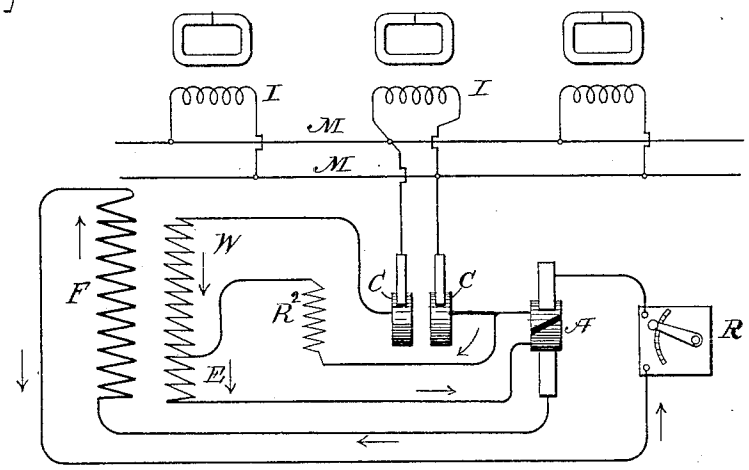
(No Model.) 3 Sheets—Sheet 1.

H. LEMP.

COMPOUND WOUND ALTERNATING CURRENT DYNAMO.

No. 479,170. Patented July 19, 1892.

Fig. 1.



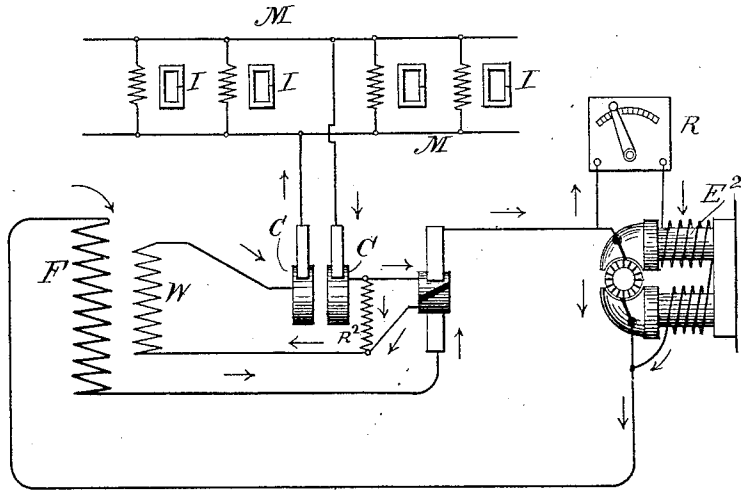


Fig. 2.

WITNESSES:

J. A. Hurdle

Wm. A. Capel

INVENTOR

Hermann Lemp

BY

H. C. Townsend

ATTORNEY.

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H. LEMP.

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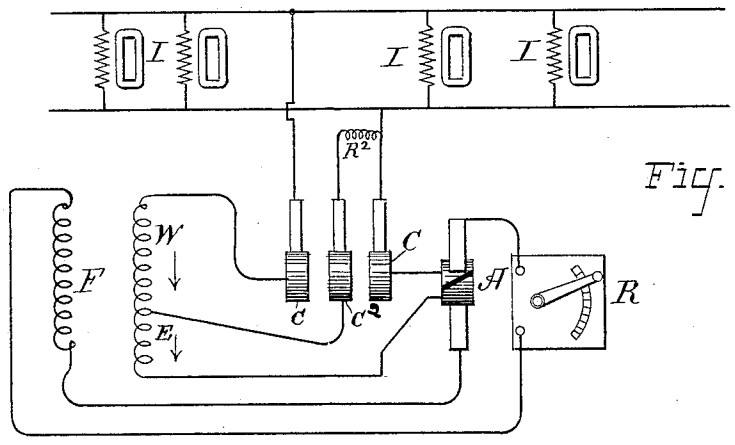

Fig. 3.

WITNESSES:

J. Mundle

Wm. A. Capel

INVENTOR

Hermann Lemp

BY

H. C. Townsend

ATTORNEY.

(No Model.) 3 Sheets—Sheet 3.

H. LEMP.

COMPOUND WOUND ALTERNATING CURRENT DYNAMO.

