove some of the iron from the core of the detractor until a brilliancy slightly below the standard brilliancy is obtained. The next step is to wind the wire so selected and ascertained onto the core of the detractor, so made of the proper size, in the manner already described. This process renders the mass and winding of the detractor practically correct both for the maximum and for the minimum number of lights in circuit, and no special adjustment further than this is necessary in order that the machine may operate satisfactorily with any intermediate number of lights in circuit.

In the construction of the dynamo regulated for constant current, Fig. 2, I adopt a similar method for determining the size and winding of the detractor.

The remaining features of construction and the appropriate connections will sufficiently appear from the drawings and from the mode of operation, as hereinafter explained.

The work to be done may be taken to be electric lighting by lamps in the main circuit.

The mode of operation in the case of the shunt-dynamo having the detractor in the main circuit, Fig. 1, is as follows: The machine being adjusted to operate the maximum number of incandescent lamps in a proper manner, if a number of these lamps less than all of them be turned out, then although the current in the main circuit is thereby diminished, yet the electro-motive force of the machine is increased. This increase of electro-motive force increases the energy of the field-magnet, so that the intensity of its field tends to increase too much; but the diminution of the current in the main circuit, by diminishing the electro-magnetic power of the helix of the detractor, causes the latter to be less magnetized than before, so that less resistance is offered to the passage of magnetism through the detractor from pole to pole of the field-magnet; hence an increasing quantity of magnetism is shunted away from the armature A and through the detractor, so that the field of magnet F tends to be weakened by the loss of the magnetism so shunted through the detractor at the same time that the said field tends to an undue increase of intensity from the increase of electro-motive force, as just described, whereby an equilibrium of effects is produced, and a uniform electro-motive force is preserved regardless of the extinction of lights, as stated, and the remaining lights in the circuit continue to burn without increase of brilliancy.

In the case of the series dynamo having the detractor in a special shunt-circuit, as shown in Fig. 2, in connection with a series of arc lights or other resistances in the main circuit, if one or more, less than all, of the lights be cut out of circuit the resistance in the main line is diminished, and the current is increased.

This increase of current increases the strength of the field-magnet, which in turn again increases the current, so that its field would be too intense for the lights in circuit; but the diminished current in the shunt-circuit resulting from the diminution of resistance just mentioned causes a diminution of the magnetic power of the helix of the detractor. The latter being in consequence less magnetized than before, allows more than before of the magnetism of the field-magnet to be shunted through the detractor, so that by this magnetic shunt the field of the magnet F tends to be weakened at the same time that the field tends, as before explained, to become too intense through undue increase of current; hence an equilibrium of effects is produced, and a uniform current is preserved regardless of extinction of resistance in the main circuit in the manner supposed, and the remaining arc lights continue to burn without increase of brilliancy.

The application of my invention in the case of a separately-excited dynamo and in the case of a magneto-dynamo or "magneto-electric generator," as it is called, as well as in the case of mixed types of dynamos needs no separate illustration or explanation, being sufficiently obvious from the applications already illustrated and explained. The general plan is this: Across the poles of the field-magnet I place a magnetic shunt which is the core of an electro-magnet of variable magnetic resistance, which resistance is automatically controlled and adjusted by the action of the coils of such electro-magnet. The detractor maintains a constant electro-motive force if its coils be in the main circuit. It maintains a constant current if its coils be in a shunt-circuit.

It is to be observed that this invention is a governor to preserve uniformity of current or electro-motive force as against variations in the number of lights in operation or as against other variable resistance in the external circuit, but is not a governor as against irregularity or variations in the speed of the engine or dynamo.

So far as concerns the present case, I disclaim all things which are claimed in Letters Patent of the United States No. 334,712, which were issued January 19, 1886, to the Mather Electric Company, for an improvement in regulators for dynamo-electric machines; neither do I broadly claim in a dynamo-electric machine the combination, with the field-magnet poles thereof, of one or more iron bridges placed directly across said poles and inclosing the armature, thereby magnetically short-circuiting the field of force, said bridges being provided with proper helices, as desired, and independent of the field-magnet coils; but

I claim as my invention, and desire to secure by Letters Patent—

1. In a dynamo-electric machine, the field-magnet F, in combination with the detractor

D, said magnet and detractor having constantly-closed circuit-connections and being placed one in the main or working-circuit of such machine, and the other in a derived circuit about the work, substantially as and for the purpose specified.

2. In a dynamo-electric machine, a field-magnet, in combination with a fixed armature thereof, said field-magnet and armature being severally wound as electro-magnets and constantly connected, one in the working-circuit of such machine and the other in a shunt-circuit about the work, substantially in the manner and for the purpose specified.

3. In a dynamo-electric machine, a field-magnet, in combination with a magnetic switch or shunt between the poles thereof, said field-magnet and switch being electro-magnets which are constantly connected in parallel arc, substantially in the manner and for the purpose specified.

4. In a dynamo-electric machine, an electro-magnet whose core is a magnetic shunt between the poles of the field-magnet, and whose

helix, being in a constantly-closed circuit, is connected in parallel with the helix of such field-magnet, substantially in the manner and for the purpose specified.

5. In a dynamo-electric machine, an electro-magnet whose poles are respectively adjacent to like poles of the field-magnet and whose helix is in a constantly-closed circuit with the armature independently of the helix of such field-magnet, substantially in the manner and for the purpose specified.

6. In a dynamo-electric machine, the detractor D, wound as an electro-magnet and constantly connected in the main or shunt circuit of such machine independently of the field-magnet, substantially in the manner and for the purpose specified.

In witness whereof I have hereunto set my name in the presence of two subscribing witnesses.

RICHARD H. MATHER.

Witnesses:

WILLARD EDDY,  
RALPH H. PARK.