No. 648,494. Patented May 1, 1900.

E. M. HEWLETT.

REGULATING DYNAMO ELECTRIC MACHINES.

(Application filed Jan. 12, 1900.)

(No Model.) 2 Sheets—Sheet 1.

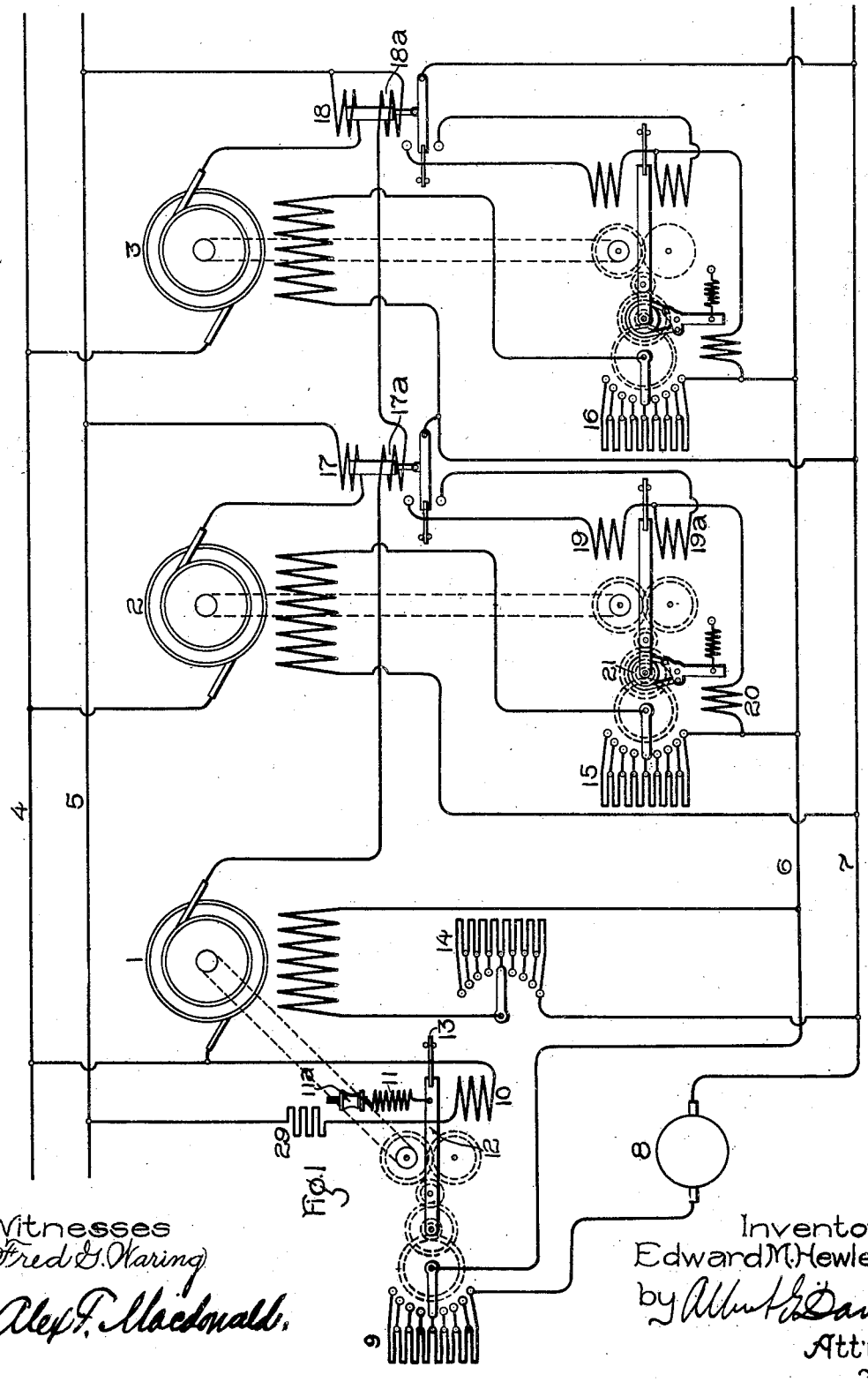

Fig. 1.

