No. 615,731. Patented Dec. 13, 1898.

W. M. MORDEY.

DYNAMO ELECTRIC MACHINE.

(Application filed Feb. 15, 1897.)

(No Model.) 3 Sheets—Sheet I.

Fig. 1.

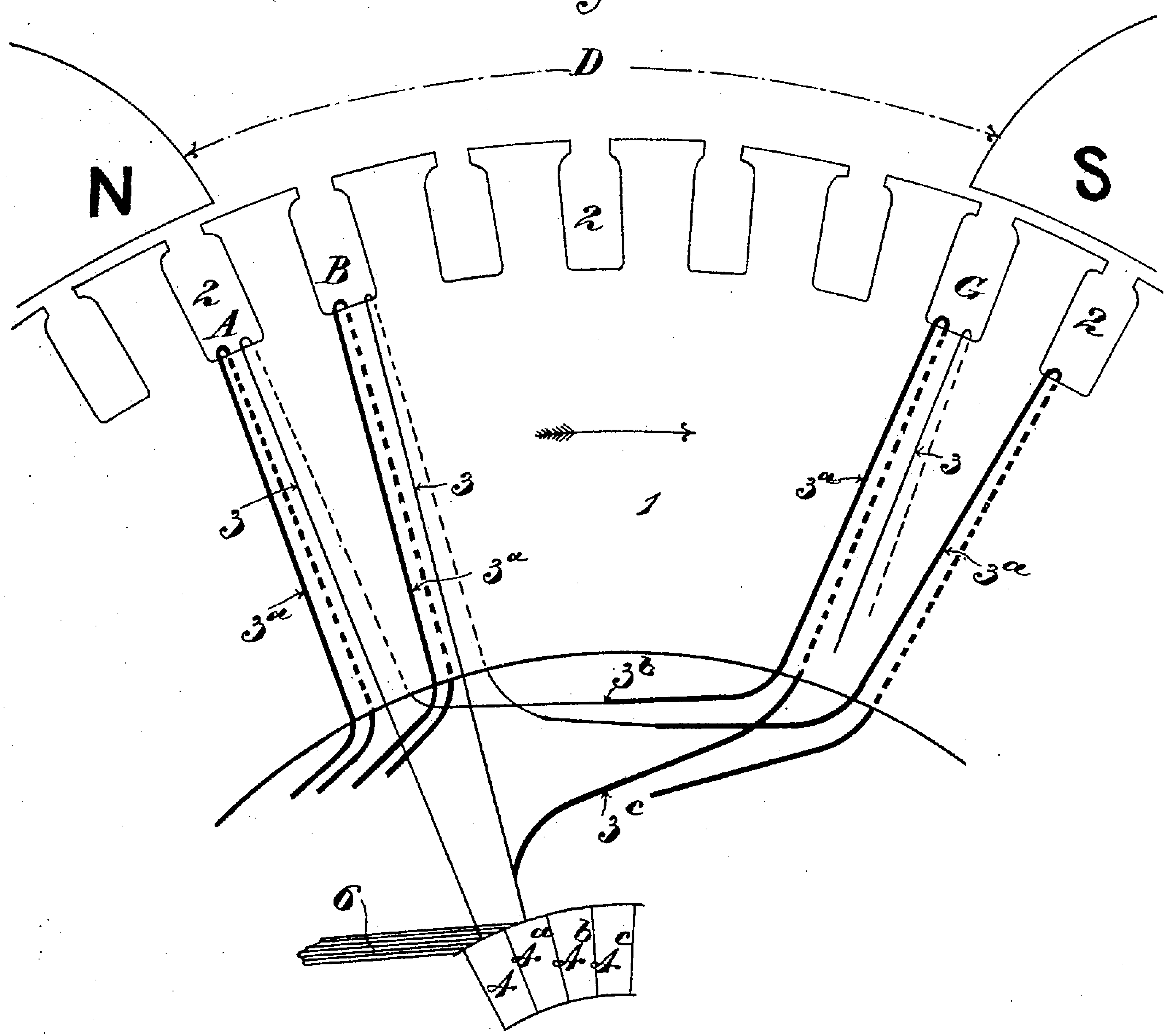

Fig. 2.

