

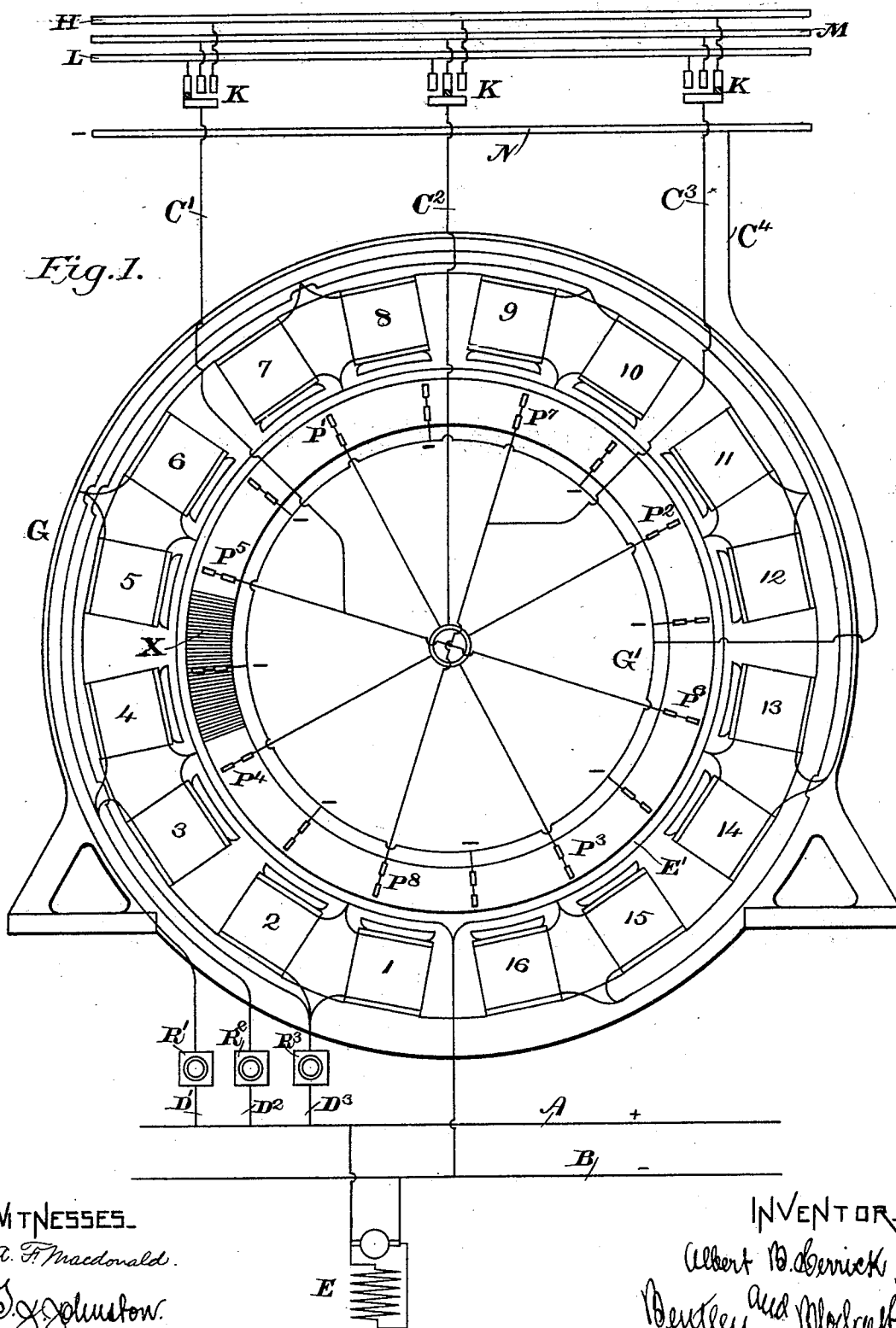
(No Model.)

2 Sheets—Sheet 1.

A. B. HERRICK.
DYNAMO ELECTRIC MACHINE.

No. 520,781.

Patented June 5, 1894.



