(No Model.)

W. S. MOODY.

ALTERNATING CURRENT GENERATOR.

No. 560,735. Patented May 26, 1896.

FIG. 1.

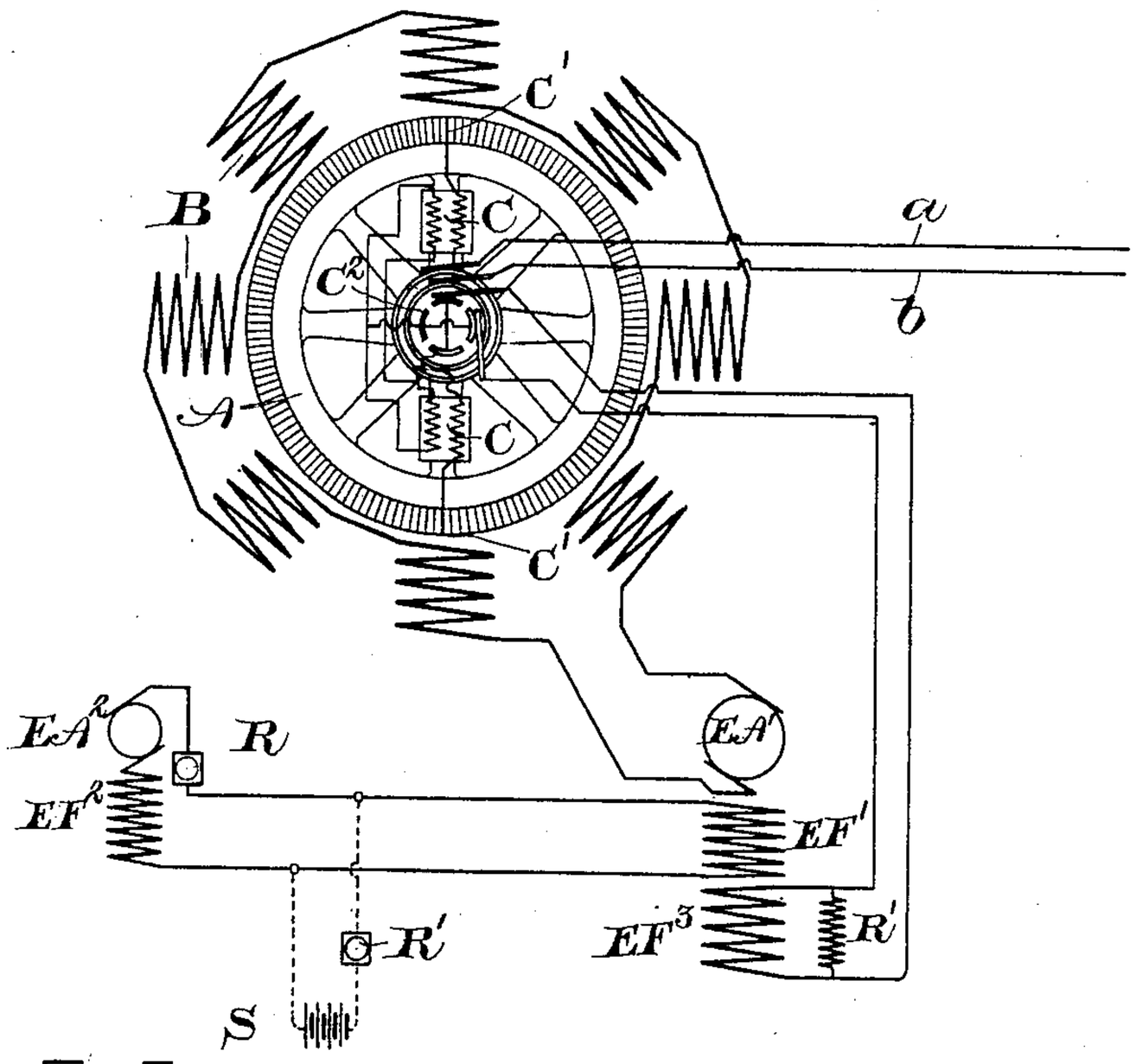
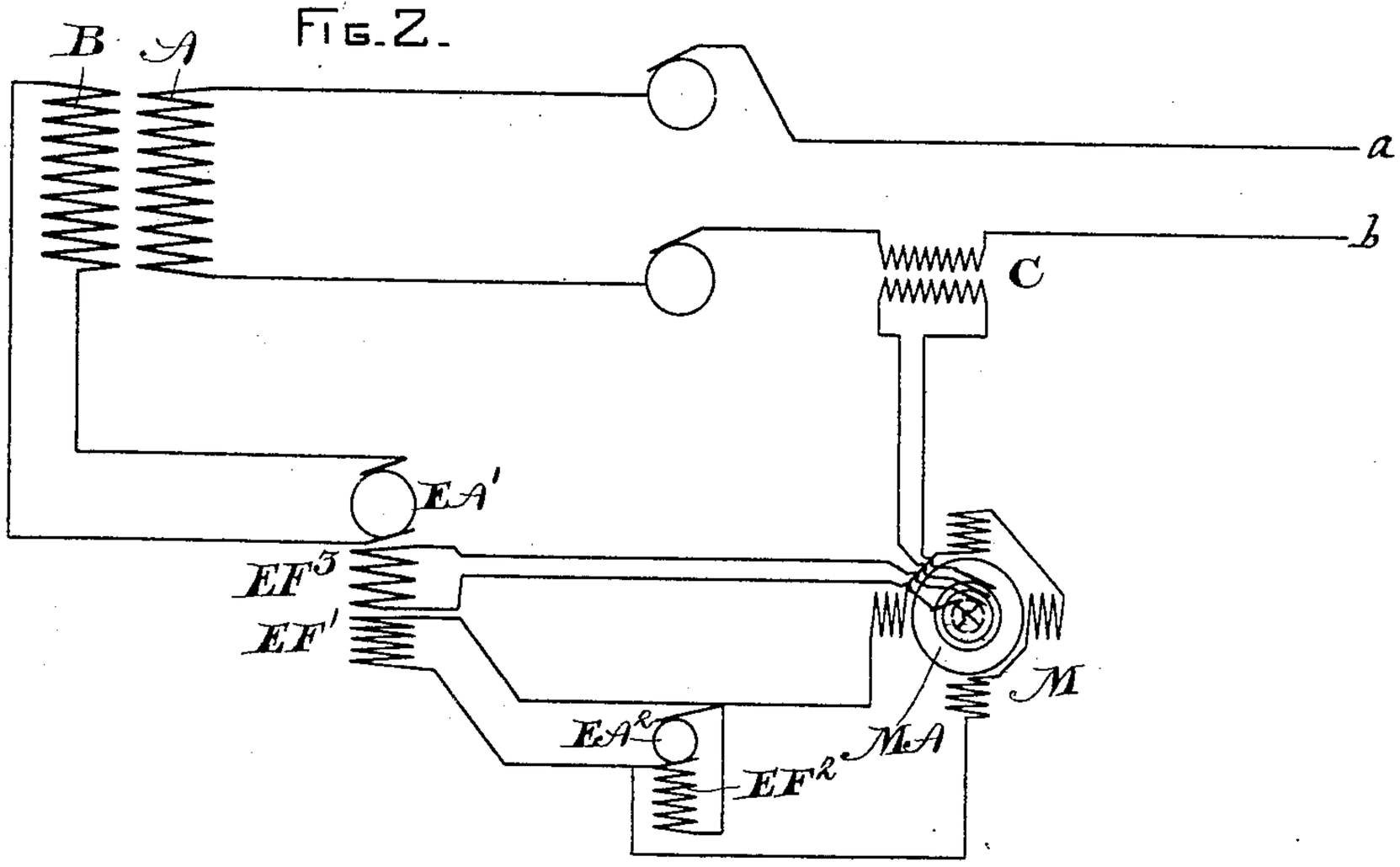