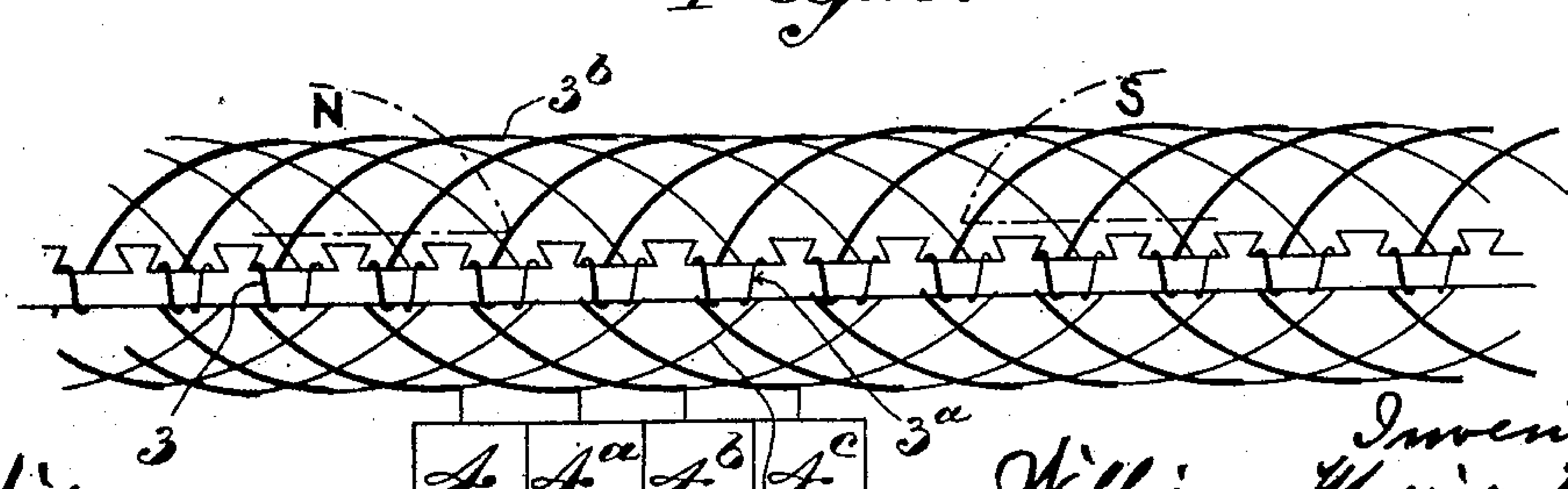

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Fig. 5.

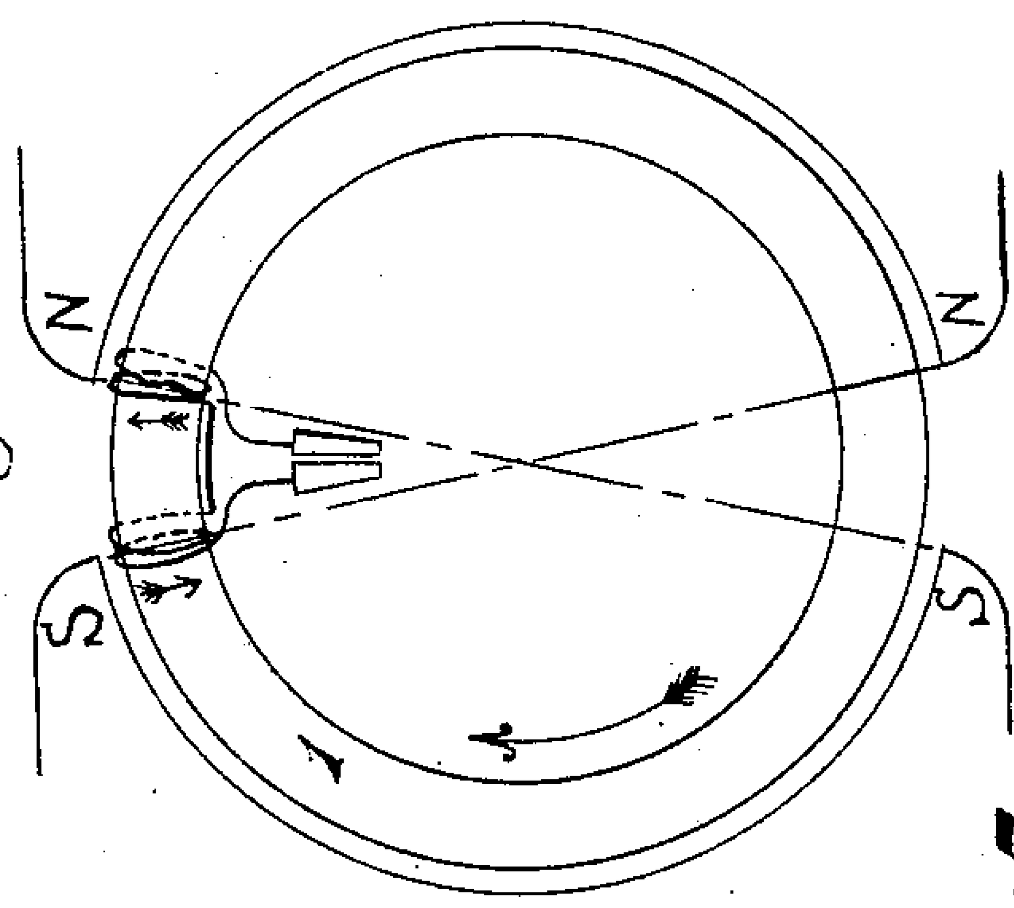

Fig. 7.

