(No Model.) 3 Sheets—Sheet 1.

C. OLIVETTI.

COMMUTATOR FOR ELECTRIC MACHINES.

No. 516,447. Patented Mar. 13, 1894.

FIG. 1.

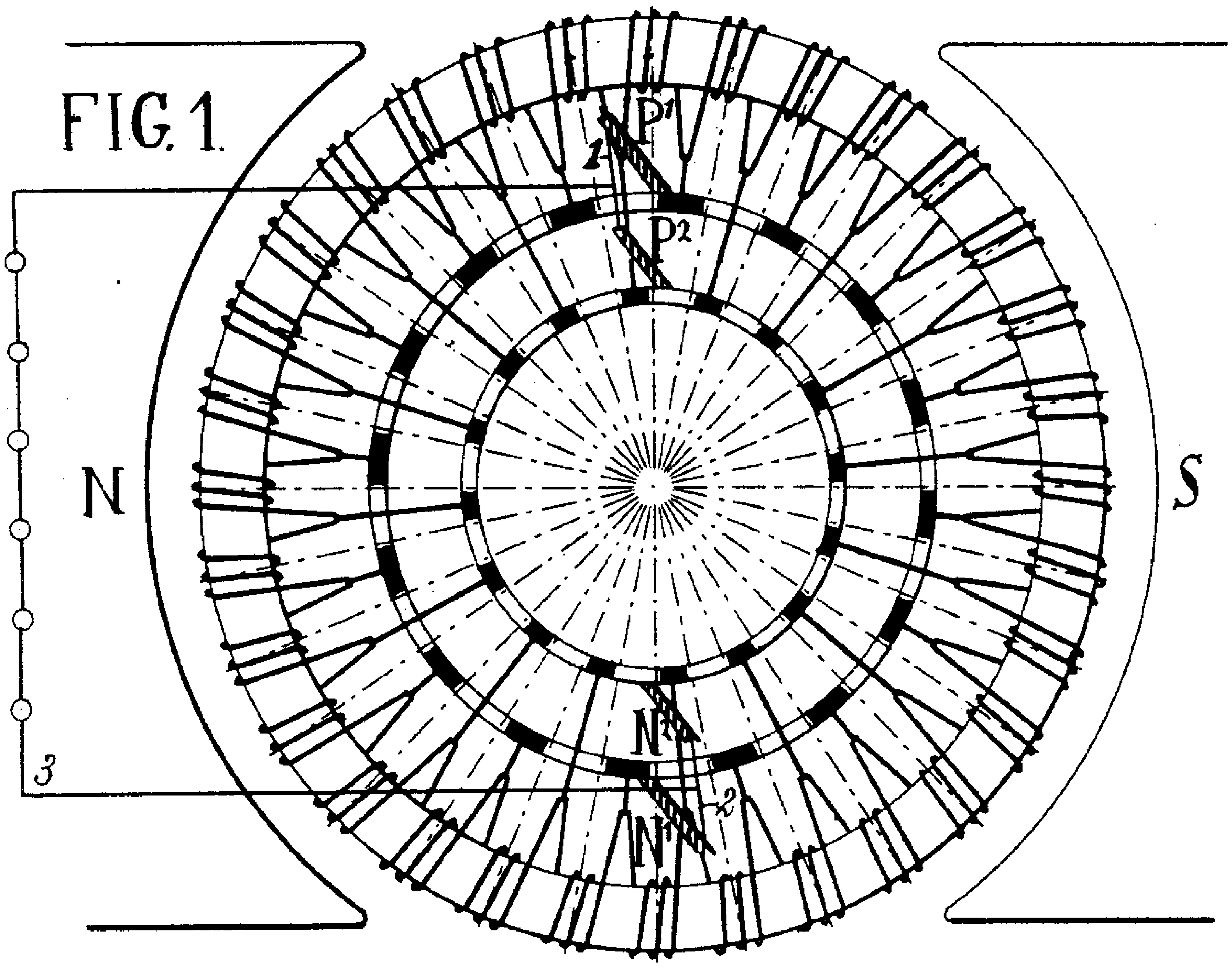

FIG. 2.

