No. 775,453. PATENTED NOV. 22, 1904.

W. L. MERRILL.

REGULATING DYNAMO ELECTRIC MACHINES.

APPLICATION FILED JUNE 11, 1902.

NO MODEL.

Fig. 1.

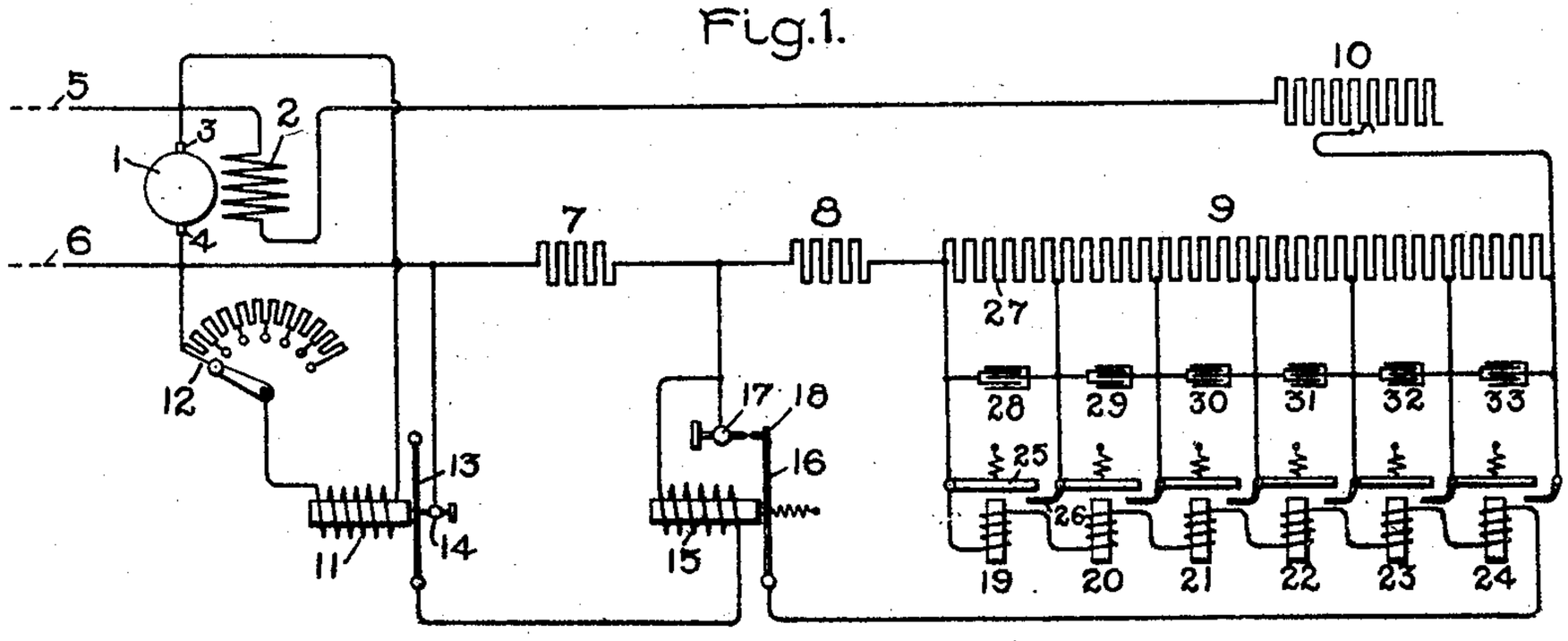
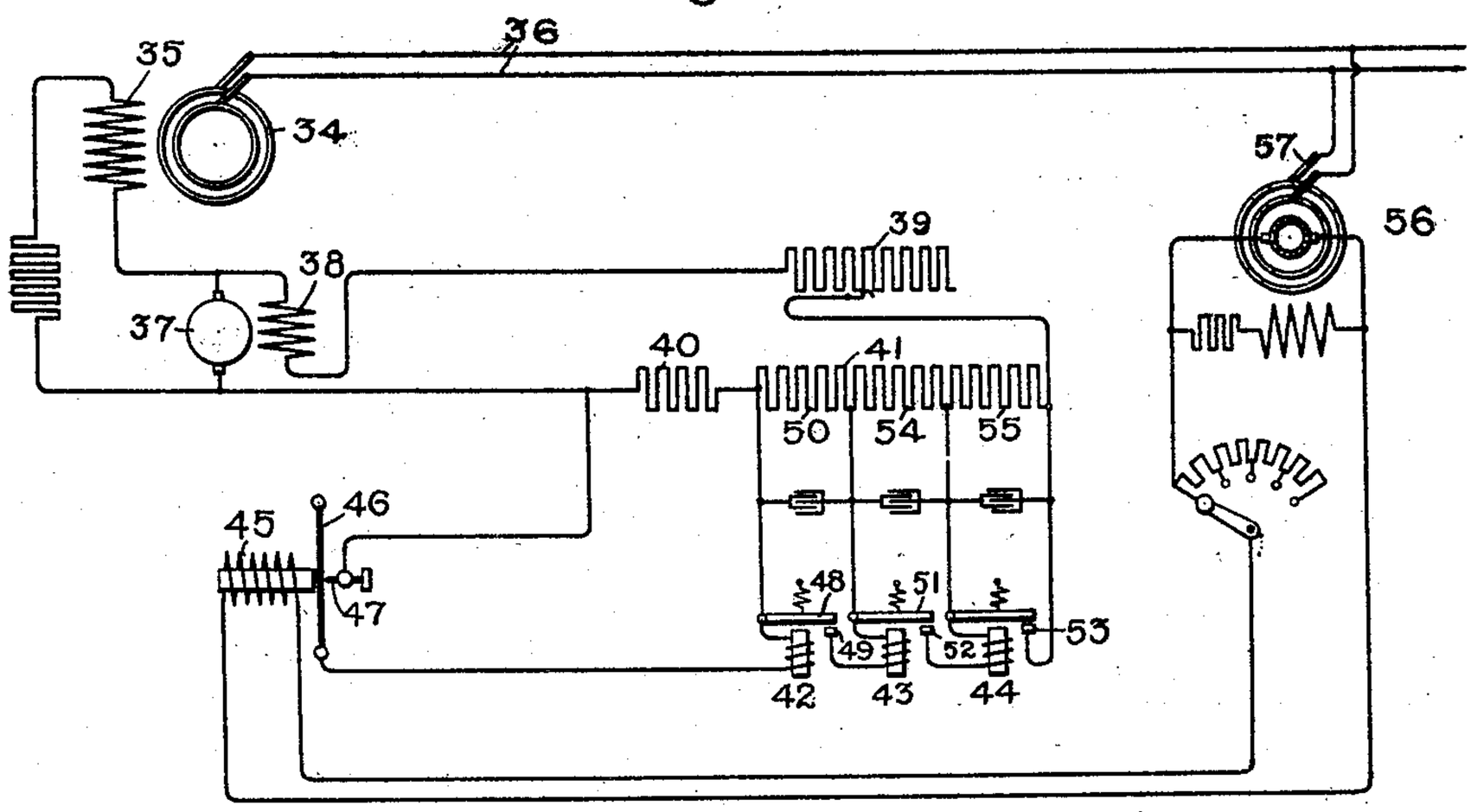