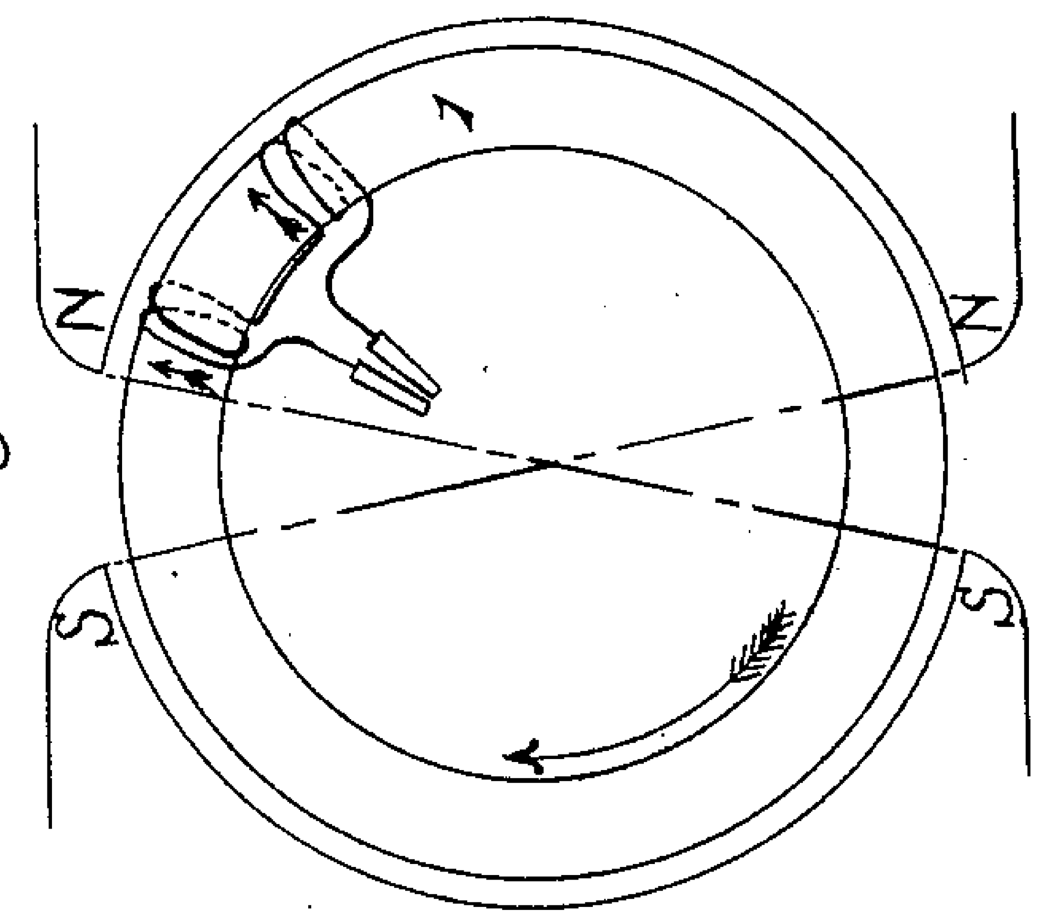

Fig. 4.