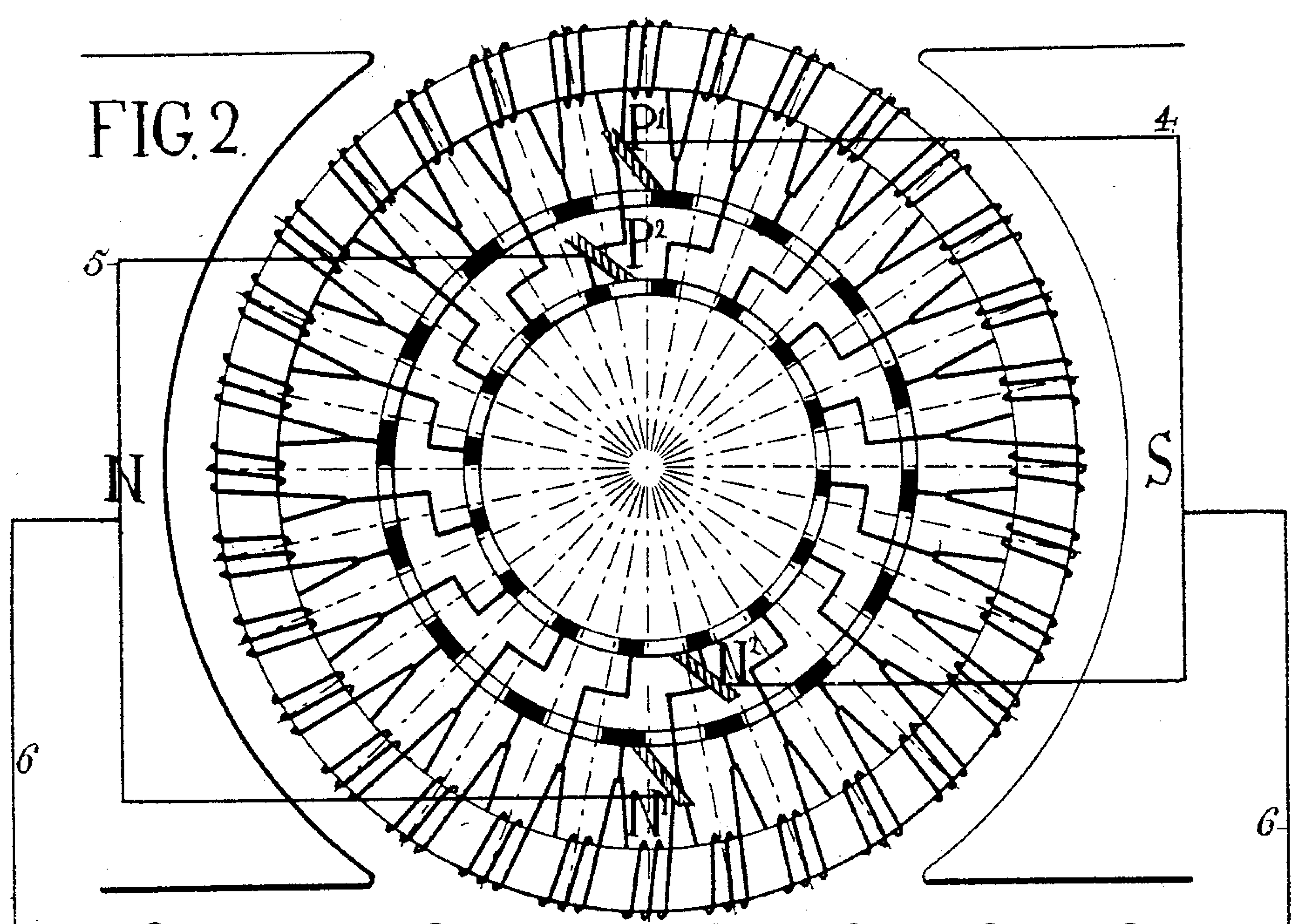

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FIG. 3

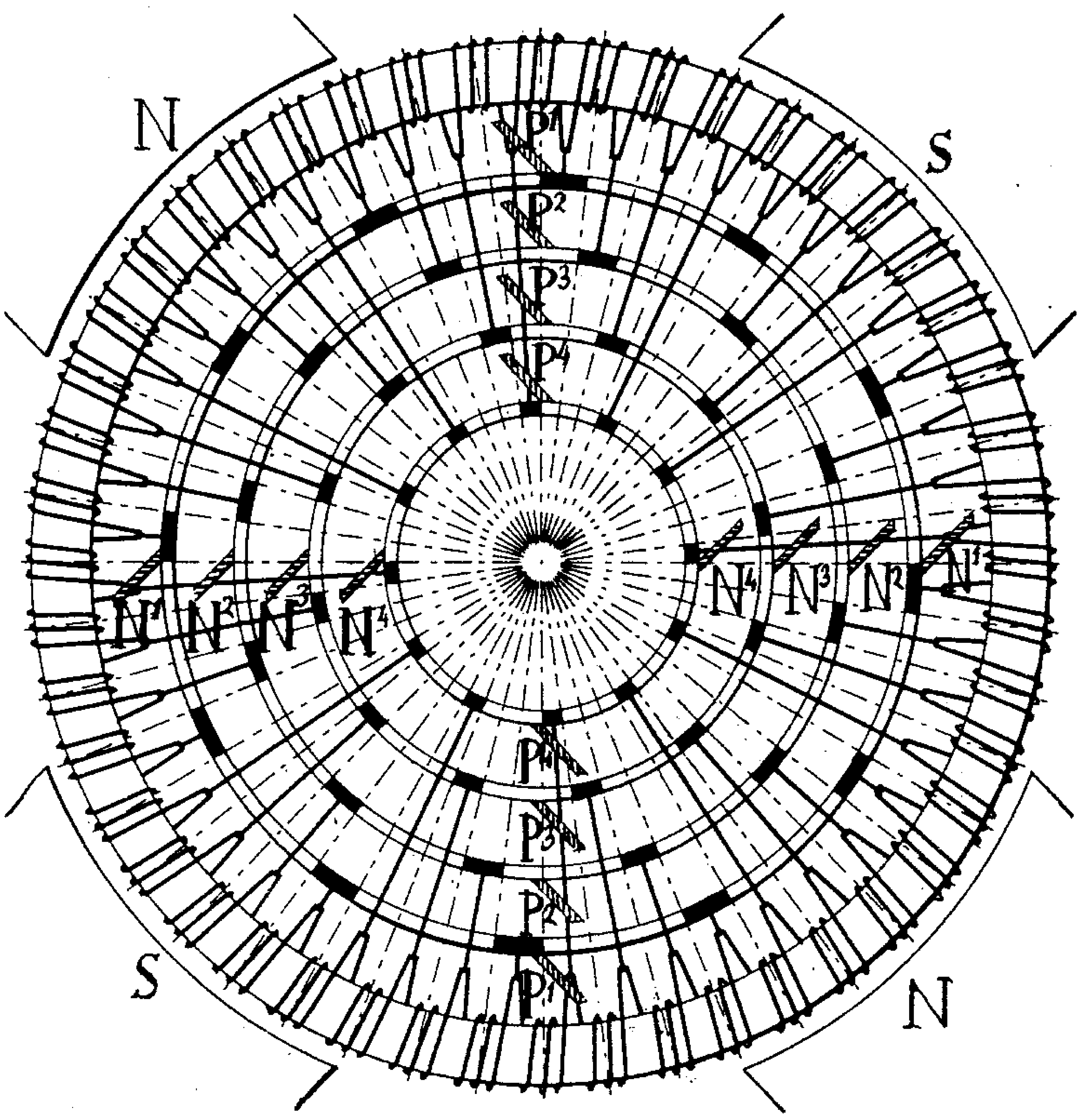