FIG. 2.



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UNITED STATES PATENT OFFICE.

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ALTERNATING-CURRENT GENERATOR.

SPECIFICATION forming part of Letters Patent No. 560,735, dated May 26, 1896.

Application filed January 17, 1896. Serial No. 575,828. (No model.)

To all whom it may concern:

Be it known that I, WALTER S. MOODY, a citizen of the United States, residing at Lynn, in the county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Regulating Alternating-Current Dynamo-Electric Machines, (Case No. 323,) of which the following is a specification.

My invention relates to the regulation of alternating-current dynamo-electric machines, and more particularly to the compounding of such machines for change of potential upon change of load. The objects thus pointed out have been attained to a greater or less perfection by other forms of apparatus; but some of these devices have been objectionable for various reasons. One principal method in use has been to use a separate exciter for such machines and to commute a part of the current of the main machine and pass it around the field-magnets of the exciter, so that the potential of the exciting-current rises with the increase of load, and thus more current is passed around the field-magnets of the main machine, and its potential is likewise raised. Another method has been to commute a part of the main current and pass it around the field-magnets of the machine itself. This latter arrangement necessitates a somewhat large commutator and the commutation of a considerable portion of the main current, while the single-exciter method of compounding has several objections, among others being the fact that the increase or decrease of field strength in the exciter brought about by the commuted main current acts to increase or decrease the current through the shunt-winding of the exciter-machine, and thus produces a sort of geometric progression in the change of potential. This is more objectionable from the fact that the current in the shunt-field winding does not respond quickly to the change of electromotive force at the terminals of the winding, but requires a certain length of time to reach its corresponding value on account of self-induction and resistance, which, added to the lag from hysteresis, prevents the electromotive force in the main machine being quickly adjusted to the varying current demand so as to compound or overcompound properly, the excitation coming on too slowly when the current falls and falling off too slowly when the load drops. Another objection to the use of the single exciter is that with alternators having large armature self-induction (which is true of the majority of those in use) the field-current is very much larger at low load than at no load, so that in case of a small amount of overcompounding, such as ten per cent. or so, there may be one hundred per cent. or even one hundred and fifty per cent. increase in the field-current. A single compound-wound exciter furnishing, say, one hundred and ten volts when full load is on the alternating-machine at a light load or no load must run at a potential of about fifty volts or less. With this condition of weak field in the exciter the current in its field-magnet winding will be extremely unstable and may fall below the critical point, so that the machine will lose its excitation entirely. This fact has been practically demonstrated within my knowledge in large machines in commercial use. This and other disadvantages of the methods commonly in use I have overcome by means of the present invention, in which I employ two exciting-machines. One of these machines furnishes to the field-magnets of the main machine all of the current which they receive. The armature of this machine has no connection with its own field-magnets, but they are separately excited by a second exciter-machine. It is in a sense a compound-wound machine, in that the winding upon its field-magnets, which derives current from the second exciter-machine, is a winding of high resistance, like an ordinary shunt-winding, and will be hereinafter referred to as the "shunt-winding." It resembles that class of winding in that a comparatively constant current is maintained through it. Upon the same field-magnets is wound a compounding-coil, which derives its energy from the main circuit. In some cases I prefer to mount a transformer upon the armature of the main machine and send current from the secondary of this transformer through a synchronous commutator mounted upon the shaft of the main machine; but for this I may substitute other arrangements, in

that case particularly where a stationary transformer is used. By this arrangement I provide a method of compounding free from the disadvantages and objections which I have pointed out. The main exciter cannot fall below the critical point in its field excitation, because the auxiliary exciter furnishes to the shunt-winding a current sufficient at all times to maintain it above this point. This current being independent of that flowing in the armature of the main exciter, it responds freely to changes in the load upon the main dynamo, as the compounding-coil may be of relatively-greater effect with the kind of excitation to which I have just referred. The current in the shunt-winding of the main exciter being independent of its own armature, the changes in the field strength produced by the compounding-coil do not directly affect the shunt-coil, and therefore the sluggishness or lack of coincidence between the demand for current and the increase of potential due to the compounding-coil does not occur, and the proportionate amount of compounding is not disturbed by this reactive influence of the shunt-coil. It is of course designed to adjust the amounts of the shunt-winding and the compounding-coil to the particular degree of overcompounding desired.

The method of operation, as will be seen from the above statement of invention, is, briefly, to supply the main-dynamo field-magnets with current from an armature rotating in a field of force produced by a constant magnetizing-current independent of the armature itself, and a second magnetizing force derived either directly or inductively from the main machine, by which is meant either the dynamo itself or the circuit supplied by it. In speaking of this independent field of force it is of course understood that the armature reaction is not referred to, but that there is no electrical connection between the main exciter-armature and its own field-magnets.

The accompanying drawings show diagrammatic embodiments of my invention, Figure 1 being a representation of the combination of machines that I have described with a transformer carried upon the armature of the main dynamo. Fig. 2 is a modified form in which a stationary armature is employed and a synchronous commutator is used to furnish the compounding-coil with direct current derived from the main circuit.