Witnesses
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Inventor:
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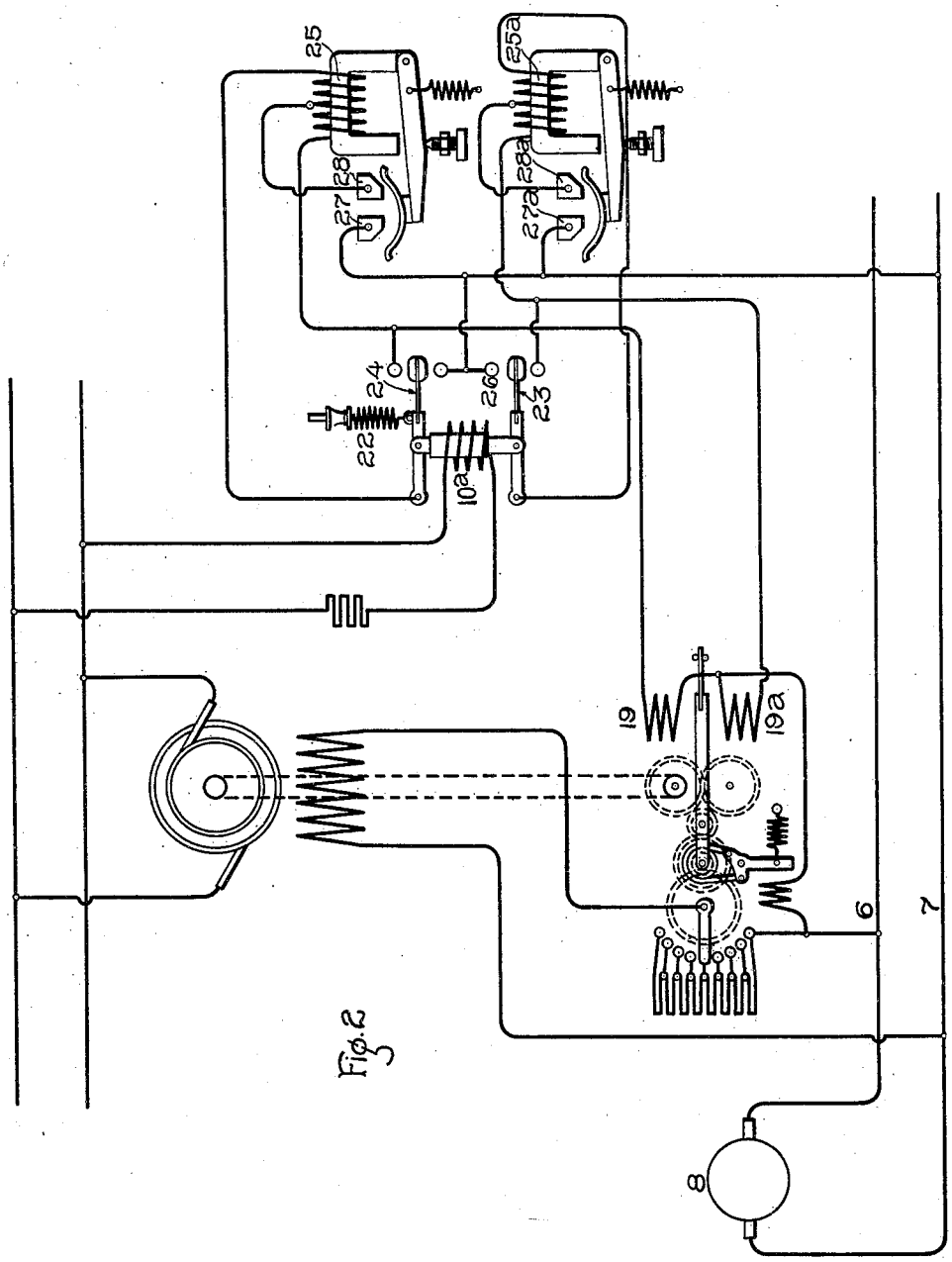

Fig. 2

Witnesses:
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UNITED STATES PATENT OFFICE.

EDWARD M. HEWLETT, OF SCHENECTADY, NEW YORK, ASSIGNOR TO THE GENERAL ELECTRIC COMPANY, OF NEW YORK.

REGULATING DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 648,494, dated May 1, 1900.

Original application filed October 27, 1899, Serial No. 734,917. Divided and this application filed January 12, 1900. Serial No. 1,174. (No model.)

To all whom it may concern:

Be it known that I, EDWARD M. HEWLETT, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Regulating Dynamo-Electric Machines, (Case No. 1,533,) of which the following is a specification.

This application is a division of application Serial No. 734,917, filed October 27, 1899.

This invention relates to the regulation of alternating currents, the object being to cause a proper division of load between a plurality of alternating-current dynamo-electric machines connected in multiple.

The invention is especially intended to preserve a uniformity of potential and a proper division of output between a plurality of alternators connected in parallel with the main circuit. Such a system is illustrated in the drawings.

In carrying out the invention I prefer to provide a common exciter-circuit for the several generators, the field-magnet coils of said generators being connected in parallel relation to such circuit, and provide in a shunt to the distributing-circuit a regulating-coil to vary the exciter-current for all the machines. I provide also for each of the several machines an independent field-magnet-regulation device controlled by the joint action of its own armature and of that of a master-machine. For the controlling devices I preferably employ differential relays, the contacts of which operate a motor-driven rheostat to cut resistance in or out of the several field-magnet circuits, accordingly as the machine being regulated rises above or falls below the electromotive force of the master-machine under variations in speed of its prime mover. I provide the motor mechanism which operates the several rheostats with a magnetically-operated brake, which acts instantly to lock or release said mechanism at the proper moment.