Fig. 2.



Witnesses.
Emma R. Gurney.
Helen Oxford

Inventor.
Wilbur L. Merrill,
by Albert G. Davis
Atty.

PHOTO-LITHOGRAPHED BY SACHETT & WILHELMS LITHO. & PTG. CO. NEW YORK.

No. 775,453. Patented November 22, 1904.

UNITED STATES PATENT OFFICE.

WILBUR L. MERRILL, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

REGULATING DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 775,453, dated November 22, 1904.

Application filed June 11, 1902. Serial No. 111,148. (No model.)

To all whom it may concern:

Be it known that I, WILBUR L. MERRILL, a citizen of the United States, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Regulating Dynamo-Electric Machines, of which the following is a specification.

My present invention relates to means for regulating the amount of current flowing in the field-windings of dynamo-electric machines, and comprises certain improvements, the novel features of which are particularly pointed out in the appended claims.

The invention itself will be best understood by reference to the following description, which is to be taken in connection with the accompanying drawings, in which—

Figure 1 represents one embodiment of my invention, and Fig. 2 a modification.

In Fig. 1 the machine to be regulated is of the direct-current type, having an armature indicated at 1 and a field-winding at 2. This field-winding is in shunt to the brushes 3 4, which bear upon the commutator, these brushes being in turn connected to the mains 5 6, by which current is conveyed to or from the machine. In series with the field-winding 2 are a number of adjustable resistance-sections represented at 7, 8, 9, and 10, the latter resistance being manually adjusted for the purpose of regulating the conditions of operation of the machine. The remaining resistance-sections are utilized in connection with the controlling-magnet 11, connected, through an adjustable resistance 12, in shunt to the terminals of the machine, as indicated. This regulating-magnet being thus connected between the terminals of the machine to be regulated is responsive in the strength of its magnetic core to variations of voltage between these terminals. Thus as the voltage at the terminals of the machine rises or falls the strength of the core of the regulating-magnet rises and falls correspondingly. Within the influence of the magnetic field produced by the regulating-magnet is placed a resiliently-mounted armature 13, consisting in this case of a stretched strip of magnetic material, which when the strength of the field of the regulating-magnet is below normal presses against an adjustable contact 14 and when the strength of the field is above normal is urged away from this contact. The opening and closing of this contact is arranged in the following manner, so as to produce corresponding variations in the resistance in circuit with the field-winding 2 of the machine to be regulated.

A relay-magnet 15 is connected in shunt to the resistance 7 and includes in circuit therewith the adjustable contact 14 and the coöperating armature or strip 13. This connection in shunt to the resistance 7 furnishes a convenient means for energizing the relay 15; but it is evident that any other suitable source of current may be employed. This relay operates upon an armature 16 to open and close at the contacts 17 18 the circuits of a plurality of other relay-magnets 19 to 24, inclusive. These magnets receive their energy from a shunt connection across a resistance 8, in series with the field 2; but, as in the case of the master-relay 15, current might be supplied to these magnets in any suitable manner. These magnets I have represented in the drawings as being connected in series with each other; but it is evident that various other modes of connection might be employed without departing essentially from my invention—such, for example, as connecting the magnets in multiple with each other or in multiple series or the like. These connections are too obvious to need illustration in the drawings.

Each of the relay-magnets 19 to 24 operates upon a corresponding armature to open and close a pair of contacts. Each pair of contacts is included in a circuit shunted about a section of the resistance 9. Thus, for example, the magnet 19, by drawing down its armature 25, brings the latter into engagement with the fixed contact 26, thereby short-circuiting the section 27 of the resistance 9. In the same way each of the other magnets acts upon its armature and a fixed contact to open or close a short circuit about the other sections of the resistance 9, as will be evident from the drawings without specific reference by numerals to

the parts thus mentioned. Across the make-and-break contacts operated by the relay-magnets 19 to 24 are connected a series of condensers 28 to 33, inclusive, for reducing the sparks produced when the contacts are opened.

In adjusting the apparatus for normal operation the adjustable contact 14 is arranged so that the attraction of the magnet 11 is such that the contact between the armature 13 and the adjustable contact 14 is just upon the point of opening. The strength of field of the machine is at the same time adjusted to the amount desired by means of the adjustable resistance 10. If now there occurs the slightest increase in voltage across the terminals of the machine, the contacts 13 and 14 open, thereby deënergizing the master-relay 15 and causing the armature of the master-relay to fall back, thus opening the circuit of the relays 19 to 24, the armatures of which fly back, thus opening the short circuits about the several sections of the resistance 9, thus suddenly inserting a large resistance in the circuit of the field 2, and so reducing the field strength. This reduction in field strength immediately reacts to reduce the voltage at the terminals of the machine, which in turn weakens the magnet 11 and allows the contacts 13 and 14 to close, thereby energizing the master-relay 15, which then closes the circuits of the relays 19 to 24, which operate to short-circuit the several sections of the resistance 9. The voltage at the terminals of the machine then rises.

In practice it is found that the armature 13 keeps up a continuous vibration, thereby causing a continuous opening and closing of the shunt-circuits about the sections of the resistance 9. The rapidity with which these operations take place prevents any perceptible variation in the voltage across the terminals of the regulated machine, and this voltage is maintained constant throughout wide variations of load.

The arrangement which I have above described is intended particularly for use in connection with machines in which the current in the field-circuit is of considerable value. By using a plurality of relays 19 to 24, controlling a corresponding number of contacts, as at 25, the current to be broken by the relays is divided up, so that only a comparatively small proportion of the total current is to be taken care of by each relay. The spark produced at each relay-contact is therefore much smaller than if a single relay were employed to shunt the resistance 9, and this spark is still further reduced in the case of each pair of the relay-contacts by the use of a condenser shunted about the same, as indicated.