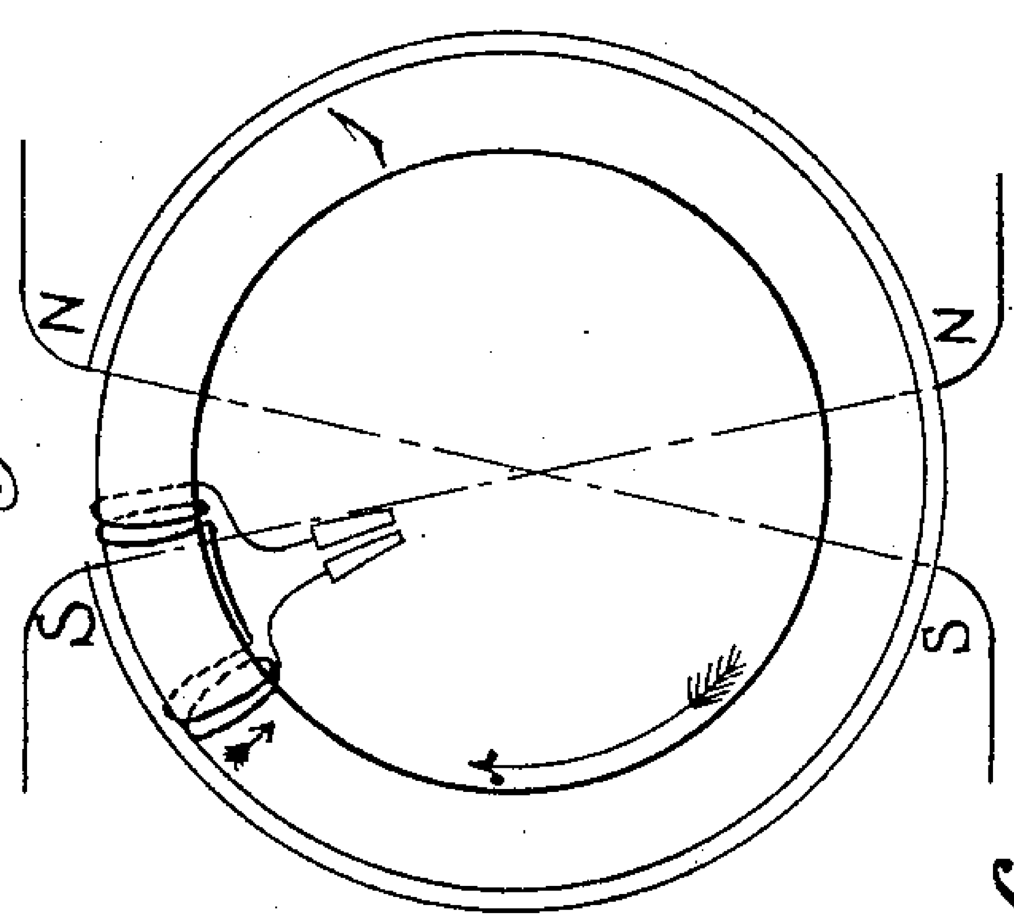

Fig. 6.