My invention comprises a system for regulating alternating currents in which a plurality of generators are employed, in which the exciter-circuit for the field-magnets of the several generators is automatically governed to permit the machines to run effectively in parallel.

It comprises also such a system in which the several field-magnet currents are variable and are jointly controlled by their own machine and a common controlling or master machine for the system.

It comprises other features, which will be hereinafter more fully described, and definitely indicated in the claims.

In the drawings which illustrate the invention, Figure 1 is a diagram of a system embodying my improvements. Fig. 2 is a diagram of a single machine, showing the improved device which I employ to prevent sparking at the contacts of the governing-relays.

1, 2, and 3 represent a plurality of alternating-current generators connected in parallel with a common distributing-circuit 4 5. The field-magnets of the several generators are connected in parallel relation to a common exciter-circuit 6 7, supplied by a suitable source of direct current 8. In this circuit I interpose a rheostat 9, automatically adjusted to increase or decrease the strength of the exciter-current in accordance with fluctuations of electromotive force across the mains 4 5, and thus to maintain the said electromotive force substantially constant. This is the arrangement for "straight" compounding. For "over" compounding I connect the regulating-circuit to some distant point in the system. In other words, I may select any preferred point in the system and maintain the potential difference at that point substantially constant.

The apparatus comprises a wheel-train governing the lever of the rheostat 9, the train being pivoted so as to be shifted into contact with one or the other of two wheels geared together and operated from the generator or prime mover or some other source of power. The lever is under the influence of a coil 10, in shunt to the system at the selected point, and a retractile spring 11, the opposing forces being normally balanced so that the train which controls the rheostat is not in gear with

either of the drive-wheels. Should the electromotive force fall, the spring will prevail and lift the armature attached to the lever 12 and shift the wheel-train into engagement with the upper gear-wheel, thereby cutting off resistance at the rheostat 9 and strengthening the field-magnets of all the machines. A flexible elastic tongue 13, secured to the free end of the lever which carries the movable wheel-train, acts to center the lever with relation to the two drive-wheels and give the apparatus stability of action.

The field-magnet of the controlling or master machine is provided with a rheostat 14, which may be hand-controlled, as shown, to adjust the output of the master-machine for large changes of load.

In order to render the action of the coil 10 uniform under change of frequency due to change of speed, I employ in series relation to it an ohmic or non-inductive resistance 29 relatively large to prevent material change of pull of the coil-core under small changes of frequency. The rheostats 15 16, which control the field-magnets of the other machines of the systems, are automatically adjusted by the influence of a pair of differentially-acting coils, as 17 17ª and 18 18ª, one connected in series relation to the machine it controls and the other to the master-machine, thus equalizing the load on the several machines. The coils act upon a common core and control a pair of contacts, completing a branch of the exciter-circuit through one or the other of two controlling-coils 19 19ª for the rheostat which regulates the field-magnetism of the machine. In the common return to the exciter-circuit from these coils is a brake-controlling coil 20, by which tension is put on or taken off of a strap-brake 21, engaging one of the wheels of the movable wheel-train which controls the rheostat. Thus any fluctuation in the main circuit acts to regulate the potential and preserve it at a definite point by varying the potential at the auxiliary bus-bars 6 7, and the load is uniformly divided among the several machines by a special adjustment of its own field-magnet circuit.

The initial voltage of the system at the selected point may be adjusted by varying the tension of the spring 11 by means of the adjusting-screw, (shown at 11ª.)