FIG. 4

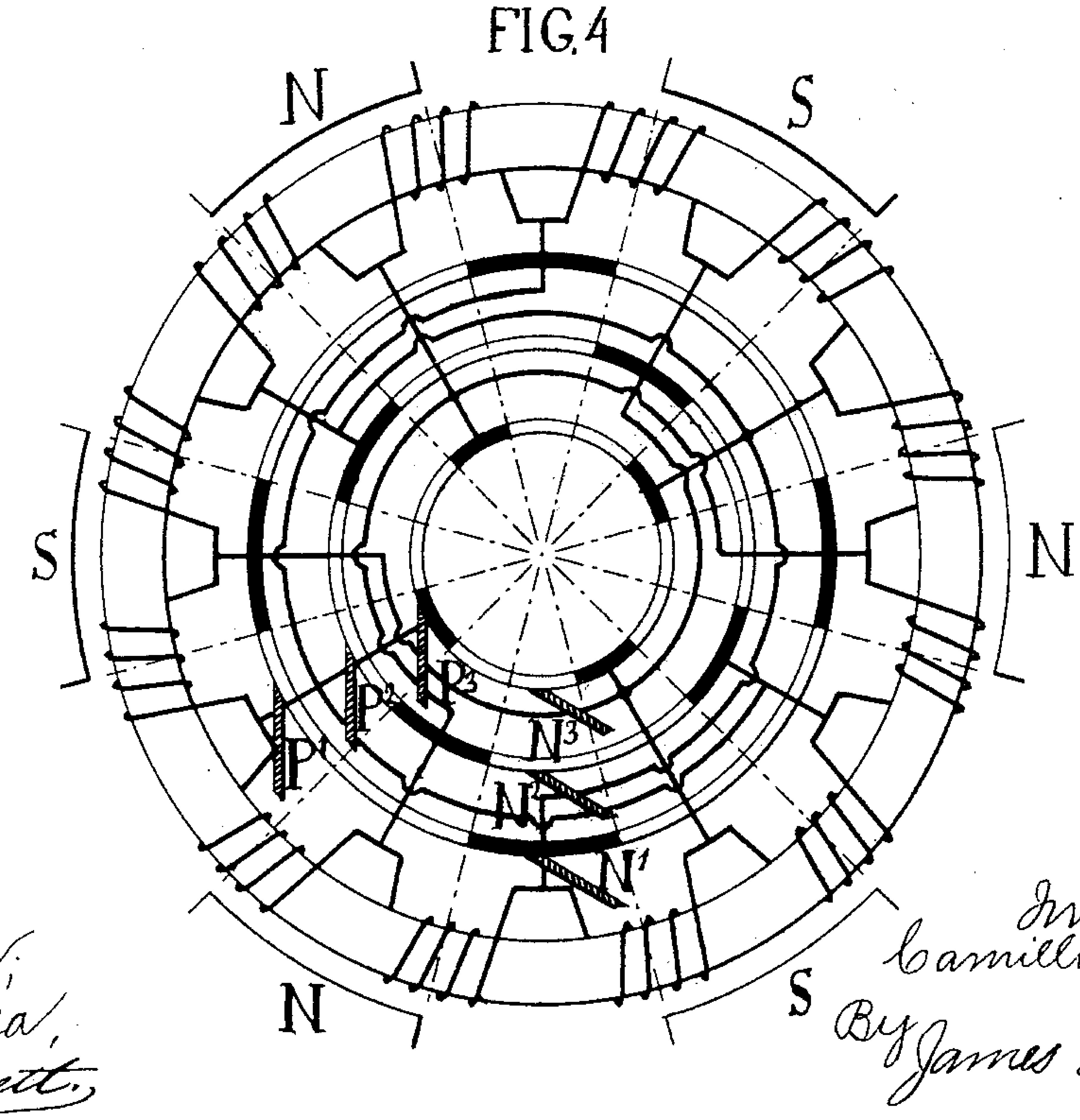

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FIG. 5.