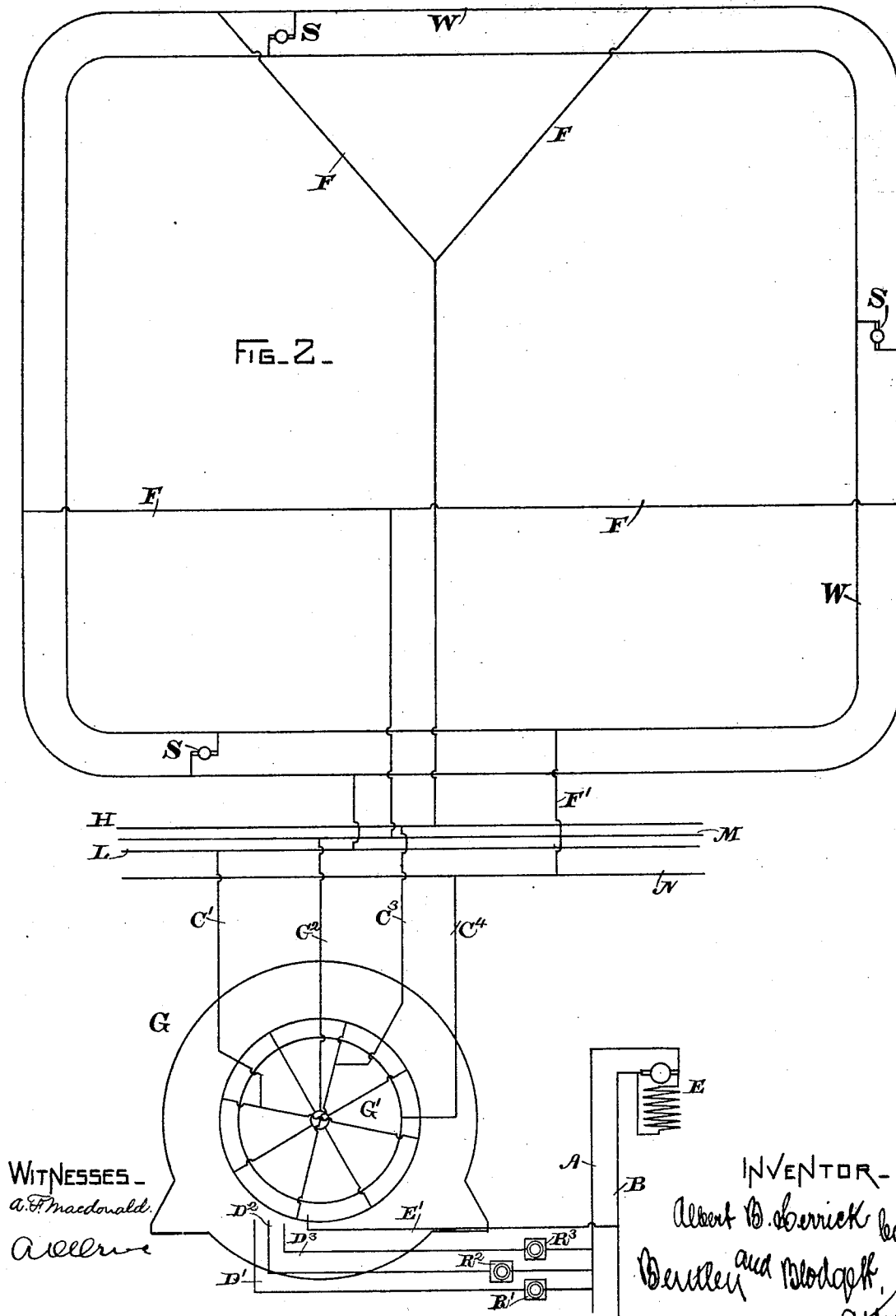
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THE NATIONAL LITHOGRAPHING COMPANY,
WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

ALBERT B. HERRICK, OF SCHENECTADY, NEW YORK, ASSIGNOR TO THE
GENERAL ELECTRIC COMPANY, OF BOSTON, MASSACHUSETTS.

DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 520,781, dated June 5, 1894.

Application filed January 25, 1894. Serial No. 498,035. (No model.)

To all whom it may concern:

Be it known that I, ALBERT B. HERRICK, a citizen of the United States, and a resident of Schenectady, county of Schenectady, and State of New York, have invented certain new and useful Improvements in Dynamo-Electric Machines, of which the following is a specification.