In order to obviate sparking at the relay-contacts, I provide a magnetically-controlled device by which when the relay operates a shunt-circuit is completed around its points of contact, in which is interposed a magnetic releasing device which will hold it closed until after the relay-contacts have opened. This organization is shown in Fig. 2 in connection with a circuit supplied by a single machine, as it is capable of general application. The relay is exemplified at 21, being shown as provided with a retractile spring 22. It comprises two insulated contact-levers 23 24, each coöperating with front and back contact-stops. The front stops have a common connection leading to one terminal of the exciter-circuit and the back stops connect, respectively, with the terminals of two interrupter-coils 25 25ª. These coils control an armature adapted to bridge two heavy contact-terminals which can safely carry the spark and which are respectively connected to middle points of the coils 25 25ª and the return branch of the exciter-circuit. Thus when the relay is actuated under fluctuation of electromotive force—say by a determinate reduction thereof—the spring 22, or it may be the opposing coil, will bring the relay-contact 23 into engagement with its front stop, thereby closing a circuit from the terminal 6 of the exciter-circuit by way of the field-magnet-regulating coil 19ª, and thence by the interrupter-coil 25ª, relay-contact 23, front stop 26, to the return-main of the exciter-circuit. The contacts 27ª 28ª are then bridged by the armature controlled by the coil 25ª, completing a shunt around the relay-contacts by way of contact 27ª, bridge-piece, contact 28ª, one-half of the controlling-coil 25ª, to contact 23. When the relay-contacts open, one-half of the coil 25ª remains in circuit by way of terminal 6 of the exciter-main, coil 19ª, one section of the coil 25ª, contact-terminals 28ª and 27ª, to main 7. When the relay-contact strikes its back stop, the other section of coil 25ª draws current by completing a branch through contact 23 and its back stop to the supply-main 6. The two sections of coil 25ª oppose one another, and its armature is released, opening the circuit without arcing. A similar action takes place with regard to the relay-contact 24. The two contact-levers are so set that on the circuit being opened by one of them it may not be closed by the other. This may be done, as will be seen in the diagram, by placing the levers so that the front stop of the upper one will not engage when the other engages its back stop. Thus by the use of the relay sensitiveness of action may be obtained for the potential-coil and controlling-currents of considerable strength may be used for operating the rheostat devices.

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

1. A system for regulating alternating-current generators, comprising a plurality of generators connected with a distribution-circuit, a common exciter-circuit connected in parallel relation with the several field-magnets, and means for automatically varying the current in the several branches to preserve a uniform relative output.

2. A system for regulating alternating-current generators, comprising a plurality of generators in parallel relation to a common distribution-circuit, an exciter-circuit feeding the several field-magnets in parallel, and current-varying devices in the several field-magnet branches controlled by the joint action of the several machines and a master-machine for the system.

3. A system for regulating alternating currents, comprising a plurality of generators in parallel relation to a common distribution-circuit, an exciter-circuit feeding the several field-magnets in parallel, a potential-coil governed by the electromotive force of the system controlling the energy flowing in the exciter-circuit, and means for independently governing the several field-magnet strengths controlled by the joint action of the corresponding machine and a master-machine for the system.

4. A system for regulating alternating currents, comprising a plurality of alternating-current generators in parallel relation to a common distribution-circuit, an exciter-circuit feeding the field-magnets of the several machines in parallel, a regulating-coil in shunt to the mains, and means controlled by the coil for varying the potential across the exciter-circuit.

5. A system for regulating alternating currents, comprising a plurality of alternating-current generators in parallel relation to a common distribution-circuit, a common exciter for the field-magnets of the several machines, means for varying current strength therein inversely as the fluctuations of electromotive force in the distribution-circuit, and an independent regulating device for the field-magnet of one machine.

6. A system for regulating alternating currents, comprising a plurality of generators in parallel with a common distribution-circuit, a common exciter for the field-magnets of the several machines, means for regulating the exciter by the fluctuation of electromotive force in the mains, and independent means for adjusting the current strength of the several field-magnets controlled by differential magnets one winding of which is in series with a master-machine and the other with the machine whose field-magnet is being regulated.

7. A system for regulating alternating currents, comprising a plurality of generators in parallel with a common distribution-circuit, a common exciter for the field-magnets of the several machines, means for regulating the exciter by the fluctuations of electromotive force in the mains, independent means for adjusting the current strength of the several field-magnets controlled by differential magnets, one winding of which is in series with the master-machine and the other with the machine whose field-magnet is being regulated, and an independent field-regulating device for the master-machine.

8. A current-regulating device comprising a coil in the governing-circuit, an armature controlled thereby provided with a clutch to engage either of two oppositely-rotating gear-wheels in its two operative positions, a magnetic brake in circuit with the coil adapted to arrest the movement of the wheel-train when the current fluctuation ceases, and a resistance-varying device controlled by the wheel-train.

9. A regulating device for an electric circuit, comprising a coil in the governing-circuit, a movable wheel-train carried by its armature and adapted to be shifted into operative relation to either of two oppositely-moving drive-wheels, a current-varying device operated by the wheel-train, and a magnetic brake in circuit with the coil adapted to release or lock the wheel-train.

10. A current-regulating device for a circuit, comprising a coil in the governing-circuit, an armature controlled thereby carrying a wheel-train adapted to be shifted into engagement with either of two oppositely-moving drive-wheels, a current-regulating device for the governing-circuit operated by the wheel-train, a strap-brake engaging one wheel of the train, and a brake-coil in the governing-circuit adapted to put on or take off tension from the strap.

In witness whereof I have hereunto set my hand this 10th day of January, 1899.

EDWARD M. HEWLETT.

Witnesses:

BENJAMIN B. HULL,

MABEL E. JACOBSON.