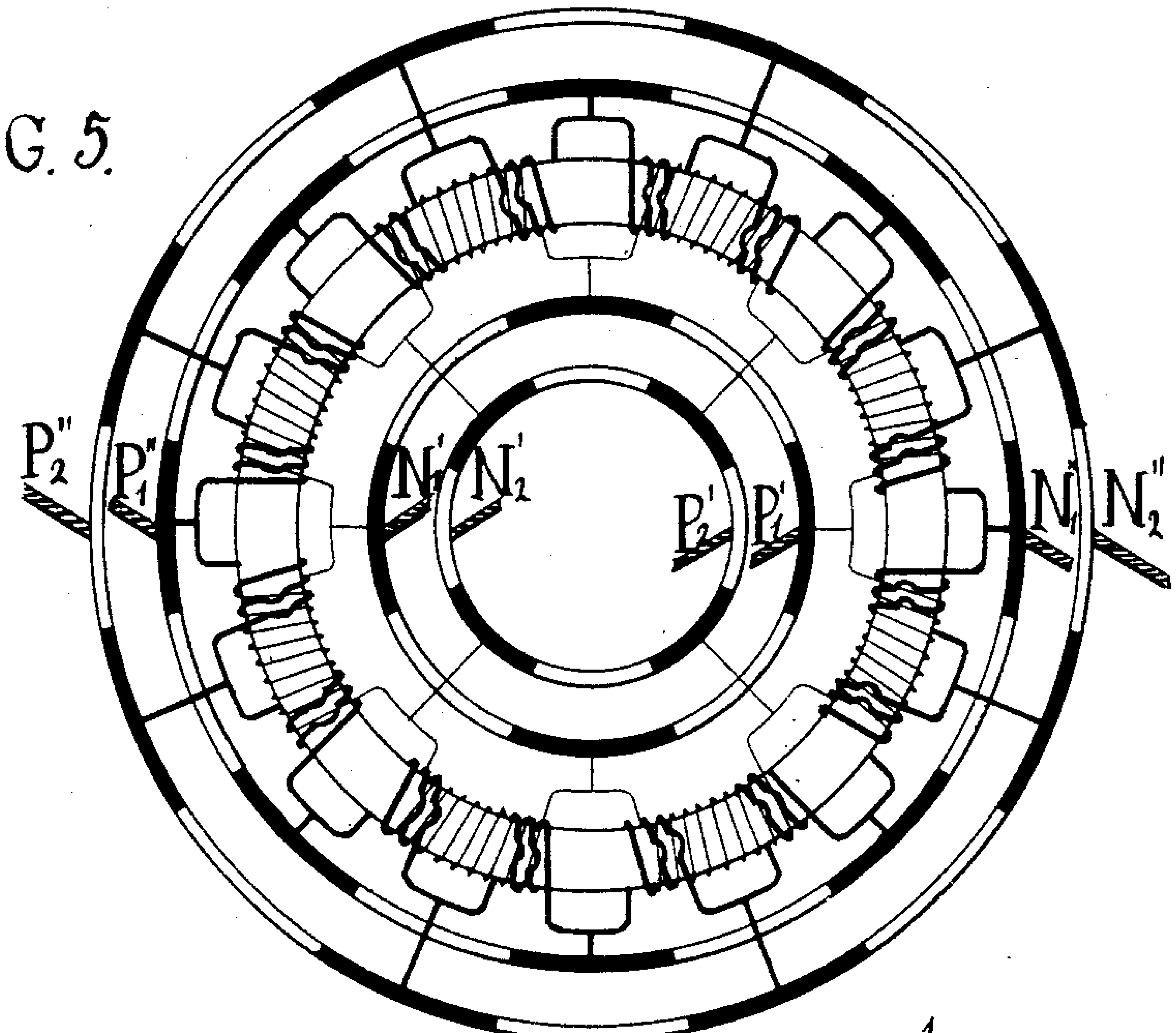