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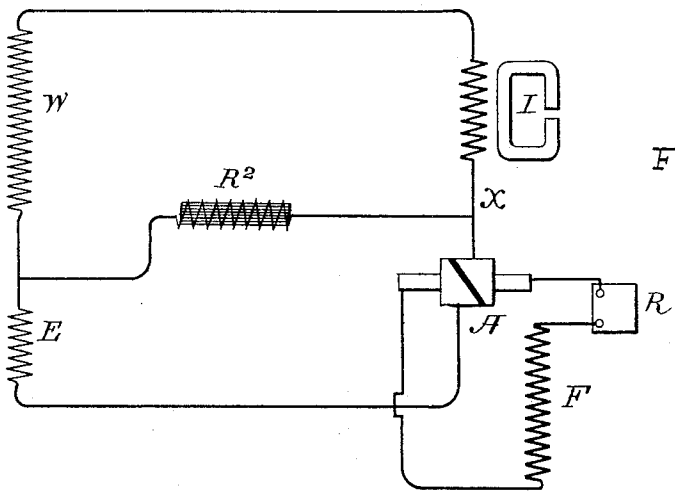

Fig. 4.

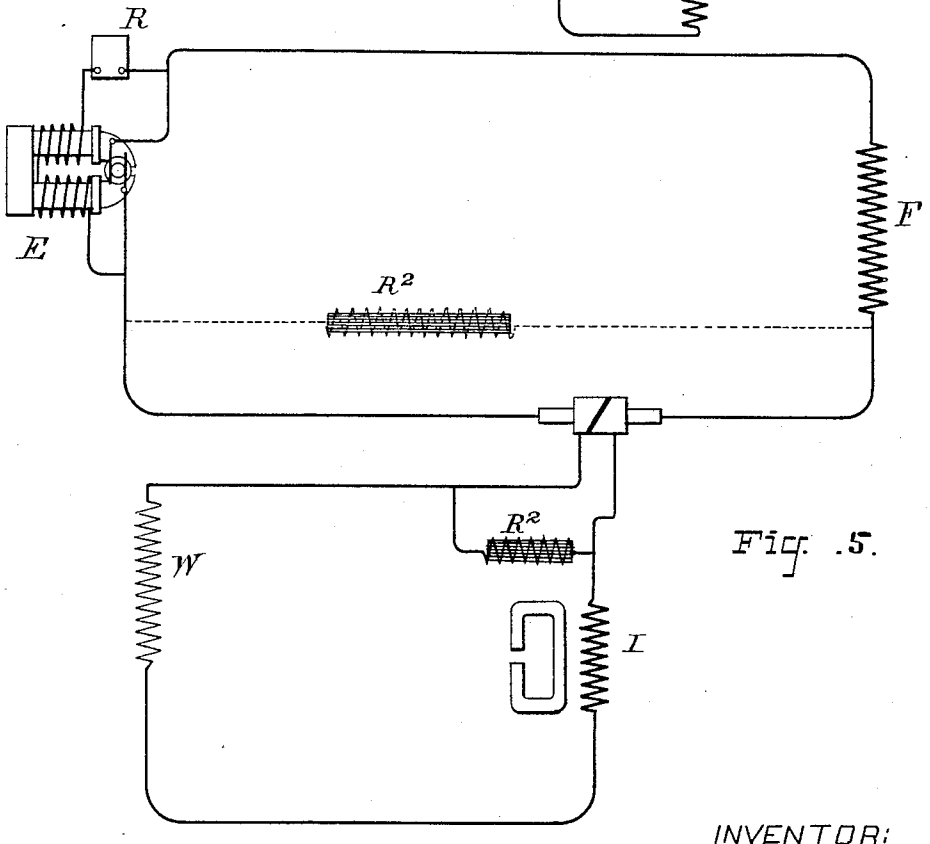

Fig. 5.

ATTEST:

J. A. Mundle

Wm. F. Capes

INVENTOR:

Hermann Lemp.

By H. L. Townsend

Attorney

UNITED STATES PATENT OFFICE.

HERMANN LEMP, OF LYNN, MASSACHUSETTS, ASSIGNOR TO THE THOMSON ELECTRIC WELDING COMPANY, OF MAINE.

COMPOUND-WOUND ALTERNATING-CURRENT DYNAMO.

SPECIFICATION forming part of Letters Patent No. 479,170, dated July 19, 1892.

Application filed October 17, 1889. Serial No. 327,257. (No model.)

To all whom it may concern:

Be it known that I, HERMANN LEMP, 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 Compound-Wound Alternating-Current Dynamo, of which the following is a specification.

My invention relates to that class of dynamo-machines in which the magnetic field is the resultant of currents flowing in different circuits or from different sources, whose actions or effects are compounded, so that the machine will be caused to supply energy of a constant potential or amount, or of a potential which shall rise or fall in predetermined degree as the load increases and causes a drop of potential over the line or feeding circuit, or of a potential which shall rise automatically in accordance with other changes of condition in the work-circuit.

The object of my invention is especially to produce an alternating-current dynamo, either self or separately excited, which shall produce a potential exactly constant under varying loads or a potential increasing or diminishing in any predetermined ratio.

In a former patent issued to me, No. 405,263, dated June 18, 1889, the field is a compound or resultant of electric energy derived from two sources connected in multiple to the field-coil, one source being that of the exciter (a separate machine or a coil in the machine itself) and the other an armature-coil, which supplies the current for work.

