(No Model.)

K. ZIPERNOWSKY & M. DÉRI.

REGULATING ALTERNATE CURRENT ELECTRIC GENERATORS.

No. 375,910. Patented Jan. 3, 1888.

FIG. 1.

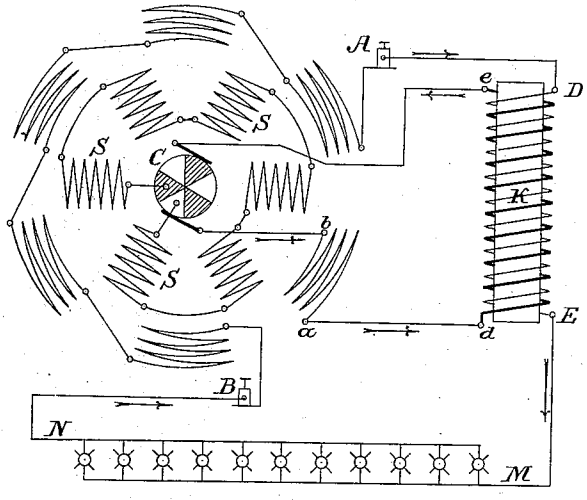


FIG. 2

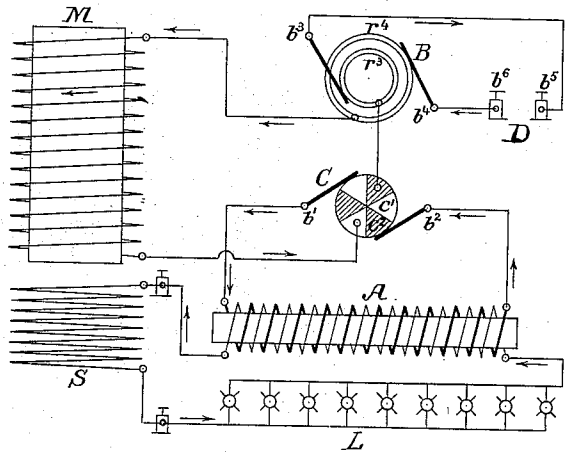
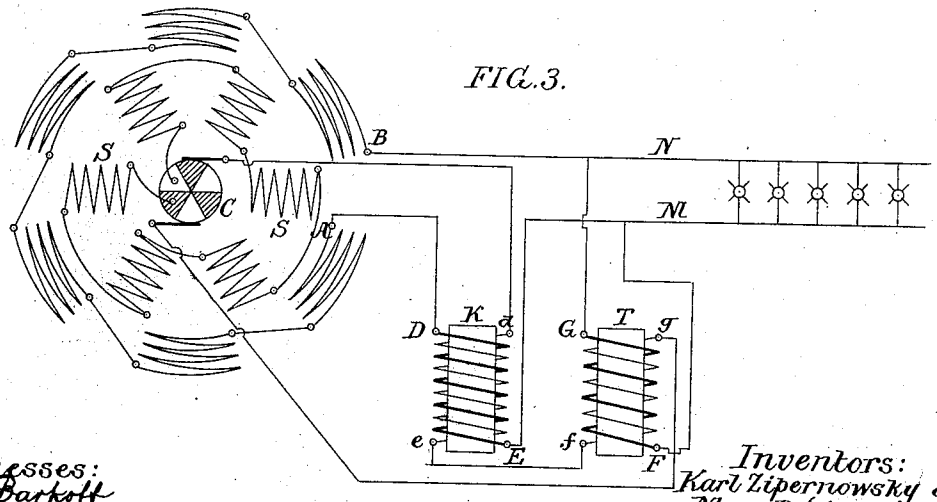


FIG. 3.



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UNITED STATES PATENT OFFICE.

KARL ZIPERNOWSKY, OF BUDA-PESTH, AND MAXIMILIAN DÉRI, OF VIENNA, AUSTRIA-HUNGARY.

REGULATING ALTERNATE-CURRENT ELECTRIC GENERATORS.

SPECIFICATION forming part of Letters Patent No. 375,910, dated January 3, 1888.

Application filed December 16, 1886. Serial No. 221,758. (No model.) Patented in Germany February 13, 1885, No. 33,951; in England March 16, 1885, No. 3,379; in France March 20, 1885, No. 167,760; in Belgium March 20, 1885, No. 63,247, and in Italy June 30, 1885, XXXVII, 113.

