No. 842,963. PATENTED FEB. 5, 1907.

M. C. A. LATOUR.

DYNAMO ELECTRIC MACHINE.

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Fig. 1.

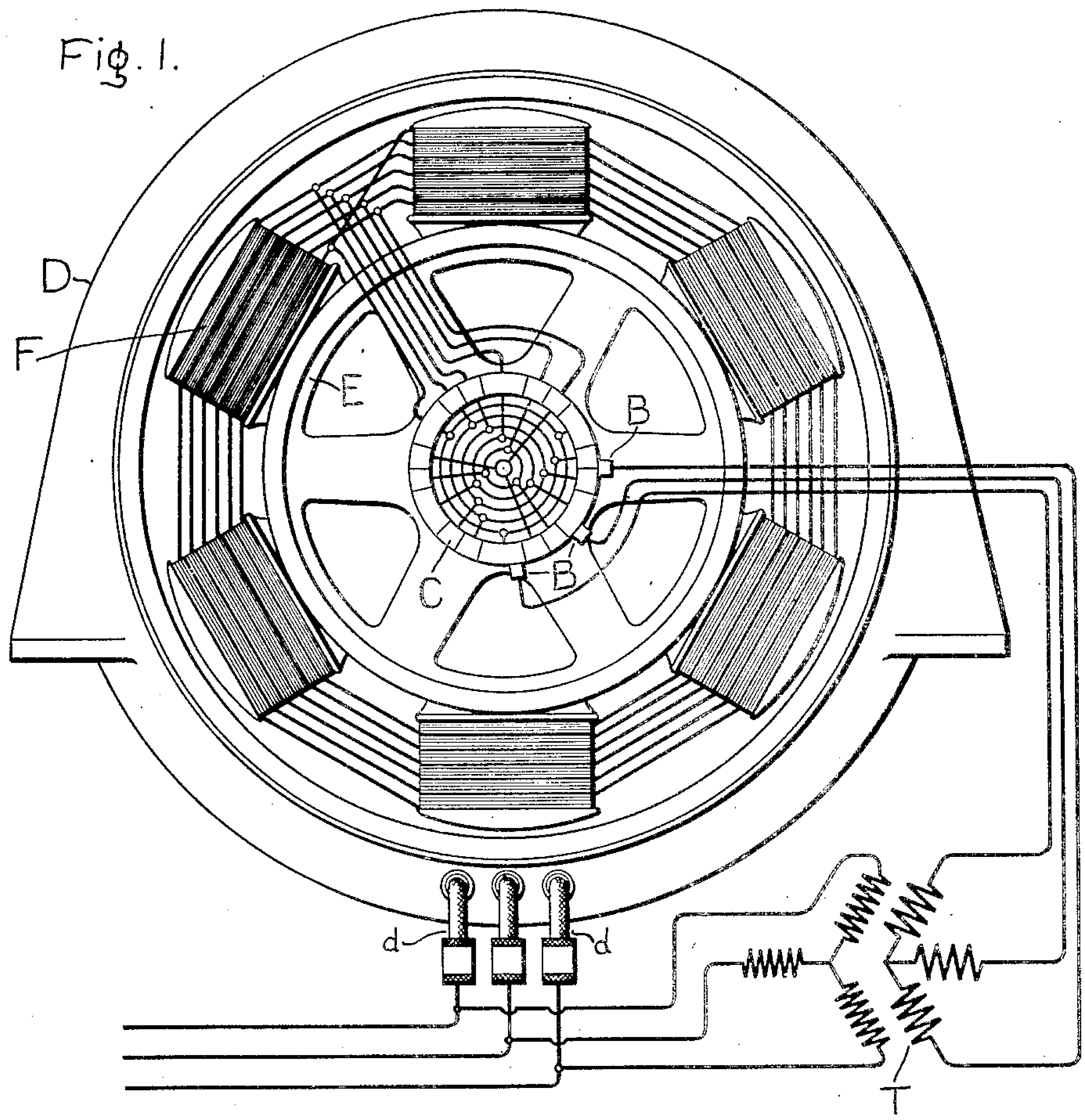
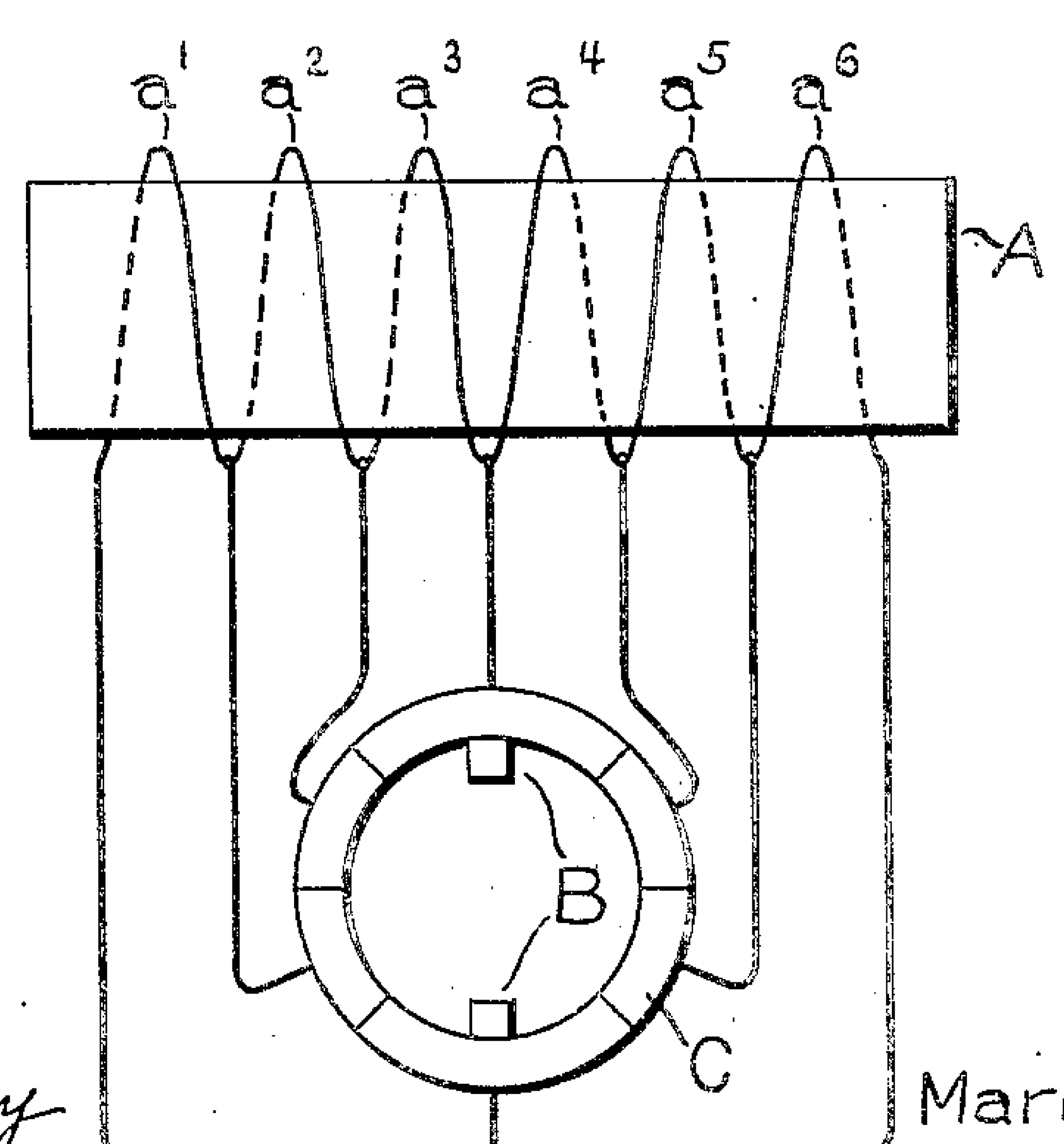


Fig. 2.