In my present invention the armature or section of armature, which may be called the "work-circuit" armature, operates (in assisting to produce the field) in series with another armature or section of armature which is devoted to maintaining the magnetic field of the machine and may be called the "field-exciting" armature or section.

My invention consists in the provision of a connection from one side of the series circuit, across which the current from the main or work armature-coil may flow in part independently of the field-exciter coil, and (in some of the arrangements embodying my invention) the current of the latter may flow in part independently without passing through the work or the first-named coil, as will hereinafter more fully appear.

Further details of connections and devices whereby, among other things, the machine may supply alternating currents to the work and yet be self-exciting will be more fully hereinafter described, and then specified in the claims.

In the accompanying drawings I have illustrated diagrammatically various arrangements of circuits and devices embodying my invention.

Figure 1 is a diagram illustrating a preferred arrangement, and shows the apparatus applied to the work of operating transformers or induction-coils whose secondaries are of large gage as compared with the primaries and adapted for developing current of large volume to be employed in electric welding or similar operations. Fig. 2 is a diagram illustrating a modified arrangement, in which the separate source hereinafter referred to is an independent dynamo-machine instead of separate coil or section of coil in the armature of the main machine. Fig. 3 shows a further modification, wherein the intermediate connection hereinafter described and containing a resistance is formed through a collector ring and brush, thus permitting adjustments to be made while the machine is running. Fig. 4 is a simplified diagram, which is the same as Fig. 1, with parts omitted for the sake of simplicity. Fig. 5 is the same as Fig. 2, but simplified by the omission of certain parts and by the representation of one of the devices arbitrarily by coils.

Referring to Fig. 1, W and E indicate, respectively, two coils or sections of coil on the armature of the machine, and A a commutator of any usual or proper description adapted to commutate the currents in an external circuit.

F indicates the field-magnet coil of the machine, placed in the series circuit with the armature-coils W and E by way of the commutator, while R is an adjustable rheostat, or preferably a reactive coil, for adjusting or regulating the current which shall flow to the field-magnet of the machine. Any other means might be used in place of R for regulating the

total field excitation operating on the armature of the machine.

C C are the usual collector-rings for taking up the alternating current developed in the armature-coils and delivering it to the work, here illustrated as a group of transformers I I, fed from the mains M M, to which the brushes bearing on C C are connected.

The coil or section of coil E, I term the "exciter" source, because it may energize the field of the machine independently by finding circuit through the field-magnet coil F independently of the coil W, which latter I term the "work-circuit" coil or source, since it supplies the current to the work. By tracing the connections it will be readily seen, however, that the coils W and E may both operate as exciting sources for the field-magnet coils F and that any portion of the current from W which operates for this purpose acts in series with the source E of energy.

R^2 indicates an artificial resistance, which may be a reactive coil or not, as desired, but is preferably of as little self-induction as possible, if the load itself is free from self-induction. If the load consists, however, of alternating-current motors or welding apparatus, then the resistance R^2 in neutral wire must be of a self-inductive nature and adjustable. This coil is preferably carried by the armature of the machine and is placed in a connection across the series circuit at such points that the currents from W may flow to the work without passing through the other source of energy E to which the field excitation is due. The nature of the connection formed by way of resistance R^2 may be more readily understood by reference to Fig. 5, where the work is typified at I by a coil and the collector-rings are omitted for the sake of simplicity. Here, as will be seen, there is a series circuit including the two exciting sources W E and the field and work I F. The intermediate connection including R^2 is made at the points between the exciting sources and the work and field, or at such points, depending upon the order in which the parts are arranged, that current from W may flow through I without flowing through the field F. By the arrangement shown it will be seen, also, that the current from E may flow through the field for exciting the same whether the work-circuit at I is closed or not.

While the connection in which R^2 is placed permits current to flow from W to the work without flowing through the field-exciting source and field, the presence of the resistance causes current to be diverted to the field-exciting source, and the amount of such resistance or self-induction will obviously be a leading factor in determining the proportion of flow through the field and, in fact, the rate of increase of flow under varying conditions of the work. This action is due to the fact that the flow of current from W to the work depends upon the potential in the series circuit at the point—say X—where the cross connection from W to the series circuit is made as related to the potential of the coil W and that the division of current from W through R^2 as one path and through E and F as the other is inversely as the resistances. If the potential falls relatively at X, there will be a tendency to an increase of flow from W; but the ratio of increase in E and F will depend upon the resistance of R^2 as related to the resistance in the other branch or series circuit including the field-exciting source. The amount of this resistance is ordinarily fixed or predetermined according to the manner in which it is desired that the machine should operate. Its presence causes the diversion of current to the series circuit with the other source, so that the electro-motive force may be maintained at the terminals of the work as the work increases—that is to say, as the work or load increases, and the potential thereby tends to fall, the current from W will come to the aid of the other source of energy and work in series therewith to keep up the potential. The amount of fixed resistance in R^2 will (the relations of the work and exciting source W and E being fixed) determine whether this assisting action shall produce a potential which shall increase as the load increases or shall diminish or shall be kept as near as practicable the same. Either action—that is to say, a gradually-increasing, a gradually-decreasing, or a uniform potential—may be had, as desired, in any predetermined ratio; but in any case the potential is supposed to be kept up to the requirements despite the tendency of the load to lower it to an ineffective point. The resistance R^2 may be determined by trial.