Referring now to the drawings by letter, A is the armature of the main dynamo-electric machine to be regulated. B indicates the field-magnets. *a b* are the mains from the armature, provided with a pair of collecting-rings. A single-phase alternator is indicated; but nothing in my invention would exclude its application to alternating-machines of other numbers of phases.

C is the transformer to which I have referred, mounted upon the armature of the main machine and connected with its armature-winding at C′ C′. From the secondary of this transformer leads pass to the commutator C^2, mounted upon the shaft of the main machine and provided with the usual brushes. From these brushes leads pass to the compounding-coil EF^3, and between these leads a resistance R′ is shown, which may or may not be adjustable, but ordinarily is of fixed amount. The shunt-coil of the main exciter is indicated at EF′, and within the field-coils furnished by these two coils rotates the armature of the main exciter EA′ in circuit with the field-magnets B of the main machine. The shunt-coil is furnished with current from the armature EA^2 of the second or auxiliary exciter, whose field-magnet EF^2 is in series with its own armature. A regulating-resistance R for determining the voltage of the main machine and incidentally that of the exciters is interpolated in the circuit at any suitable point.

In Fig. 2 the same reference-letters indicate like parts; but the transformer C is in the main circuit and is stationary. It supplies energy to the armature MA of the synchronous motor M, acting as a rotary converter, the field-magnets of which are supplied with current from the auxiliary exciter. The portion of the main current transmitted by induction through the transformer C is fed to the armature of this converter and is there rectified by the commutator and fed to the compounding-coil EF^3.

The electrical operation of the devices just described will be readily apparent to those skilled in the art, while the advantages of the method of operation have been pointed out above.

It is manifest that another source of current for supplying the constant excitation of the main exciter might be substituted for the auxiliary dynamo which I have shown. Such a source of current is indicated in Fig. 1 in dotted lines, a storage-battery being diagrammatically shown at S with a resistance R′ in its circuit for adjusting the electromotive force, although any other means might of course be used.

In addition to the advantages which I have already stated I am enabled by the combination of apparatus and method of operation which I have illustrated and described to dispense with potential-responsive magnets as employed in many forms of regulator now in use, and I also dispense with contacts to be opened and closed by the action of such potential-responsive devices, thus overcoming the objections not only to these devices but to the auxiliary arrangements so often necessary to eliminate the sparking in their operation.

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

1. The method of compounding alternating-current dynamo-electric machines for change of potential under change of load, which consists in supplying to the field-magnets cur-

rent from an armature revolving in a compound field of force independent of the armature itself, part of such field of force supplied by a separate excitation substantially fixed in amount, and part by a commuted current derived from the main machine.

2. The method of compounding alternating-current dynamo-electric machines for change of potential under change of load, which consists in supplying to the field-magnets current from an armature revolving in a compound field of force independent of the armature itself, part of such field of force supplied by separate excitation substantially fixed in amount, and part by a commuted current derived inductively from the main machine.

3. In combination, an alternating-current dynamo-electric machine, an exciter-armature in circuit with its field-magnet winding, a coil of high resistance upon the field-magnets of the exciter, an external source of current for the coil, and another coil upon the field-magnets, the latter coil deriving its energy from the alternator.

4. In combination, an alternating-current dynamo-electric machine, an exciter-armature in circuit with its field-magnet winding, the latter armature having no electrical connection with its own field-magnet winding, a coil upon the exciter field-magnets in circuit with a source of substantially constant electromotive force, and a compounding-coil upon the exciter field-magnets deriving energy by induction from the main circuit.

5. In combination, an alternating-current dynamo-electric machine, an exciter-armature in circuit with its field-magnet winding, an auxiliary exciter supplying a field-magnet coil upon the main exciter with substantially constant electromotive force, a compounding-coil upon the field-magnets of the main exciter, and a synchronous commutator rectifying part of the main current and supplying it to the compounding-coil.

6. In combination, an alternating-current dynamo-electric machine, a main exciter-armature in circuit with its field-magnet winding, an auxiliary exciter, a synchronous converter, a high-resistance coil upon the field-magnets of the main exciter, electrical connections from the auxiliary exciter to the high-resistance coil and the field-magnets of the converter, and a compounding-coil upon the field-magnets of the main exciter and in circuit with the converter.

In witness whereof I have hereunto set my hand this 14th day of January, 1896.

WALTER S. MOODY.

Witnesses:
JOHN W. GIBBONEY,
HENRY M. HOBART.