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UNITED STATES PATENT OFFICE.

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DYNAMO-ELECTRIC MACHINE.

No. 842,963. **Specification of Letters Patent.** **Patented Feb. 5, 1907.**

Application filed November 9, 1905. Serial No. 286,508.

To all whom it may concern:

Be it known that I, MARIUS C. A. LATOUR, a citizen of the French Republic, residing at Paris, France, have invented certain new and useful Improvements in Dynamo-Electric Machines, of which the following is a specification.

My invention relates to dynamo-electric machines, and consists in an improvement in the arrangement described in Patent No. 789,436, issued to me May 9, 1905, which patent shows a novel means for producing a unidirectional flux in a magnetic circuit by means of alternating currents, so as to enable an alternating-current generator to excite its own field-magnet by currents derived from the armature, so that it will be self-exciting, self-compounding, or both.

The invention disclosed in my former patent, as well as the present improvement, is based on the mathematical truth expressed by the equation

$$\sin.^2 a + \cos.^2 a = 1.$$

In the arrangement of my former patent I applied this formula by superimposing in a single magnetic circuit a plurality of magnetomotive forces each varying as the sine of the phase angle of one of a plurality of phases, accomplishing this by impressing upon a magnetizing-winding polyphase voltages and simultaneously varying the effective number of turns connected to each phase of the voltage in accordance with the variations of the sine of the phase angle of said voltage. The description thus far of my former patent applies equally to my present invention.

The improvement consists in the particular arrangement whereby the effective turns of the exciting-winding are varied in the desired manner. For accomplishing this purpose I showed an arrangement in my former patent in which the magnetizing-winding was formed of a plurality of sections, the number of turns of the sections varying with a sine function, all the sections being connected in series in the closed circuit and the points of connection between the sections being connected to a many-part commutator. If current is supplied through the commutator to the magnetizing-winding and the commutator is revolved, the effective turns of the magnetizing-winding are varied in accordance with the sine function, owing to the proportioning of the number of turns connected between adjacent segments of the commutator.

By my present invention I am enabled to form the winding of equal sections and obtain the desired variation in effective turns by varying the width of the commutator-segments. Obviously as far as operation of the machine is concerned it makes no difference whether the segments are all of the same width and the coil-sections varied or the coil-sections are all of the same number of turns and the commutator-segments are of different widths. In either case the rate of the variation in the number of effective turns will vary in different positions of the commutator relative to the brushes.

My present invention accordingly consists in the combination of a magnetic circuit, an exciting-winding therefor provided with a many-part commutator, the number of turns in the several windings connected between adjacent segments of the commutator being equal and the widths of the commutator-segments varying progressively in accordance with a sine function, and means for supplying polyphase voltages to said commutator.

My invention further consists in an application of the above arrangement to the excitation of alternating-current dynamo-electric machine.

My invention will best be understood by reference to the accompanying drawings, in which—

Figure 1 shows, somewhat diagrammatically, an alternating-current dynamo-electric machine provided with a field excitation in accordance with my present invention; and Fig. 2 is an explanatory diagram.

Referring first to Fig. 2, A represents a portion of a magnetic circuit on which is placed a number of sections a' to a^6, one half of the sections being wound oppositely to the other half and the whole connected in a closed circuit. The closed-circuit winding formed by these sections is tapped at points between adjacent sections to the segments of a six-part commutator C. B B represent brushes bearing on the commutator. Evidently the number of effective turns of the winding connected in circuit with the brushes will vary during the rotation of the brushes. Considering the number of turns in each section, it will be seen, as pointed out in my former patent, that in order to obtain a sinusoidal variation of the number of effective turns in a circuit the successive coils or sections, if the segments of the commutator are all of equal width, should contain a number of turns, as set forth by the following expressions:

The number of turns in the first coil $= k \sin. a$.