In Fig. 2 certain other features of my invention are shown in connection with the regulation of an alternating-current machine, the armature of which is indicated conventionally at 34 and the field-winding at 35. From the armature extend the alternating-current mains 36, which supply current to a suitable receiving circuit or circuits. The field-winding 35 of the alternating-current machine is supplied with current from an exciter, the armature of which is indicated at 37 and its field-winding at 38. In circuit with this field-winding is an adjustable resistance 39, corresponding to the resistance 10 in Fig. 1 and other adjustable resistances 40 and 41. The resistance 41 is divided into three sections, about which shunt-circuits are alternately opened and closed by the operation of the relay-magnets 42, 43, and 44, which relay-magnets are controlled directly by the regulating-magnet 45. This regulating-magnet acts upon an armature 46, consisting, as shown, of a stretched strip of magnetic material, which armature is adapted to make contact with an adjustable contact 47. The coil of the relay 42 is shunted about the resistance 40 in the field-circuit and includes in circuit therewith the make-and-break contacts 46 and 47. When the contacts 46 and 47 close, the magnet 42 is energized, thus drawing down its armature 48, which when it touches the fixed contact 49 closes the circuit of the next relay-coil 43 about the section 50 of the resistance 41. The magnet 43 being thus energized in turn draws down its armature 51, which when it meets the coöperating fixed contact 52 closes the circuit of the last relay-magnet 44 of the series, the armature of which in turn is drawn down against the contact 53, thereby shunting the remaining sections 54 and 55 of the resistance 41.

Separation of the contacts 46 and 47, due to strengthening of the controlling-magnet 45, causes a reverse action to take place, whereupon the sections of the resistance 41 are successively open-circuited in a reverse order from that described.

I have found that if the controlling-magnet 45 is connected directly across the alternating-current mains 36 the resulting regulation may be very unsatisfactory, due to a sort of surging or hunting which takes place, the voltage of the mains being caused to rise and fall more or less spasmodically. This is perhaps due to some time lag between the regulating effect communicated to the exciter of the main machine and the resulting action of the exciter on the field of the main machine. Whatever the cause of the phenomenon may be, I find that it may be prevented by supplying the controlling-magnet 45 with a direct current derived from and proportional to the voltage of the alternating-current mains 36, to which end I connect the regulating-magnet 45 in circuit with the direct-current end of a small rotary converter 56, the alternating-current terminals 57 of which are connected across the mains 36.

It will be noted in connection with Fig. 2 that the relay-magnets 42 to 44 are controlled

directly from the regulating-magnet 45 instead of through the instrumentality of a relay, as in Fig. 1. This direct control is suitable where the relay-magnets 42 to 44 have their solenoids so wound or are otherwise arranged so that they carry no larger current than can be conveniently handled by the contacts 46 and 47. If the relay-magnets for any reason carry too large a current to be controlled directly by the controlling-magnet 45, I may interpose a relay, such as shown at 15 in Fig. 1; but the use of this latter relay is not an essential element of my invention broadly considered.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. The combination of a dynamo-electric machine, a sectional resistance in the field-circuit of said dynamo-electric machine, short-circuiting contacts for each section, and actuating means for said contacts supplied by current derived from said field-circuit.

2. The combination of an alternating-current dynamo-electric machine, a vibrator for controlling the voltage of said dynamo-electric machine, and means for supplying said vibrator with direct current of a voltage varying in response to variation of voltage of said dynamo-electric machine.

3. The combination of an alternating-current dynamo-electric machine, vibratory resistance-varying mechanism for varying the voltage of said dynamo-electric machine, and means for controlling said mechanism by direct current varying in voltage with the variation of voltage of said dynamo-electric machine.

4. The combination with an alternating-current dynamo-electric machine, of a contact making and breaking device for controlling the voltage of said dynamo-electric machine, and means for deriving a direct current from a connection across the alternating-current mains extending from said machine and supplying said direct current to said device.

5. The combination of a dynamo-electric machine, an exciter therefor, a sectional resistance or a series of resistances in series in the field-circuit of said exciter, circuit making and breaking devices in shunt respectively to the sections or resistances in the field-circuit and actuated by current in the field-circuit, and a magnet responsive to the voltage at the terminals of said machine for controlling said contacts.

6. The combination of an alternating-current dynamo-electric machine, an exciter therefor, a resistance in circuit with the field of said exciter, a magnet for causing said resistance to be cut into and out of the field-circuit, and means for supplying said magnet with a direct current of a voltage varying in response to variation of the voltage on the mains extending from said alternating-current dynamo-electric machine.

7. The combination of an alternating-current dynamo-electric machine, an exciter therefor, a rotary converter connected across mains extending from said alternating-current dynamo-electric machine, and a vibratory resistance-changing device supplied with direct current from said rotary converter.

In witness whereof I have hereunto set my hand this 10th day of June, 1902.

WILBUR L. MERRILL.

Witnesses:

BENJAMIN B. HULL,

HELEN ORFORD.