(No Model.) 2 Sheets—Sheet 1.

W. STANLEY, Jr.

DYNAMO ELECTRIC GENERATOR.

No. 418,659. Patented Dec. 31, 1889.

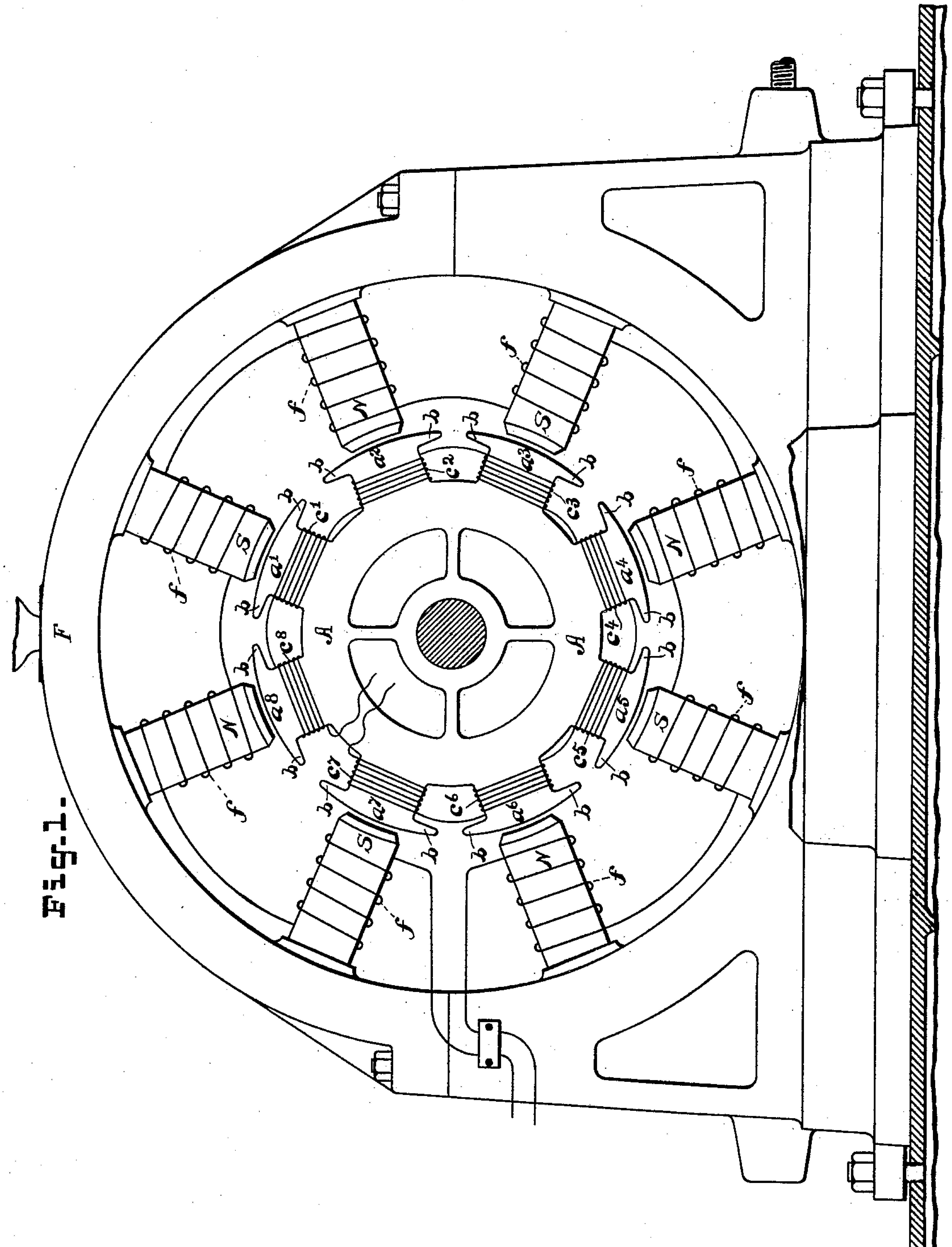

Fig. 1.

Witnesses
George Brown, Jr.
James W. Smith

Inventor
William Stanley Jr.
By his Attorney
Charles A. Terry

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(No Model.)