The number of turns in the second coil $= k \sin. a + \frac{2\pi}{n}$.

The number of turns in the third coil $= k \sin. a + \frac{4\pi}{n}$, &c.,

k being a constant and n being the number of coils.

Now, as has been pointed out above, it makes absolutely no difference in the operation of the machine whether the coils vary in number of turns and the segments are equal or the coils are equal and the segments vary in width. In either case any desired rate of variation in effective number of turns may be obtained. In other words, the formulæ given above, if the coil-sections are equal, will give the proper width of the commutator-segments for obtaining the desired variation. Rewriting the formulæ as applied to the width of commutator-segments, we have the following:

The width of first segment $= k \sin. a$.

The width of the second segment $= k \sin. a + \frac{2\pi}{n}$.

The width of the third segment $= k \sin. a + \frac{4\pi}{n}$, &c.,

k being a constant and n the number of segments.

Now in order to take a simple example let

$$a = \frac{\pi}{n},\ n = 6, \text{ and } k = 2.$$

Substituting these values in the expressions given above, the width of the several segments will be as follows: 1, 2, 1, −1, −2, −1. It is this arrangement that is shown in Fig. 2, the negative signs being taken care of by reversing the direction of winding one-half the segments, as shown.

Now if the brushes B B are placed, as shown, on the commutator it will be seen that the current on entering and leaving the brushes divides, half going through each half of the sections and the current in all the sections assisting in producing the magnetization—that is, the total number of ampere-turns is equal to 3I, I being the current entering at the brushes. If this current is an alternating current, the ampere-turns at any instant will be equal to 3I sin. a, where I is the maximum value of the current entering the brushes. Now if the brushes B B are revolved in synchronism with the alternation of the currents entering the brushes the effective number of turns traversed by the current entering the brushes will also vary, as sin. a, and the resultant ampere-turns at any instant may be expressed by 3I sin.^{2} a. Now if a second pair of brushes be placed on the commutator displaced ninety degrees from the brushes B B and if a current be sent through this second set displaced in phase ninety degrees from the current sent through the brushes B B a second flux will be produced corresponding to the ampere-turns the effective value of which at any instant will be equal to 3I cos.^{2} a, and the resultant will be equal to 3I—that is, the flux will be constant and unidirectional—and in general if any polyphase arrangement of brushes is employed on the commutator C and if polyphase currents are supplied to those brushes of a frequency corresponding to the speed of relative rotation of brushes and commutator a constant unidirectional flux will be produced in the magnetic circuit A. Furthermore, an external polyphase source is not essential for supplying the polyphase currents to the commutator. If the second set of brushes, as described above, be simply short-circuited instead of being connected to a source of current displaced ninety electrical degrees in phase, a current will flow through the short circuit, due to the induction in the exciting-winding, and the magnetomotive force due to this current will vary approximately with the square of a sine function, and with the magnetomotive force due to the current impressed upon the first set of brushes will produce a substantially constant unidirectional flux, though this arrangement is not as efficient as an excitation from an external polyphase source. For producing such a flux it is merely essential that the necessary magnetomotive forces, each varying as a sine^2 function, should be produced, and the source of the current which produces them is immaterial.