My invention relates to a method of and apparatus for taking a plurality of currents of different potential from a single dynamo-electric machine, and has for its object to provide an efficient means of compensating for the drop in an extended system of distribution used either for power or for lighting; and my invention consists in the method herein pointed out, which is generally applicable, not only to the above purpose, but to any case in which a plurality of currents of different potential may be required, and also in the combination of apparatus and circuits, in a way hereinafter particularly pointed out, to attain the objects of my invention; and further, in the dynamo-electric machine itself, as will be more particularly described.

To attain the ends pointed out, I preferably provide a composite magnetic field, in which the armature is rotated; that is to say, I provide a magnetic field in some parts of which the magnetic intensity or number of magnetic lines of force to the square inch is greater than in other parts, and this sub-division of the field may be extended to any desired degree, so that, if desired, I may obtain from a multipolar machine a varying number of currents, even as many as half the number of poles in the field; and from the brushes located adjacent to each pole, if the circuits be subdivided as just suggested, I take a current of the particular potential desired, using all of the negative brushes as a common return of the various currents.

For the purposes of my invention as applied to a system of distribution, currents of three different degrees of electro-motive force will ordinarily be found sufficient, and in exemplifying the construction which I prefer, I have selected that number as easiest of illustration and description. In such a number the current of medium potential, as I shall call it, will be the one of greatest volume, as

ordinarily the distributing station is located as nearly as possible at the center of the system; while the two other currents in the case illustrated, called, for convenience, the high potential and low potential currents, will be of smaller volume, the high potential current being transmitted, as will be easily understood by those skilled in the art, to the more distant portions of the system, while the low potential current will supply the parts of the system nearest to the power station. It is also best in carrying out my invention to arrange the different portions of the composite field in such order that the armature conductor shall not pass from the part of the field of greatest intensity to that of least intensity at once, but to interpose a portion of the field having an intermediate intensity or adapted to generate a current of medium potential, as above described; for which purpose I arrange the brushes so that a brush taking current of greatest potential is succeeded first by a negative brush, then by a brush taking current of medium potential with its corresponding negative brush, then by a brush of least potential with its corresponding negative, which is next succeeded by a brush of medium potential with its corresponding negative, and so on around the circumference of the armature. This arrangement has the advantage of causing the armature conductors to move through a field of force the changes in which are gradual and not sudden, so that as the conductors progress from one part of the field to another, the potential of the current in it is changed gradually and not by sudden steps. It will be readily understood that the sub-division of current may be less than that illustrated, or, as already indicated, may be carried to any desired extent.

In the convenient diagrammatic illustration which I have adopted to exemplify my invention, I have shown a multipolar machine having sixteen poles, and provided, as is common with such machines, with a separate exciter; but it is manifest that my improved method and construction is equally applicable to the case of self-excited machines having shunt windings or to compound-excited apparatus, whether directly compounded or

over-compounded for a compensating or over-compensating rise of potential and in accordance with the increase of load; this over-compounding might, if the machine were specially constructed to allow of it, be so proportioned as to give for each of the different currents selected a different compounding action so as to over-compound for the high potential feeders taking current to the more distant parts of the line, to compound to a less degree for the middle portions of the line, and to compound very little or not at all for the parts of the system nearest to the power station, wherein ordinarily the current is supplied with a negligible drop of potential. As the system of distribution increases in extent, the problem of supplying its outlying portions without special machinery becomes a complicated one; in stations employing many machines connected to common bus-bars, the difficulties have been met by the method of raising the potential to a degree adequate to compensate for the drop to the most distant point, or over feeders having the greatest resistance, and adding resistances to all of the other feeders to equalize the pressure upon the system and the current supplied in the different feeders; or separate machines have been run having a greater electro-motive force, and feeding into the system at its most distant point; or resort has been had to one or another of the so-called "booster" systems, in which often a number of small machines are connected in the various feeders, or else as an alternative, the size of the more distant feeders has been increased; all of these methods are objectionable on the ground of expense, the extra resistances of the first method wasting current, the extra machines of the second being a ground of expense on the interest account and in their running, their usefulness being confined to the times when a somewhat large load is being carried on the outlying part of the system, the third necessitating a multiplicity of small machines troublesome to care for, complicating the system, and incurring additional loss attendant on a second transformation of energy and the fourth involving a waste of copper, inasmuch as the greater the distance, the larger the feeder, it increasing both in length and size. It is to obviate these defects that I have devised my present method and machine, which is fully illustrated in the accompanying drawings, hereby referred to and made part of this specification, in which like letters and figures refer to like parts throughout, wherein—

Figure 1 is a diagrammatic side elevation of a multipolar dynamo constructed according to my invention, and Fig. 2 is a diagram of a system of distribution employing such a dynamo.