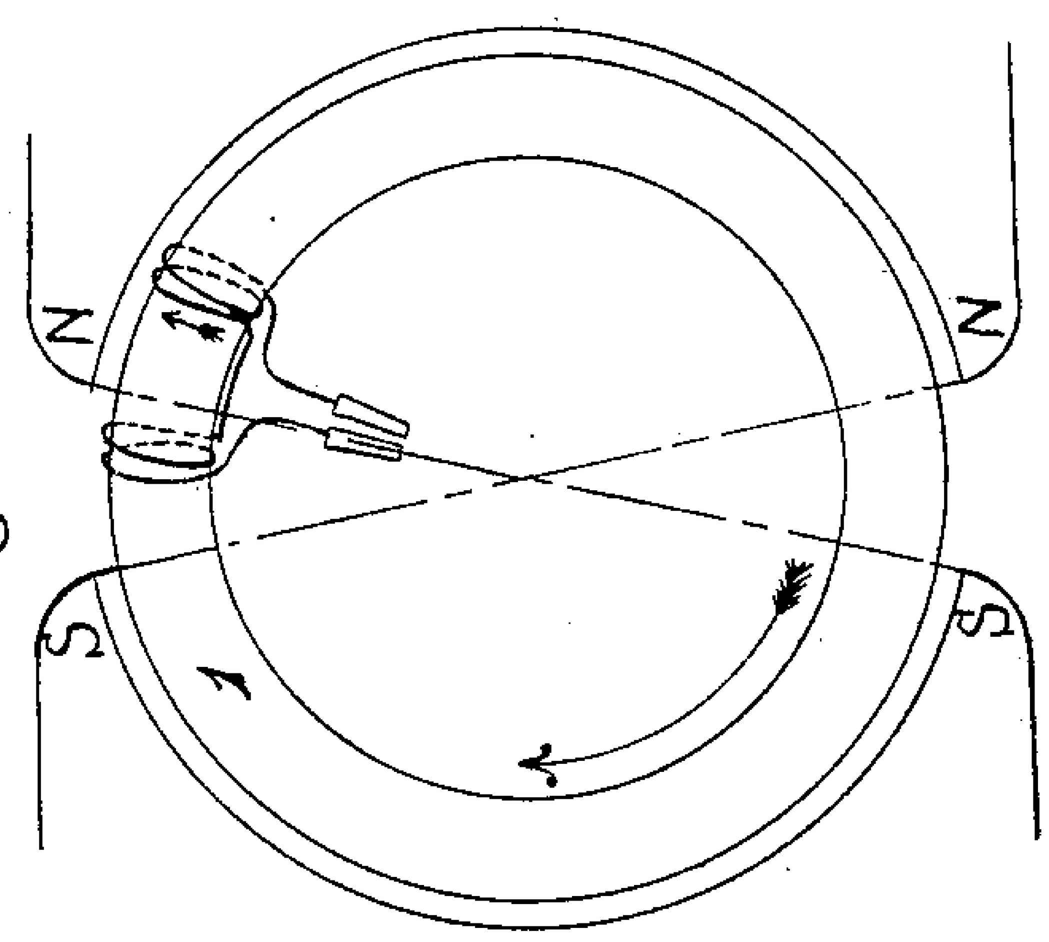

Fig. 3.