2 Sheets—Sheet 2.

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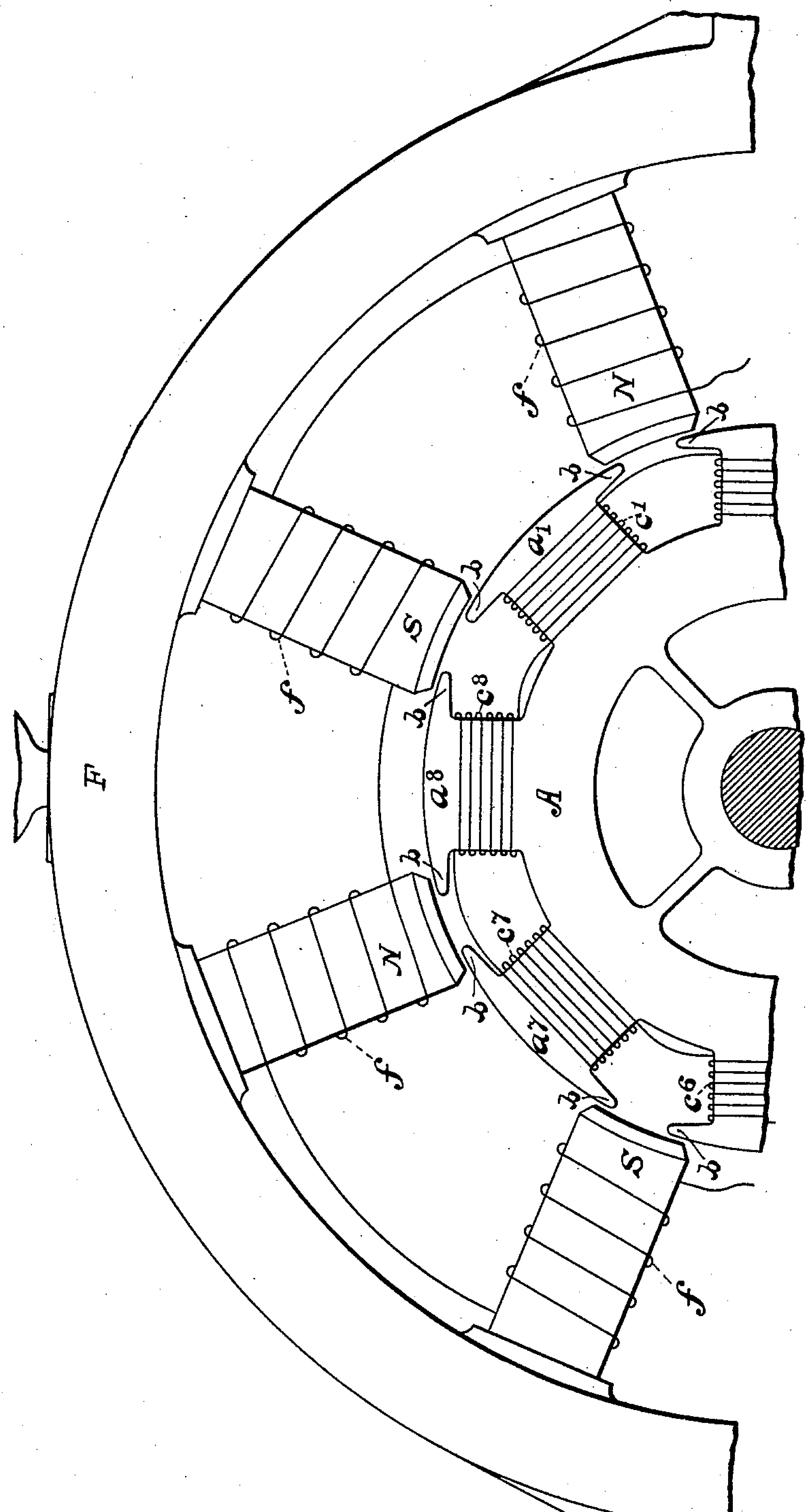

Fig. 2.

Witnesses
George Brown Jr.
James W. Smith

Inventor
William Stanley Jr.
By his Attorney
Charles A. Terry

UNITED STATES PATENT OFFICE.

WILLIAM STANLEY, JR., OF GREAT BARRINGTON, MASSACHUSETTS.

DYNAMO-ELECTRIC GENERATOR.

SPECIFICATION forming part of Letters Patent No. 418,659, dated December 31, 1889.