To all whom it may concern:

Be it known that we, KARL ZIPERNOWSKY, residing at Buda-Pesth, Austria-Hungary, and MAXIMILIAN DÉRI, residing at Vienna, Austria-Hungary, and both subjects of the Emperor of Austria-Hungary, have invented a new and useful Regulation of Alternating-Current Electric Generators, (for which patents have been taken in Germany February 13, 1885. No. 33,951; in France, March 20, 1885, No. 167,760; in Great Britain, March 16, 1885, No. 3,379; in Belgium, March 20, 1885, No. 63,247, and in Italy, June 30, 1885, Vol. 37, No. 113,) of which the following is a specification.

The object of our invention is to maintain, automatically, a constant difference of potential or intensity of current with alternating electric currents, notwithstanding any variations in the performance of the generator of electricity.

In the accompanying drawings, Figure 1 is a diagram of one form of our improved regulating devices. Fig. 2 is a diagram illustrating another method of carrying out our invention, and Fig. 3 is a diagram illustrating another feature of our invention.

Usually the magnets of alternating-current machines are excited by a current of a given uniform electro-motive force, which current may either be furnished by a separate continuous-current dynamo, (exciter), or by a "directed" current derived from the alternating-current dynamo itself. (In the following description we wish to have understood by the term "directed" current a current which by its mode of generation would be an alternating one, but which by the use of a special commutator has the direction of every second impulse reversed, and in consequence of this has become an intermittent current, the several impulses of which have all the same direction. Such a current is suitable for the excitation of electro magnets, and this is done in the so-called "self-exciting alternating-current machines.") In magneto-electric machines the magnetization is of course invariable. To obtain a constant tension or intensity of the main current, it is, however, requisite that the magnetization be variable and directly dependent on the state of the main current. This object we attain in the following manner: The main current, which is to be regulated, passes through one of the coils of an induction-coil or alternating-current transformer before arriving at the points of consumption. The second coil of the transformer is inserted in the field-magnet circuit. The alternating current induced in this second coil by the main current passing through the first is converted into a direct current by a commutator on the shaft of the machine. Where the secondary coil of this transformer is so inserted in the exciting-circuit that the current indirectly induced therein is added to the otherwise-furnished exciting-current, the magnetization will vary in the same direction with the main current. If, however, the secondary induced current counteracts the exciting-current, the variation of magnetization will take place in an inverse direction. The first arrangement serves for regulating the tension of the main current, the second for regulating its intensity.

The leading principle of our self-acting regulation consists in exciting the electro-magnets by the combined action of two currents of different origin. The one of these currents is, by reason of its origin, constant, (or nearly so,) and this is the "exciting-current," properly so called. The other is produced by the main current through induction in a transformer, and, being naturally dependent on the state of the main current, is of course variable. Ordinarily the first of these two currents preponderates, and will be relatively stronger in proportion as the variations in the main current to be balanced are less. If the variations to be compensated are very considerable, the constant exciting-current may become less preponderant, and in some cases it may even be entirely dispensed with, if it is not, as in generators with permanent magnets, otherwise superfluous.

To illustrate our method we give two examples. (Shown in Figs. 1 and 2.)

Fig. 1 is a diagram of an alternating current-generator in which the electros S rotate, while the armature-coils remain stationary.

The magnetizing-current is supplied by special induced wires *a b* in the armature, and is directed by the commutator C. A and B are the points at which the working-current issues from the armature of the machine. *a* and *b* are the terminals of the exciting-current. D E is the coil of the regulating-transformer inserted into the main line. *d e* is the coil in the exciting-circuit. The main current passes from A over D E to the main M, then through the consuming devices (indicated by small circles) to N, and returns to B. The exciting-current flows from *a* to *d*. There it is re-enforced by the current induced in *d e*. Then it proceeds to the commutator C, and after having traversed the electro magnets S as a directed current it returns to *b*. Assuming, now, for example, that the difference of potential between M and N is to be maintained constant, we establish by the separate exciting armature-coil *a b* the requisite tension when the main current is weakest, and provide for the induction in *d e* in such a manner that when the main current attains its maximum intensity the increase of magnetization will (under otherwise equal conditions) still cause the same tension to be maintained at M N. Then the same tension will approximately be attained also for intermediate current strengths.