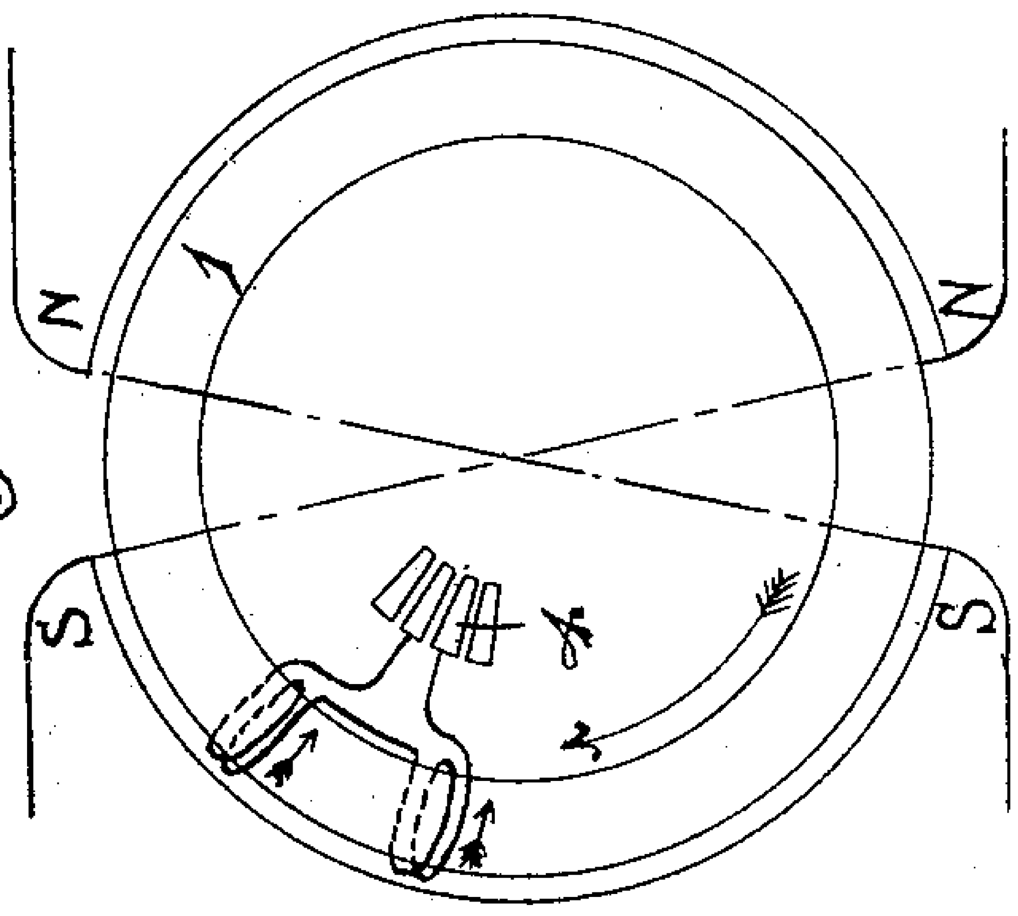

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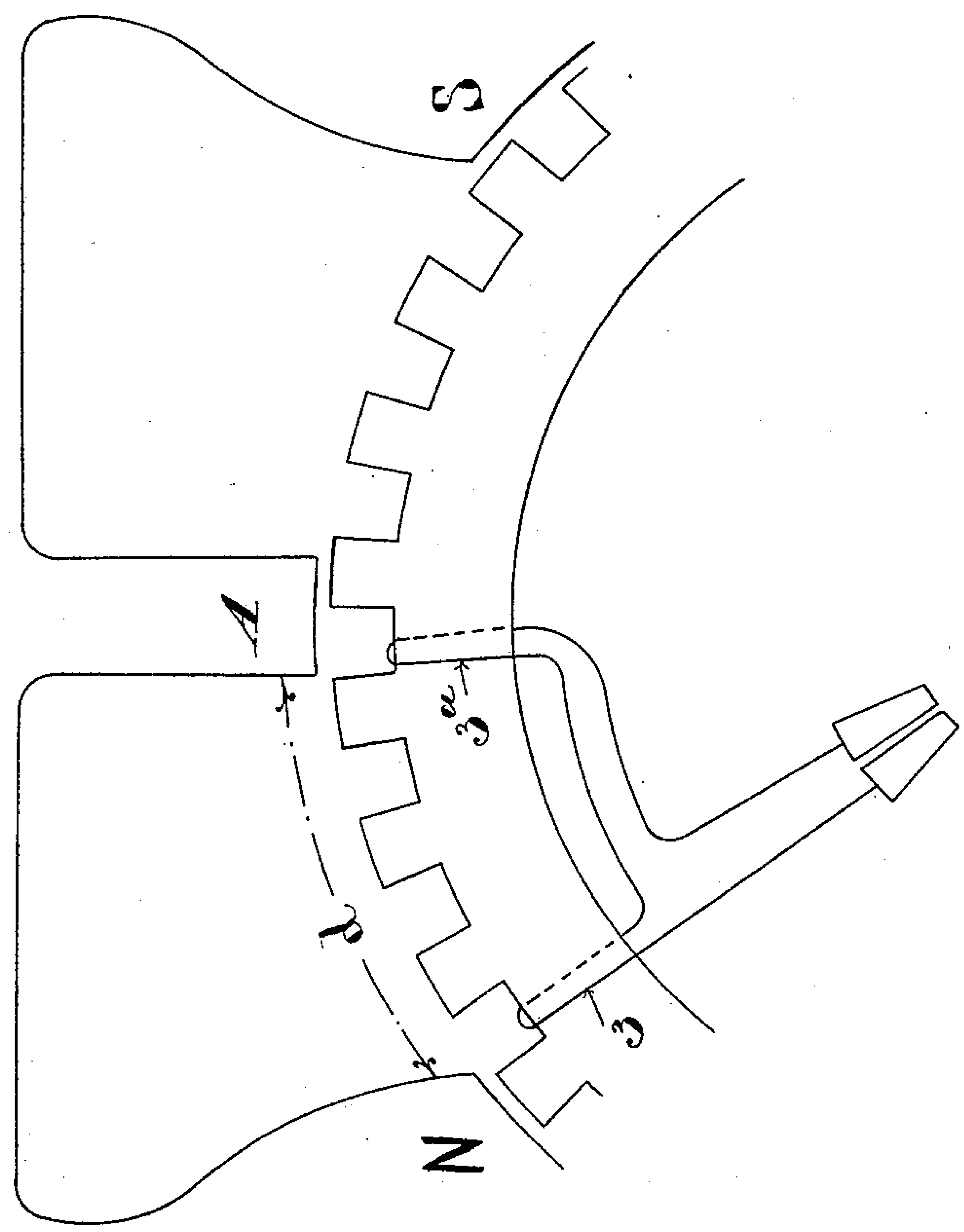
Fig. 8.



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UNITED STATES PATENT OFFICE.

WILLIAM MORRIS MORDEY, OF LOUGHBOROUGH, ENGLAND.

DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 615,731, dated December 13, 1898.

Application filed February 15, 1897. Serial No. 623,451. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM MORRIS MORDEY, a subject of the Queen of Great Britain and Ireland, residing at Loughborough, in the county of Leicester, England, have invented Improvements in Dynamo-Electric Machines, (for which I have obtained foreign patents as follows: in Great Britain, dated June 17, 1896, No. 13,405; in France, dated December 16, 1896, No. 262,256; in Italy, dated December 31, 1896, Reg. Att., Vol. LXXXV, No. 107; in Belgium, dated December 17, 1896, No. 125,233; in Austria, dated March 18, 1897, No. 47/927; in Germany, dated January 17, 1897, No. 99,019; in Switzerland, dated January 16, 1897, No. 13,928; in Norway, dated March 5, 1897, No. 6,578; in Canada, dated July 23, 1897, No. 56,759, and in Hungary, dated April 12, 1897, No. 9,278,) of which the following is a specification.

This invention has for its object improvements in dynamos, and relates particularly to the removal in a simple and inexpensive way of the difficulties caused by sparking and armature reaction, which difficulties are most pronounced in machines having armature-windings sunk in slots or holes in the armature-core, especially when armatures so constructed are used with a small clearance or air-space between the armature and the poles of the field-magnet. In such machines the armature reaction is considerable and the output is greatly reduced by the sparking at the brushes and the necessity for a large forward lead.