Application filed August 31, 1889. Serial No. 322,582. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM STANLEY, Jr., a citizen of the United States, residing in Great Barrington, in the county of Berkshire and State of Massachusetts, have invented a new and useful Improvement in Dynamo-Electric Generators, (Case No. 340,) of which the following is a specification.

The invention relates to the construction and operation of that class of electric generators employed for maintaining a constant current in a work-circuit while the amount of work being done in such circuit is varied.

The object of the invention is to provide a simple and efficient form of generator, which will operate automatically to deliver a constant or approximately-constant current throughout considerable variations in the load placed upon it without necessitating the employment of external regulating apparatus.

In constructing a generator for delivering a constant current under varying loads, it must be borne in mind that the current flowing is dependent, first, upon the electro-motive force originating the current, and, second, upon the resistance which the current encounters being directly proportional to the former and inversely proportional to the latter. It follows, then, that in order that the current may remain constant the electro-motive force must be increased in proportion as the resistance is increased, and vice versa. The electro-motive force varies in any given instance with the number of lines of force cut per unit of time by the armature-coils. For this reason it has been customary to increase the field of force of a generator when an increase of electro-motive force is desired, and to decrease the field of force as the value of the electro-motive force desired is diminished.

The purpose of the present invention is to produce the required variations in the electro-motive force for delivering a constant or approximately-constant current by causing variations in the resistance of the work-circuit to occasion sufficient changes in the inductive actions taking place between the armature and field-magnet to vary the number of lines of force, cutting the armature-coils proportionately to the variations in the electro-motive force required. This is accomplished by developing opposing magnetic potentials on the part of the field-magnet and armature, and permitting the excess of the former to develop resultant lines of force which thread through or cut the armature-coils, and by varying the magnetic potential of the armature by variations in the phase, time, and strength of the current flowing in its coils, so that the excess of the effective magnetic potential of the field-magnet above that of the armature will vary directly as the work being done. From this it will follow that the number of lines of force threading the armature-coils will vary with variations in load.

For the purpose of obtaining very considerable variations in electro-motive force from slight variations in current, the armature-core is wound with coils having a large number of convolutions, so that a slight decrease, for instance, in the value of the current, will result in a great decrease in the number of ampère turns in the armature. This tends to correspondingly lessen the magnetic potential of the armature and permit more lines of force to develop and thread the armature-coils. The number of armature convolutions being great, these additional lines of force will produce a great increase in the electro-motive force. By properly proportioning the parts this increase of electro-motive force may be made of such value that the current delivered will vary only between narrow limits under all conditions.

The revolution of the armature carrying the coils past the poles of the field-magnet tends to produce an alternating current in the armature-coils, and were the rise and fall of the alternate armature-poles due to this current coincident with the passage of the coils across the alternate north and south poles of the field-magnet, then the magnetic polarization of the armature would occur at such times as to allow practically no lines of force to flow through the armature-coils, for there would be a magnetic potential on the part of the field-magnet due to a given number of ampère turns, opposed by the magnetic potential on the part of the armature due approximately to the same number of ampère turns.

In practice the relative time between the appearance of maximum armature polarization due to the current in the armature-coils and the passage of a pole thus produced across the field-magnet pole varies with the resistance of the external circuit. It is evident that the difference in the time of the occurrence of the maximum armature polarization and the passage of the armature-pole across the field-magnet pole will to a great extent determine the number of lines of force permitted to thread the armature-coils and therefore the electro-motive force which will be produced in the armature-coils with a given field of force. The relative position of the armature-pole at the time of maximum strength and the field-magnet pole varies with the resistance in the external circuit of the armature, the displacement between the two opposing poles being increased as the resistance of the external circuit is increased, thereby lessening the opposing effect of the armature upon the field-magnet and allowing more lines of force to pass through the armature-coils, thus increasing the electro-motive force of the armature. The opposing effect of the armature-current in cutting down the field-magnetic potential is thus diminished with an increase of load, not only by the diminution in the quantity of the current flowing, but also by the shifting of the positions which the armature-poles occupy with reference to the field-magnet when the maximum armature polarization appears.