In this description I have referred to a single machine, but I do not thereby intend to confine myself to the employment of a single generator embodying my improvements and

method, as it is manifest that where a system requires a large amount of power, two or more such generators may be combined in ways well understood in the art.

Referring by letters and figures to the drawings, G is a generator having sixteen poles, G' is its rotating armature.

E is an exciter.

The bus-bars into which the generator feeds are divided, the positive bars numbering three and being marked respectively H, M and L; the bar H being designed to take the highest electro-motive force of the generator, the bar M the middle, and the bar L its lowest electro-motive force. The negative bus-bar is marked N and a single one serves as a common return for the current from all of the positive bars. From the exciter E leads go to bus-bars A, B, and from the positive bus-bar A three leads, D', D², D³ pass around the field-magnets of the machine, rheostats R', R², R³ being inserted in the leads. The lead D' passes around the field-magnets (which I have marked consecutively 1 to 16), including only the field-magnets 5 and 6, 13 and 14, and then passing to the common return for the exciter, which I have marked E'. It will be observed that the poles selected are on diametrically opposite sides of the armature of the machine; the lead D² from the positive bus-bar of the exciter passes around the field-magnet poles 3 and 4, 7 and 8, 11 and 12, 15 and 16, supplying them all in multiple, and returning by the common return E'. The lead D³ passes around the remaining poles 1 and 2, 9 and 10. It will thus be observed that a composite magnetic field is formed which is symmetrical; that is to say, the opposite poles of the field form independent magnetic circuits, the poles on opposite sides of the armature being magnetized to the same strength relatively to one another.

Referring now to the armature, which is of the so-called "direct-driven" or multipolar type, having a side bearing commutator as commonly employed in armatures adapted to generate large currents, and in which the armature conductors themselves form the bars of the commutator, it will be seen that the brushes taking various currents are connected; in ordinary armatures of this type where a single current is taken, all of the positive brushes are connected and all of the negative brushes are also connected, but in my improved construction I divide the brushes, as in the case illustrated, into three groups; those which I have marked P', P², P³ and P⁴ are connected together and by a lead C² are connected to the middle positive bus-bar M; those which I have marked P⁵, P⁶ are cross-connected and by a lead C' are connected to the low potential positive bus-bar L, while those which I have marked P⁷, P⁸ are connected by a common lead C³ to the high potential positive bus-bar H. From the negative bar a common lead C⁴ extends to all of the negative brushes, which I have given no lettering except a

minus sign. As already described in the general statement of invention, these brushes will be found to alternate in the order of highest potential,—negative, medium potential, negative, lowest potential, negative, medium potential, negative, and so on around the commutator, a part of which is illustrated at X, the rest of it being omitted for clearness of illustration. The parts of Fig. 1 marked K, K, are suitable switches by which all three of the positive bus-bars may be connected when currents of only one potential are taken from the armature.

Referring now to Fig. 2, I show the generator referred to illustrated diagrammatically, the various parts being lettered as in Fig. 1; and in addition I show track rails W, W of a railway circuit supplied by feeders F, F, F, and having electric cars or locomotives S, S upon the rails in different positions, the feeders extending from the high potential bus-bar H going to the more distant part of the system, while those from the middle bar M go to the parts half way from the station to the outer edge of the system, and the low potential bus-bar L is connected at the nearest point. A common feeder F' connects with the track rails which are of course united to form a ground return, as commonly practiced in railway work. For the railway and its motors illustrated may be substituted incandescent or arc lights or any other translating device.