Now, referring to Fig. 1, the application of my invention to a self-exciting or self-compounding dynamo-electric machine will be explained. In this figure, D represents the armature of a three-phase machine, the armature-terminals being represented at d. E represents the field-spider, carrying the field-coils F and the commutator C, on which bear the three brushes B B B, displaced from each other by one hundred and twenty electrical degrees. The winding of each individual field-coil is in six sections, corresponding to the six sections shown in Fig. 2, one-half of the sections being inversely wound or connected. The first sections of all the field-coils are connected in series with each other in one group, and the group is then connected to a second group formed by the second sections of all the field-coils, the last section of the last group being connected to the first section of the first group. All the several sections are thus connected in a closed circuit. The points of connection between one section of the last field-coil of one group and the following section of the first field-coil of the next group is connected to a segment of the commutator C. This commutator is provided with eighteen segments in three groups of six segments each, the corresponding segments of each group being electrically connected. Thus there is one group per pair of poles, and each group corresponds to the six-part commutator shown in Fig. 2, having two segments of twice the width of the remaining segments. T represents a transformer having its primary connected to the armature-circuit and its secondary connected to the brushes B B B. The transformer T may be a simple potential transformer, as illustrated, or it may be any one of the several arrangements of compounding transformers which are now well-known in the art. By means of the polyphase currents impressed upon the commutator-brushes a constant unidirectional flux is produced in each field-pole, and the machine consequently operates in exactly the same manner as though the field were excited by direct current. In this manner the machine may be self-exciting or self-compounding, or both, and with very little change from the standard construction of synchronous alternating-current machines.

The improved arrangement, as above described, possesses certain mechanical advantages over the particular arrangement shown in my earlier patent, No. 789,436. In the earlier patent the sections were of different numbers of turns, and in order to maintain the resistance of the field-circuit uniform it is desirable that the sections should be of the same resistance in spite of the difference in the number of turns, or, in other words, that the sections with the larger number of turns should be wound with conductors of greater cross-section, as pointed out in my former patent. With the present arrangement the coil-sections can all be equal in both the number of turns and in cross-section and the proper rate of variation secured by adjusting the width of segments. It is of course true that my present invention does not utilize the field-copper to the very best advantage; but the slight difference in efficiency of the field-winding will ordinarily be of negligible importance.

It will of course be understood that when in the foregoing description and appended claims I speak of "commutator-segments of different widths" I mean of different widths electrically. Whether the commutator is built up of bars which are all insulated from each other and some of the bars have a greater width mechanically than others or whether the commutator is built up of bars all of the same mechanical width and two or more bars electrically connected to form electrically a single segment of the width desired, is of course entirely immaterial for the purposes of my invention. Accordingly I do not desire to limit myself to the particular construction and arrangement of parts here shown, but aim in the appended claims to cover all modifications which are within the scope of my invention.

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

1. In combination, a magnetic circuit, an exciting-winding therefor provided with a many-part commutator, the number of turns in the several sections connected between adjacent segments of the commutator being equal and the width of the commutator-segments varying progressively in accordance with a sine function, and means for supplying polyphase currents to said commutator.

2. In combination, a magnetic circuit, an exciting-winding comprising a plurality of equal coils or sections connected in series in a closed circuit, half of said sections being reversely wound relatively to the other half, a many-part commutator having its segments connected to the terminals of the several sections and said segments varying progressively in width in accordance with a sine function, and means for supplying polyphase currents to said commutator.

3. In a dynamo-electric machine, a field-magnet, field-coils thereon arranged in equal sections one half of which are reversely wound relatively to the other half, a many-part commutator connected to the field-winding and having segments varying progressively in width in accordance with a sine function, and means for supplying polyphase currents to said commutator.

4. In a dynamo-electric machine, a field-magnet, a winding for each pole thereof comprising a plurality of equal sections, one half of which are reversely wound relatively to the other half, similar sections of all the windings being connected in a group and all the groups being connected in series in a closed circuit, a many-part commutator connected to the points of connection between the several groups, and having segments varying progressively in width in accordance with a sine function, and means for supplying polyphase currents to said commutator.

5. In a dynamo-electric machine, a polyphase armature-winding, a field-magnet, a winding for each pole of the magnet comprising a plurality of equal sections, one half of which are reversely wound relatively to the other half, similar sections of all the pole-windings being connected in a group and all the groups being connected in series in a closed circuit, a many-part commutator connected to the points of connection between

the several groups and having segments varying progressively in width in accordance with a sine function, a polyphase arrangement of brushes bearing on the commutator, and connections for supplying to said brushes polyphase currents derived from the armature.

In witness whereof I have hereunto set my hand this 8th day of November, 1905.

MARIUS C. A. LATOUR.

Witnesses:

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