In constructing a machine, a field strength for operating upon the armature is selected according to the well-known principles governing the construction of dynamo-electric machines, reference being had to the size of machine and output desired, and then, having selected the current required to be delivered by the machine, wire is wound upon the armature preferably in such a manner as to produce strong local poles and of such length that when traversed by the normal current for which the machine is designed it will produce a magnetic potential upon the part of the armature approximately the same to the magnetic potential of the field-magnet—that is to say, the number of ampère-turns in both the field-magnet and armature would be approximately equal. The energizing-force of the field-magnet remains practically constant; but the magnetic potential or number of lines of force produced with a constant energizing-force depends upon the condition of the magnetic circuit provided therefor. It is the function of the armature of the machine to vary the magnetic conductivity of this magnetic circuit, and this it does by opposing to the field-magnetic potential the counter-magnetic potential of the armature, which counter-magnetic potential varies with the work being done.

An application of the invention will be described in connection with the accompanying drawings, in which—

Figure 1 is a side elevation of a field-magnet and armature, and Fig. 2 is an enlarged detail showing the armature in a different position with reference to the field-magnet poles.

Referring to the figures, A represents the armature, and F the field-magnet, of an electric generator. The field-magnet is constructed with poles N S N S—in this instance eight in number. The poles are wound with coils *f f*, which may be connected in the circuit of an independent source of currents or excited in any manner serving to secure constant excitation. The armature is shown as having eight polar projections a' a^2 a^3, &c. These polar projections have in this instance laterally-projecting flanges or lugs *b*. Coils c' c^2 c^3, having a great number of convolutions, are wound about the poles and beneath the lugs, and tend to produce strong magnetic poles at the polar projections. The direction of the winding upon the armature-poles is reversed at each succeeding pole, as indicated, so that the tendency of the current traversing the coils is to produce opposite polarities at alternate poles. The alternate field-magnet poles are also of opposite polarity. The coils of the armature consist of many convolutions, so that a slight variation in the quantity of current flowing through the coils produces considerable variation in the ampère-turns.

The principal features entering into the operation of the machine are the following: The field-magnet tends to develop a large number of lines of force. The revolution of the armature carrying the coils through these lines of force develops an alternating current in the coils. This alternating current tends to set up in the armature-core lines of force at such moments as to oppose or stem back a portion of the lines of force of the field-magnet pole toward which it is moving, thus permitting only a comparatively few to be effective in generating an electro-motive force in the armature-coils. These two tendencies to establish lines of force may properly be considered as the magnetic potentials of the field and armature. The excess of the magnetic potential of the field above that of the armature at the time when the field-poles are effective in sending lines of force through the armature-core is that which is effective in producing electro-motive force in the armature-coils. The number of lines of force resulting from this difference of magnetic potentials, and which are thus effective in developing current in the armature-coils, will remain approximately constant so long as the resistance offered to the flow of the current on the work-circuit remains constant; but as the resistance increases, the tendency of the armature-current to be diminished will, for the reasons already stated, allow a greater number of lines of force to cut the armature-coils, thus increasing the electro-motive force sufficiently to hold the current approximately at a predetermined value. In practice there will be a slight decrease in the current unless certain compensation is secured by other means. As already set forth, the shifting of time of development of maximum polarization of the armature with reference to the passage of the armature-poles across the field-magnet poles by changes in the resistance of the armature-circuit will be effective in producing the compensation, and in practice such shifting may be made of sufficient effect to render the current very nearly constant in value.

In order to obtain the full effect of the counter influence of the shifting of time of maximum magnetic potential of the armature, the lateral flanges or lugs *b b* may be provided. These encompass such a portion of the armature-periphery as to afford a more or less perfect path for the lines of force of the field-magnet from one pole to its neighbor when in certain positions of the armature. It is evident that by this construction a less displacement of the phase of the armature magnetization is necessary in order to produce the required opposition to the field-magnetic potential to stem back the lines of force and prevent them from threading the armature-coils.

In practice, excellent results are obtained by employing a field-magnet with eight poles and have a cylindrical opening fifteen and nine-sixteenths inches in diameter and eleven inches in length, the core projections being about three and five-eighths inches thick and having their ends beveled, the width of the face between the edges of the bevels being one and three-fourths inches. These poles are each wound with five hundred and eighty-eight turns, making a total of four thousand seven hundred and four turns. The size of wire is No. 11. The armature is also made with eight poles, and is ten and one-fourth inches in length and fifteen and three-eighths inches in diameter. The width of the pole-cores is three inches and the lugs projecting one inch on each side, making the total width five inches. The poles are wound with seven layers of No. 16 wire, twenty-three turns per layer.