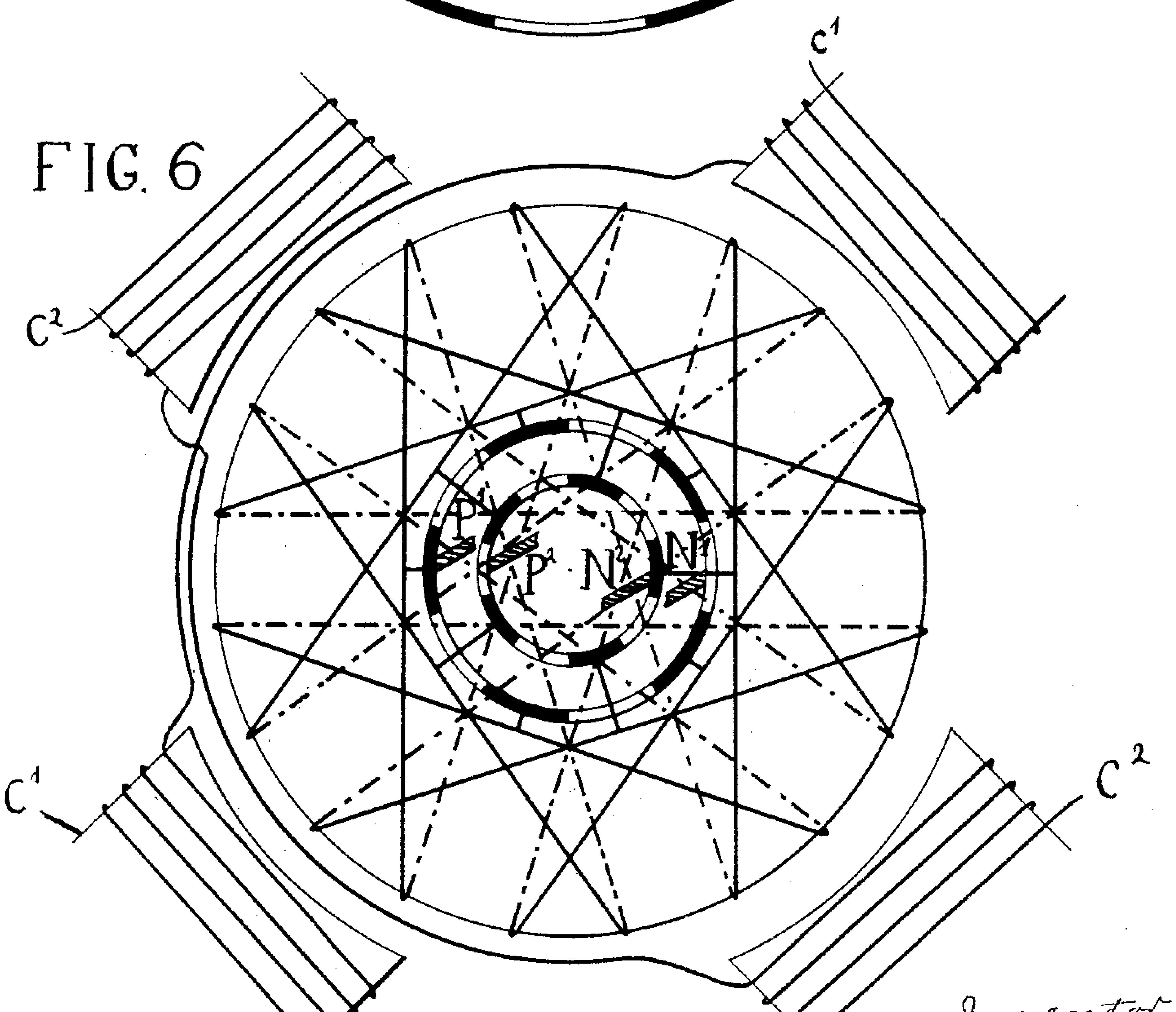