In Fig. 2 is shown one manner of employing a secondary generator, A, for regulating the machine in case of the electros being excited by a separate continuous current at D, whether such a current be obtained from a separate dynamo or a primary or secondary battery, or by any other means. The main alternating current generated in the armature S traverses the primary coil of the transformer A, and to the various consumption devices. The secondary induced current from A passes to two contact-brushes, b' and b^2, of the commutator C, attached to the shaft of the alternating-current machine. On the same shaft there are two contact-rings, r^3 and r^4, with two brushes b^3 and b^4, these latter being connected with the source of the continuous exciting-current at b^5 and b^6. One end of the magnet-coil wires M of the alternating-current generator is connected to one of the two systems of sectors of the commutator—*i. e.*, with c', while its other end is fastened to the ring r^4, the second ring, r^3 being connected to the other segments, c^2, of the commutator. The magnetizing-current therefore flows as a continuous current from b^6 to b^4, and thence through M to c', where it meets the variable directed current. This latter passes through b' A b^2 as an alternating current to join at c^2, again the exciting-current re-enforcing or weakening it, as above stated, and then proceeds to r^3 b^3, and returns to b^5; but each of these currents may also enter into separate magnet-coils, the continuous current entering through contact-rings into one set of coils, as is usually the case, while the auxiliary current induced in the regulating-transformer is directed by a commutator and sent into another set of magnet-coils.

In both of the examples illustrated the electro-magnets of the generator have been assumed to be moving and the armature-coils stationary. Of course, however, the arrangement may be reversed, this necessitating but slight alterations in the mode of connecting up the circuits. The essential features of the method of regulation by means of transformers is sufficiently set forth in the above examples. Furthermore, numerous combinations of the available currents may be employed for the purpose of suitably exciting the magnets.

The practically constant part of the exciting current may be taken from one of the following sources: First, from an extraneous source (dynamo, battery, &c.;) second, from the armature of the alternating-current machine itself, either from special armature-wires, or as a portion of the main current itself, when this will be of constant intensity; third, from a transformer in which it is induced by any of the currents indicated above.

The variable exciting current is obtained from the armature of the alternating-current generator either by means of a derived circuit from the main line, where constant intensity of the external working-current is aimed at, or by means of the total main current itself acting in the regulating transformer, where constant tension is required. This variable current, it will be seen, is also either obtained directly or by the intervention of an induction coil or transformer; hence in some cases two transformers are used, or one with three different coils. This latter is done when both the constant and the variable part of the excitation are produced indirectly by induction-coils.

As an example, we show in Fig. 3 the disposition of a magnetizing and of a regulating transformer in connection with a self-exciting alternating-current generator which shall furnish a current of uniform tension. S are the magnet-coils, their terminals being connected to the two systems of sectors of the commutator. A B are the terminals of the generator for the main current of the generator. M and N are the mains proceeding to the consuming devices. T is the transformer for generating the constant part of the exciting-current. The primary terminals F G are connected in multiple arc with the mains. From its secondary terminals the one *g* is connected to one of the commutator-brushes, the other to the terminal *e* of one of the coils of the regulating-transformer K, the other end, *d*, of this coil being in electric connection with the second commutator-brush. The second coil, D E, of this transformer K is inserted in the main circuit of the generator. The exciting-current is generated through induction in *f g*, and is re-enforced by the auxiliary current induced in *d e* by the main current passing through D E. An important advantage of this mode of regulation is real-

ized in the particular case of very high tension currents.

By the use of the transformer, as above described, the employment of the high tension for exciting can be readily avoided, as we can make the magnetizing-current of any suitable potential or intensity, irrespective of what character the main current of the generator is. We have by these means perfectly succeeded in causing the magnets of the generator of electricity to vary automatically in such proportions that the difference of potential of the current at the consuming devices will remain nearly constant.

Any form of transformers or induction coils may be used in carrying out this invention.

What we claim is this:

1. The combination of an alternating-current generator with an induction-coil or transformer having one of its coils in the exciting-circuit of the generator and the other in the main circuit or a part thereof, substantially as and for the purpose set forth.

2. The combination of an alternating-current generator with an induction-coil or transformer having one of its coils in the main circuit or a part thereof and the other in the exciting-circuit, and a commutator to convert the several impulses of the exciting-current into a directed current in the field-magnet coils of the generator, substantially as set forth.

3. The combination of an alternating-current generator with an induction-coil or transformer having one of its coils in circuit with the armature-coils and the other in circuit with the field-magnet coils and also with coils on the armature, and a commutator to convert the several impulses of this exciting-current into a directed current in the field-magnet coils of the generator.

4. The combination of the armature and field-magnet coils of an alternating-current generator, and devices for producing a constant or nearly constant exciting-current therefor, with an induction-coil or alternating-current transformer having one of its coils in the working-circuit and the other in the exciting-circuit, and a commutator for directing the alternating current in the latter, all substantially as described.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

KARL ZIPERNOWSKY.
MAX DÉRI.

Witnesses to the signature of Karl Zipernowsky:
OTTO T. BLÁTHY,
ROBT. M. HOOPER.

Witnesses to the signature of Max Déri:
ARMIRY GÉLYI,
ANNA ZIPERNOWSKY.