The operation of my improved system will be readily understood from the statement of invention. It is this: in Fig. 1 the greater part of the current is supplied to the middle potential bus-bar M, it having four of the eight positive brushes connected to it; the high potential and low potential bars each being connected to two of the positive brushes. As the load upon the parts of the system supplied from the high potential bar rises, the current increasing and the potential falling, the rheostat D³ would be adjusted to increase the magnetization of the field-magnets 1, 2, 9, 10, and the armature conductors in passing through this part of the composite field would furnish a higher electro-motive force to the bus-bar H, the same steps being taken, when necessary, to effect the same ends in either or both of the other circuits. It is manifest that in the case of a compound-wound machine or an over-compounded machine, the same effect would be automatically provided by a series winding to the extent designed by the engineer in constructing the machine, and the load, as it moves from one part of the system to the other, will be taken care of by the increase in pressure which the increase in current automatically causes. From what has just been said about the machine illustrated in Fig. 1, the operation of the system in Fig. 2 will be readily understood, the feeders F, F supplying the increased current demanded, which by the operation of the machine is generated

at such appropriate electro-motive force as may be desired.

By the word "composite" as used with reference to the magnetic field of the machine described herein, I do not mean "compound" as usually applied in dynamo-electric machines to a field produced by a series winding and a shunt winding combined, but I mean a field in which one part is more highly magnetized than another.

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

1. The method of simultaneously generating a plurality of currents of different electro-motive forces in a single armature, which consists in rotating such armature in a composite field of force having some of its parts more highly magnetized than others.

2. The method of simultaneously generating a plurality of currents of different electro-motive forces in a single armature, which consists in rotating such an armature in a composite field of force generated by a plurality of magnetic poles supplied with different amounts of magnetizing current.

3. The method of simultaneously generating currents of different electro-motive forces in the same armature, which consists in rotating such armature in a multipolar field of force and supplying the field-magnets generating such field of force with currents adapted to cause a greater degree of magnetization in some of such field magnets than in others.

4. The method of compensating for drop in potential in an extended system of distribution supplied by a single generator, which consists in rotating the armature of such generator in a composite field of force generated by field-magnets supplied with different exciting currents, then sub-dividing the collected currents and supplying the parts of such system having the greatest drop with the currents of highest potential, and the parts having less drop with currents of lower potential, as set out herein.

5. The method of compensating for drop in the different parts of a system of distribution, which consists in generating simultaneously currents of different electro-motive force in a single dynamo-electric machine, supplying the currents of higher electro-motive force to the more distant parts of the system, and those of lower electro-motive force to the parts nearer the power station.

6. In a dynamo-electric machine, a number of field-magnets supplied with different amounts of exciting current, an armature rotated in the field of such magnets, a commutator and brushes thereon adjacent to the field-magnets, all of the brushes adjacent to the field-magnets supplied with the same amount of magnetizing current having a common connection.

7. In a dynamo-electric machine a composite field-magnet system comprising groups of field-magnets symmetrically arranged, the

groups being supplied with different amounts of exciting current, an armature rotated in the field of force generated by such magnets, and connections arranged, as herein described, to take currents of different potential from such armature as its conductors pass the different groups of field-magnets.

8. In a dynamo-electric machine a field-magnet system comprising groups of field-magnets symmetrically disposed, a source of current for such field-magnets, regulating appliances included in the leads from such source of current to the different groups of field-magnets and arranged to independently regulate the magnetic effect of each group, an armature rotated adjacent to such field-magnets, commutator brushes bearing thereon, and leads from such brushes to bus-bars; all arranged, as herein described, to take from a single armature currents of different potential.

9. In a system of distribution, a generator adapted to deliver currents of different potential to different positive bus-bars, feeder lines adapted to feed the currents of highest poten-

tial to the parts of the system having the greatest drop, and other feeders arranged to supply the parts of the system having a less drop.

10. In a system of distribution, a generator having a field-magnet system producing a composite magnetic field in which some portions are more highly magnetized than others, an armature rotating in such field, brushes taking currents of different potential from such armature, bus-bars supplied from such brushes, and feeders taking currents from such bus-bars and arranged to take the current of highest potential to the parts of the system having the greatest drop and the currents of less potential to the parts of the system having a less drop.

In witness whereof I have hereunto set my hand this 16th day of January, 1894.

ALBERT B. HERRICK.

Witnesses:

GUSTAVE FAURE,
W. A. PEARSON.