FIG. 6



Witnesses;
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UNITED STATES PATENT OFFICE.

CAMILLO OLIVETTI, OF IVREA, ITALY.

COMMUTATOR FOR ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 516,447, dated March 13, 1894.

Application filed April 29, 1893. Serial No. 472,424. (No model.)

To all whom it may concern:

Be it known that I, CAMILLO OLIVETTI, a subject of the King of Italy, residing at Ivrea, Piemonte, Italy, have invented a new and useful Improvement in Commutators for Electric Machines, of which the following is a specification.

To enable others skilled in the art to understand and to make and use my said invention, I will describe the same in detail, reference being had to the accompanying drawings, in which—

Figure 1 is a diagram showing the armature and pole-pieces of a bi-polar generator, or motor, as the case may be, employing a continuous current. Fig. 2 is a similar view showing a modified arrangement of the partial commutator and a corresponding disposition of the brushes, together with the external circuit connections whereby an alternating current is produced. Fig. 3 is a diagram showing the armature and pole-pieces of a four-pole machine, in which my invention is embodied. Fig. 4 is a diagram showing the like parts of a six-pole machine constructed in accordance with my invention. Fig. 5 is a diagram showing the application of the invention to a continuous current transformer, having a fixed armature and primary and secondary coils. Fig. 6 is a diagram showing the application of the invention to a transformer having a drum-armature.

In ordinary continuous current commutators, segments have generally to be very near each other with only a small extent of insulating material between them.