This machine may be run at fourteen hundred and twenty-five revolutions per minute, and with a current of five and a half to six ampères in the field-magnet coils will yield nine or nine and a half ampères at an electro-motive force of three thousand eight hundred volts.

I claim as my invention—

1. The method of generating and maintaining in an electric circuit of varying resistance current of constant or approximately-constant quantity, which consists in maintaining a constant or approximately-constant magnetic potential on the part of the field-magnet, causing the maximum current flowing in the armature to develop an approximately equal opposing magnetic potential, and varying the number of resultant lines of magnetic force allowed to flow through the armature-coils directly with the variations in the resistance of the circuit, thereby producing such variations in the electro-motive force of the current generated as to maintain its quantity constant or approximately constant.

2. The hereinbefore-described method of generating and maintaining constant or approximately-constant currents in an electric circuit of varying resistance, which consists in developing a field of force of constant or approximately-constant magnetic potential, rotating an armature in such field, and by currents generated in the armature developing an opposing magnetic potential in the armature in value approximately the same as that of the field, and thus permitting only a comparatively small number of lines of force to be effective upon the armature-coils, and by slight variations in the current delivered varying such effective lines of force directly as the load upon the generator varies, thereby causing the electro-motive force of the current delivered to be increased proportionately with increments of load.

3. The method of governing the current developed in an electric generator, which consists in opposing the passage of the lines of magnetic force through the coils of the armature by an approximately-equal magnetic potential of the latter, varying such opposing magnetic potential inversely as the work being done varies, and thereby varying the number of lines of force inducing electro-motive force in the coils.

4. The hereinbefore-described method of generating and controlling a current, which consists in developing a current in the armature-coils of a generator, establishing thereby an armature magnetic potential approximately equal and opposed to the passage of field lines of force through the armature-coils and thereby permitting a number of lines of force to thread the armature-coils dependent upon the armature polarization.

5. The hereinbefore-described method of generating constant currents in a circuit of variable resistance, which consists in generating an alternating current by the rotation of armature-coils within a field of force of constant value, generating by the maximum armature-current an approximately-equal opposing magnetic potential in the armature-core, opposing the passage of lines of force through the armature-coils by such opposing magnetic potential, and varying the time of appearance of the maximum and minimum magnetic potential of the armature with reference to the passage of the armature-poles across the field-magnet poles by variations in the resistance of the armature-circuit, thereby permitting more lines of force to traverse the armature-coils as the resistance of the armature-circuit increases and diminishing such lines of force as the resistance of the armature-circuit decreases.

6. The hereinbefore-described method of

generating an approximately-constant current, which consists in generating a current by the revolution of an armature in a field of magnetic potential, developing in the armature by the current generated counter-magnetic potential of rising and falling value and approximately equal to the field-magnet potential, and changing the value and time of development of maximum counter-potential by changes in resistance of the circuit traversed by the current.

7. The hereinbefore-described method of controlling a generated electric current, which consists in opposing the magnetic potential of the field-magnet by alternating counter-magnetic potential of the armature, which is approximately equal to the field-magnet potential when the armature is short-circuited, and varying the effect of such counter-magnetic potential by varying the positions of its phases with reference to the field-magnet poles by variations in the resistance of the external circuit.

8. The hereinbefore-described method of controlling a generated electric current, which consists in opposing the magnetic potential of the field-magnet by an alternating counter-magnetic potential of the armature in effective value approximately equal to the field-magnet potential and varying the opposing effect of such counter-magnetic potential by varying the position of its phases with reference to the field-magnet poles by variations in the current flowing.

9. As a sub-method in the method of controlling a generated electric current, the production of two magnetic potentials, the one having a tendency to maintain itself approximately constant and the other alternating in character, causing the poles formed by the latter to alternately approach toward and recede from points of highest and lowest inductive influence with reference to the other magnetic potentials, approximately equal in effective value, and causing the times of development of maximum values of said alternating magnetic potential with reference to the times of approaching toward and receding from said points of highest and lowest positions of inductive influence to vary with slight changes in current.

In testimony whereof I have hereunto subscribed my name this 24th day of August, A. D. 1889.

WILLIAM STANLEY, Jr.

Witnesses:

W. D. Uptegraff,

Charles A. Terry.