The following is a description of a Gramme dynamo constructed according to my invention. The armature is preferably made with slots or holes at the outer surface. The coils are wound in the usual way, the number of turns for any given electromotive force being substantially the same as in the ordinary armature; but instead of connecting the consecutive coils in series (as is usual in a Gramme winding) each coil is joined to another coil situated a certain distance away on the armature-core, these two coils so separated being treated as a single coil so far as connection to the commutator is concerned, as I shall now proceed to explain by reference to the accompanying drawings, wherein—

Figure 1 shows, diagrammatically, in end elevation part of a Gramme dynamo with armature-coils arranged according to my invention. Fig. 2 is a developed plan view showing, diagrammatically, a greater portion of the armature-winding than Fig. 1. Figs. 3 to 7, inclusive, show various positions of one element of the winding. Fig. 8 is a diagram showing part of a dynamo according to this invention with an auxiliary pole.

Referring to Fig. 1, 1 is the armature-core, formed at its outer surface or periphery with slots 2, in each of which and around the core are wound two armature-coils 3 3^a. For the sake of clearness I indicate only six coils. At A there are two coils 3 3^a. At B come the next two coils 3 3^a. At G are other two coils 3 3^a. It is to be noted that the distance between the coil 3 at A and the coil 3^a at G is, according to my invention, equal or approximately equal to the distance or gap D between the tips of the adjacent poles N S. The parts being thus arranged, the connections of the coils are as follows: One end of the coil 3, located at A, is in communication with one segment (or sector) 4 of the commutator. The other end of the same coil 3 is connected to one end of the coil 3^a, located at G. The other end of this last-mentioned coil 3^a is connected by a conductor 3^c to that end of the coil 3 located at B, which communicates with the commutator-segment 4^a. All the coils of the armature are to be connected according to the method just above explained. Each connected pair of coils 3 3^a constitutes one element of the whole winding. It will be seen that with this connection of the coils the current and electromotive force are in the same direction in each connected pair of coils or element during the greater part of each half-revolution, but that as the element comes into the region of commutation its two connected parts have generated in them opposing electromotive forces, due to the fact that while one part is under the tip or end of one pole-piece the other part is under the tip or end of the next following pole-piece of opposite polarity. In this way I am enabled to collect in an active part of the field without sparking and with a smaller forward lead of the brushes than is usual, or with no lead of the brushes, or even with a backward lead thereof, thereby enabling me to obtain the economy of power and of material that result from the use of a small air-gap. The actual collecting position is determined by the relation as to number of turns or of angular position, or both, of the connected portion of each element.

Fig. 2 is a developed plan view showing, diagrammatically, a greater number of elements than Fig. 1 and also illustrating the relation of the elements to each other, to the field-magnet poles N S, (shown in dotted lines,) to the interpolar gap, and to the commutator-segments, some of which are shown at 4 4^a 4^b 4^c. Figs. 3, 4, 5, 6, and 7 show five successive positions of one element of the winding. In these diagrammatic views the slots shown at 2 in Fig. 1 are omitted in order to simplify the drawings. The small arrows indicate how the electromotive forces in the two coils constituting this one element assist one another in the positions represented in Figs. 3 and 7—that is to say, during the greater part of the revolution—and how in the position represented in Fig. 5 the said forces oppose one another. The act of commutation should occur just when or a very slight interval of time after the position represented in Fig. 5 is attained. Figs. 4 and 6 show two intermediate positions of the element.

By way of further elucidation I will now compare an example of my arrangement with an ordinary Gramme arrangement having the same number of turns or convolutions. I select for this comparison an ordinary Gramme ring in which there are four hundred and twenty turns or convolutions grouped as seventy successive elements of six turns or convolutions each, furnished with a commutator having seventy segments or bars, the beginning of each element of the winding being connected to one segment of the commutator and the end of such element being connected to the next adjacent segment of the commutator. Now according to my invention this same Gramme ring would be modified in its disposition, as follows: Each element of six convolutions would be separated into two coils, each of three convolutions. The second of the coils would be wound on the ring at a certain distance from the first, (along the ring,) as hereinbefore fully described; but the whole six convolutions would still be joined in series between two adjacent segments of the commutator. There would still be seventy segments in the commutator and four hundred and twenty convolutions, in total, around the ring.

I may use a larger or smaller number of slots in proportion to the coils than are shown in the drawings and referred to in the foregoing description. For example, I may have only one turn in each slot or I may have several turns, or, on the other hand, I may distribute the portions of each element over several slots without departing from the spirit of my invention.