If there be no work in circuit and the machine be running, the exciting-current in coil E will pass through the field-magnet and back by way of resistance R^2, thus exciting the machine. If now current is allowed to flow through the external circuit containing the work I, a potential will be developed by coil W at the point of attachment of the cross connection. As such potential rises in relation to that at X the return of the exciting-current through the resistance will diminish and finally will become zero, all the current of both coils then flowing in series as a combined source of field excitation, immediately after which the relations of potential will change, so that current will flow from W, partly through the resistance R^2, to the work directly without passing through the exciter source E. As the load varies, and consequently the potential changes at X, the amount of current flowing by way of field-coil F from W will also vary, and will thus reinforce the coil E to a varying extent, so as to maintain the potential.

While it is desirable that the resistance R^2, which is ordinarily fixed once for all in the construction of the machine, should rotate with the armature, it is not necessary that it should do so, and in some instances it may be

desirable that it should be supported independently of the armature, so as to be capable of adjustment while the machine is running. This capacity for adjustment may be obtained readily by the provision of an extra collecting-ring C^2, as indicated in Fig. 3, and by placing the artificial resistance or reactive wire in the connection from a brush bearing on such ring to a wire leading from the brush of one of the rings C.

The artificial resistance R^2 may be of any desired character and constructed in any desired manner. The two sources, instead of being coils on the same armature, may be on separate armatures, and the exciter source E might be an entirely-independent machine, the armature of which would be in the series circuit with the field F and the coil W moving in such field. This modification is indicated in Fig. 2, where E^2 indicates the separate or independent machine, whose armature, as indicated, is placed in such series circuit. The field of such machine may be maintained by current from any source, but preferably by current forming a shunt or branch of the series circuit and controlled by a rheostat R, which by determining the strength of the field determines the amount of current flowing to the field-magnet coil F.

In Fig. 5 the arrangement shown in Fig. 2 is illustrated in simplified form. The cross connection including resistance R^2 is shown in full lines in Fig. 5 as arranged in the same relation to the circuits that it is in Fig. 2, this cross connection forming in effect a circuit from one side of the series circuit at the point between the work and the field-coils to the other side of the series circuit at a point between the two sources. In Figs. 1, 2, 4, and 5 it is connected to the alternating portions of the series circuit. An equivalent connection would obviously, however, be as indicated in dotted lines, the difference being, however, that in the latter case, the connections being to a continuous portion of the circuit, the adjustments would have to be made with reference to the action of R^2 as a dead-resistance, whereas in the arrangement shown in Fig. 2 the action of R^2 might be that of a self-inductive or kicking coil.

What I claim as my invention is—

1. In a dynamo-electric machine, the combination, with the field-magnet, of two armatures or armature-coils in series with one another, one being the source of current for the work-circuit, and a connection leading across from one side to the other of the series circuit and containing an artificial resistance.

2. In an alternating-current dynamo, the combination, with a field-magnet circuit and an alternating-current work-circuit, of two armatures or armature-coils connected in series through the field-magnet coil, a commutator in such series circuit, a cross connection at an uncommuted portion of the circuit, and a reactive coil or resistance in such connection.

3. The combination, substantially as described, of a field-magnet circuit, two armatures or sections of armature supplying the same in series, a commutator in the series circuit, an uncommuted portion of circuit forming the work-circuit, a connection from one side of the series circuit to the other, made at alternating-current points, and a reactive coil in the said connection.

4. The combination, substantially as described, of two armature coils or sections of coil in series, a field-magnet circuit supplied from the same in series, a commutator in the series connections, a work-circuit in the alternating-current connection to the commutator, a connection across from one side of the series circuit to the other, an artificial resistance in said connection, and a collector-ring for forming such connection.

5. The combination, with the two coils or sections of coil in series, a commutator in the circuit supplied by such coils in series, and an artificial resistance carried by the armature and placed in a connection from a point between the coils to the circuit leading to the commutator.

Signed at Lynn, in the county of Essex and State of Massachusetts, this 14th day of October, A. D. 1889.

HERMANN LEMP.

Witnesses:

J. WESLEY GIBBONEY,

D. MCKILLOP.