It often happens, especially with currents of high tension, that an electric arc is established between one segment and another. One object of my invention is to provide against this evil, and I effect this by distributing in a regular and uniform manner the commutator segments on two or more surfaces, which may be cylinders of the same or of different diameter, or annular surfaces or disks, or generally surfaces of suitable solids of revolution about the axis of the armature. Thus the commutator is divided into a certain number of partial commutators. Each partial commutator is provided with brushes which may be connected in various ways in order to vary the character of the currents passing through them. The partial commutators are insulated from each other and are rigidly connected with the armature. This arrangement of commutator may be applied to dynamo and magneto electric generators and motors, to continuous current transformers and to transformers of alternate into continuous currents, and generally to all electric machines in which the ordinary continuous current commutators may be applied. Whatever may be the type of the armature to which this commutator is to be applied, the segments of each partial commutator are connected with the armature coils in a succession depending upon the number of partial commutators employed.

Let 1. 2. 3. 4. 5., &c., indicate the successive armature coils in the order in which the windings are made. I will call the end of the first coil, the point of connection of the first armature coil with the second; the end of the second coil, the point of connection of the second coil with the third and so on to the last coil which is connected with the first. When there are two partial commutators, the segments of the one are connected in proper order with the ends of the coils of odd numbers—1. 3. 5. 7., &c., and the segments of the second partial commutator are connected with the ends of the coils of even numbers—2. 4. 6. 8., &c. When there are three partial commutators, the segments of the first are connected with the ends of the coils 1. 4. 7. 10. 13, &c., the segments of the second with the ends of coils 2. 5. 8. 11. 14, &c., and the segments of the third with the ends of coils 3. 6. 9. 12. 15., &c. Generally if there are n-partial commutators (n being a divisor of the number of the armature coils) the segments of the first partial commutator are respectively connected with the ends of the coils 1, $(1+n,)$ $(1+2\ n.,)$ $(1+3n,)$ &c.; the segments of the second partial commutator are connected with the ends of the coils 2, $(2+n,)$ $(2+2\ n,)$ $(2+3\ n,)$ &c.; the segments of the third partial commutator are connected with the ends of coils 3, $(3+n,)$ $(3+2\ n,)$ $(3+3\ n)$ and so on for all the other partial commutators. As there is thus in each partial commutator only $\frac{1}{n}$th part of the whole number of segments, each segment may have breadth equal or a little greater than in an ordinary commutator, while their distance apart is so much increased that there is little risk of an arc being established.

I provide each partial commutator with one pair of brushes, or, in the case of multipolar machines, with several pairs of brushes, the one of each pair being negative and the other positive; and each brush is placed suitably for the set of coils and for the position of the inducing poles related to it. I may connect together all the positive brushes and also all the negative brushes. With this connection the machine can act with continuous current. I may also make two groups of brushes, one group by connecting the positive brushes of some of the partial commutators with the negative brushes of some of the other partial commutators, and a second group by connecting the remaining brushes in a similar manner. With this connection the machine acts as an alternate current machine. But the alternating current is regular only when the two groups of brushes are symmetrical.

When the machine is used for alternating currents, regular or not, a positive and a negative brush belonging to the same group should not be in action together.

Fig. 1 represents diagrammatically a bipolar dynamo (generator or motor) with a ring armature, having thirty-two coils, to which is applied a commutator divided, according to my invention, into two partial commutators. There are two positive brushes P′ P^2 and two negative brushes N′ N^2. The current is continuous when P′ P^2 are connected together and N′ N^2 also connected together. The current is alternating when the brush P′. is connected with N^2 and the brush N′ with P^2. Fig. 2 represents diagrammatically a similar dynamo to which is applied a commutator similar to that in Fig. 1 but modified in turning the one partial commutator partly round relatively to the other, the brushes being correspondingly turned. The connections with the coils and the connections that may be made of the brushes are the same as in the preceding example. In both Figs. 1 and 2, the segments are shown of the same breadth as in an ordinary continuous current commutator, that is to say, each occupies a little less than one thirty-second of the circumference.