Auxiliary poles may be used between the ordinary pole-tips, so arranged as regards position and polarity as to produce in one coil or portion of each element passing through the region between the pole-tips an electromotive force similar to that produced by one of the poles. The polarity to be given to each auxiliary pole for a Gramme armature should be the reverse of that for a drum armature. Fig. 8 is a diagrammatic illustration of such an arrangement as applied in a machine of Gramme type. N S are the ordinary poles, and A is an auxiliary pole placed between the tips of the two poles N S. In such an arrangement the gap *d*, together with the relative number of turns in the portions 3 and 3^a of each element, determines the distance apart of the coils 3 3^a of each element. The auxiliary pole A in this case should have S polarity and in the next succeeding space the auxiliary pole should have N polarity, assuming that commutation takes place approximately in the position shown in Fig. 8 and with a right-handed direction of rotation of the armature. In a drum dynamo A should have the reverse polarity to that for a Gramme because the separate portions of the element should be under the influence of similar polarities at the time of commutation. It is to be understood that Fig. 8 shows only the auxiliary pole between one pair of pole-tips, the space or spaces between the other pole-tips being provided with auxiliary poles having the same order as regards polarity. The auxiliary poles are conveniently magnetized by a winding in connection with the ordinary field-winding, preferably by a shunt-winding, to give an initial magnetization and by a series winding to increase or maintain the magnetization as the load increases, after the manner of a compound-wound field-magnet.

In applying my invention in multipolar machines, whether with series or parallel winding, I space the winding so that the electromotive forces in any one element of the winding oppose one another during the moment of commutation but aid one another during the greater part of the revolution.

My improvements are applicable to dynamos whether used as generators or as motors. Also, although I have described my invention by way of example mainly in connection with a dynamo having an armature of the Gramme type, it is of course equally applicable to dynamos having armatures of the drum type, as described in the specification of another application for Letters Patent, Serial No. 664,767, filed by me as a division of this application.

I know that a method of coupling has been proposed according to which at the time of commutation a coil under the influence of a field-magnet is in series with one not then under that influence. In such an arrangement the current flows in different ways in the coils, the object arrived at being to lessen the cross-magnetizing effect. Such a connection or coupling, however, is different from mine and does not give the same result.

What I claim is—

1. In a dynamo-electric machine, an armature having each element of its winding arranged as a pair of coils or separate portions so disposed and connected that during the greater part of the revolution the electromotive forces in the two coils or the separate portions are additive, while at the time of commutation they are in opposition.

2. In a dynamo-electric machine a Gramme armature having twice as many coils as there are segments of the commutator, the said coils being joined two in series so as to form pairs of coils each of which pairs constitutes one element of the winding, the angular breadth or spacing between the two coils constituting each element being equal or approximately equal to the angular breadth or spacing between the edges of two adjacent magnetic poles of opposite polarity so that while one coil is under the tip or end of one pole-piece the other part is under the tip or end of the next following pole-piece of opposite polarity.

3. In a dynamo-electric machine a Gramme armature having each element of its winding comprised between two segments of the commutator divided into two connected portions which are spaced apart so that at the moment of commutation the two portions will be under the influences of opposite magnetic fields so that the electromotive forces generated in them will be in opposition.

4. A Gramme armature having its coils connected up in pairs each pair being connected with a commutator-strip and in series with the other pairs of coils, one coil of each pair being arranged in advance of and separated from the other by the rearward coils of other pairs of coils, substantially as described.

5. An armature comprising an annular iron core having longitudinal slots or recesses in its periphery, a commutator, and a Gramme winding wound in said slots or recesses and composed of coils connected up in pairs forming elements each of which is connected to a segment of said commutator, and is arranged in series with the other elements, the coils of each pair being separated from each other by coils of other elements.

6. A dynamo-electric machine comprising a field-magnet having poles N S and an armature having an annular iron core 1 formed with longitudinal slots or recesses 2 in its periphery, commutator-segments, and a Gramme winding consisting of a number of pairs of coils 3, 3^a located in said slots or recesses and arranged at a distance apart such that while one coil is under the tip or end of one pole-piece the other part is under the tip or end of the next following pole-piece of opposite polarity, one end of each coil 3 being in communication with one segment of the commutator and the other end of said coil being in connection by a conductor 3^b with one end of the corresponding coil 3^a to that end of the next forward coil 3 that is communicated with the next segment of the commutator, substantially as described and shown.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WILLIAM MORRIS MORDEY.

Witnesses:

PERCY E. MATTOCKS,
WM. O. BROWN.