Fig. 3 represents diagrammatically a four-pole dynamo with ring armature having forty-eight coils. The number of partial commutators is four, each having four brushes symmetrically arranged. When the eight positive brushes P′ P^2 P^3 P^4 are connected, and the eight negative N′ N^2 N^3 N^4 also connected the dynamo acts for continuous currents. When the four positive brushes P′ P^3 are connected with the four negative brushes N^2 N^4 and the four negative N′ N^3 with the four positive P^2 P^4; also when the four brushes P′ P^2 are connected with the four, N^3 N^4, and the four brushes N′ N^2 with the four P^3 P^4, the current is in both cases alternating and regular. In this figure each segment occupies one forty-eighth of the circumference, that is to say, it is a little broader than it would be in an ordinary continuous current commutator. In like manner Fig. 4 represents diagrammatically a six-pole dynamo with ring armature having twelve coils and three partial commutators. But in this case only two brushes for each partial commutator are employed, instead of six, because all the segments which are in similar conditions relatively to the couples of inducing poles are connected together. (The same result could be obtained by connecting in series each armature coil with all the coils which are under similar conditions relatively to the couples of inducing poles.) In this example the numbers of partial commutators, of coils and of inducing poles are chosen so as to have those segments which must be connected together in different partial commutators. In this case as in Fig. 2, two of the partial commutators may be turned partly round and the brushes relating to them, in such manner that segments which must be connected together are arranged on the same radius. In the example given at Fig. 4, the current is continuous when the brushes P′ P^2 P^3 are connected and the brushes N′ N^2 N^3 also connected.

Fig. 5 shows diagrammatically the application of commutators according to this invention to a continuous current transformer having a fixed armature wound with primary and secondary coils, each set of coils being connected to a separate commutator which is divided into two partial commutators, the one pair shown within and the other pair shown outside the coiled ring for the sake of clearness. All the brushes revolve at the same velocity. The primary winding of eight coils is connected to the inner pair and the secondary of sixteen coils is connected to the outer pair of partial commutators. This transformer acts in different manners according to different connections of the brushes, as for example:—When P'_1 is connected with P'_2, N'_1 with N'_2 and P''_1 with P''_2, and N''_1 with N_2'', the apparatus transforms continuous currents into continuous currents. When P'_1 is connected with P'_2, N'_1 with N'_2, P''_1 with N''_2, P''_2 with N''_1 the apparatus transforms continuous into alternating currents. When P'_1 is connected with N'_2, N'_1 with P'_2, P''_1 with P''_2, N''_1 with N''_2, the apparatus transforms alternating currents into continuous currents. When P'_1 is connected with N'_2, P'_2 with N'_1, P''_1 with N''_2, P''_2 with N''_1 the apparatus transforms alternating currents into other alternating currents differing in current, tension and frequency. In the two last cases the brushes must revolve with such speed that, at each inversion of the primary current, the one brush of the primary commutator should be leaving and the other entering a segment. For this purpose, a synchronous subsidiary motor might be employed. In this example the axis of the various commutators is not necessarily coincident with the axis of the armature.

Fig. 6 shows diagrammatically the application of a commutator divided into two partial commutators to a transformer having a drum armature (ten coils) of two alternate currents (c' c^2), having a difference of phase of ninety degrees, into one continuous current. The brushes have the continuous current connection namely P′ with P^2 and N′ with N^2 and, as the armature is stationary, they revolve with the same speed as that of the rotating magnetic field. Although there are four polar pieces, the apparatus must be considered bipolar, because the magnetic field at any instant has only one middle direction through the armature.

The brushes P′ and P^2 in Fig. 1, have an electrical connection 1 of any suitable kind, and the opposite brushes N′ and N^2 have a similar connection 2. The terminals of the external circuit 3 are connected to the said parts 1 and 2, respectively. In Fig. 2, the brush P′ has an electrical connection 4 to the opposite but alternating brush N^2, while the brush P^2 has a like connection 5 to the opposite, alternating brush N′. The terminals of the external circuit 6 are united to these connections to obtain an alternating current.

The circuit connections of the modified forms shown in the other figures of the drawings are so fully set forth in preceding parts of the specification that they require no detailed description.

Having thus described the nature of my invention and the best means I know for carrying the same into practical effect, I claim—

In an electrical machine, a commutator divided into a plurality of electrically separated parts, each part consisting of a series of commutator-segments provided with broad, intervening, insulating spaces, brushes being provided for each electrically separated part of the commutator the arrangement being such that the brushes of the same polarity shall have successive and continuous action, substantially as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 18th day of April, A. D. 1893.

CAMILLO OLIVETTI.

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