No. 841,545. PATENTED JAN. 15, 1907.

M. C. A. LATOUR.

DYNAMO ELECTRIC MACHINE.

APPLICATION FILED JUNE 29, 1906.

Fig. 1

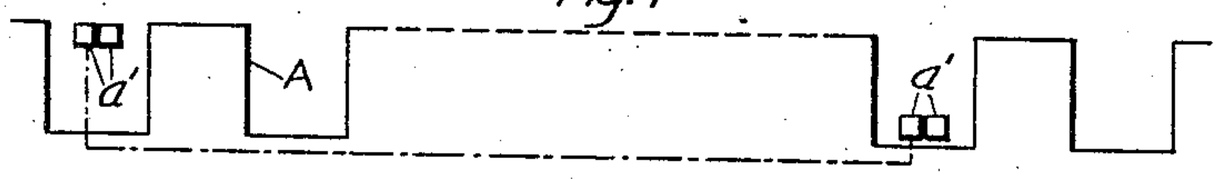


Fig. 2

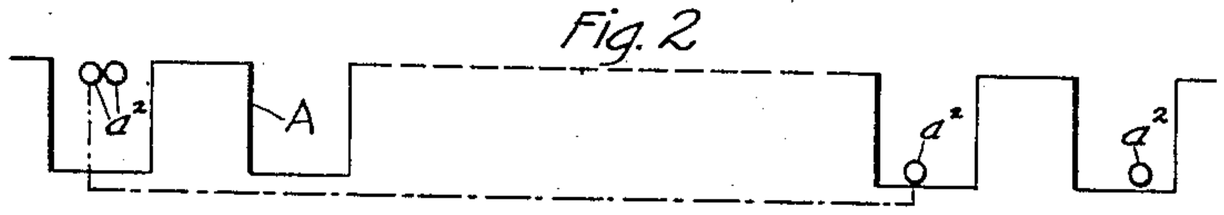


Fig. 3

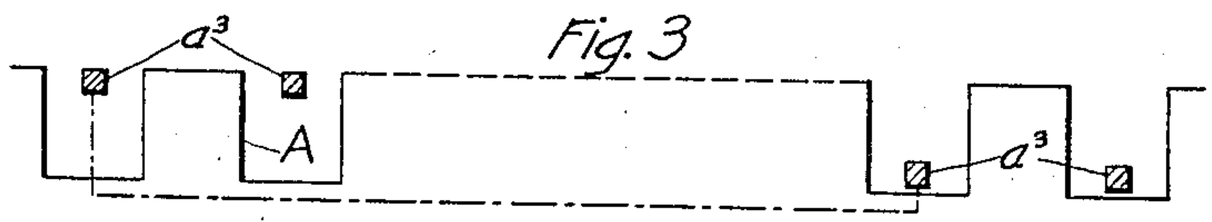


Fig. 4

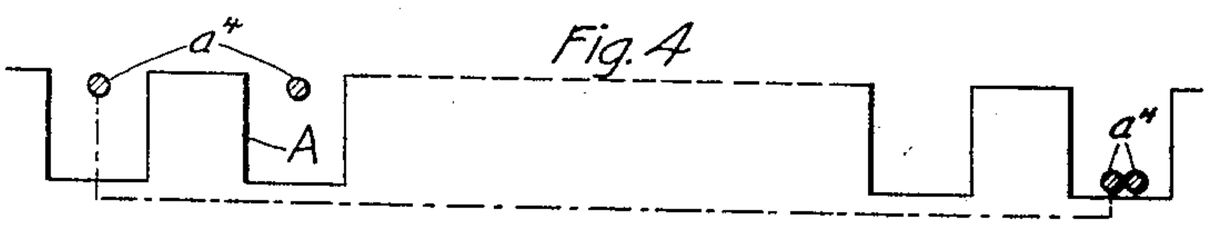


Fig. 5

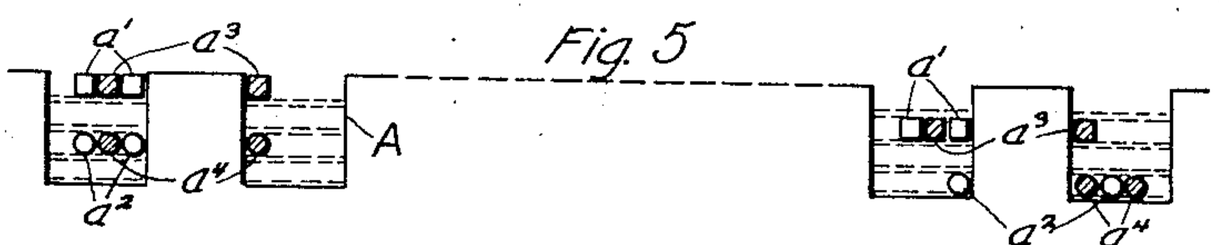


Fig. 6

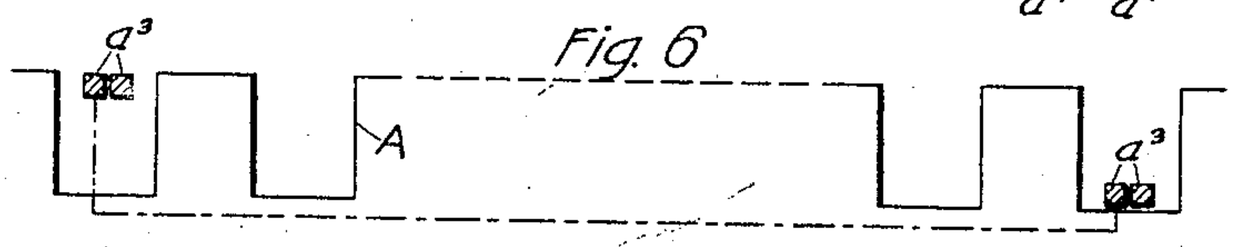


Fig. 7

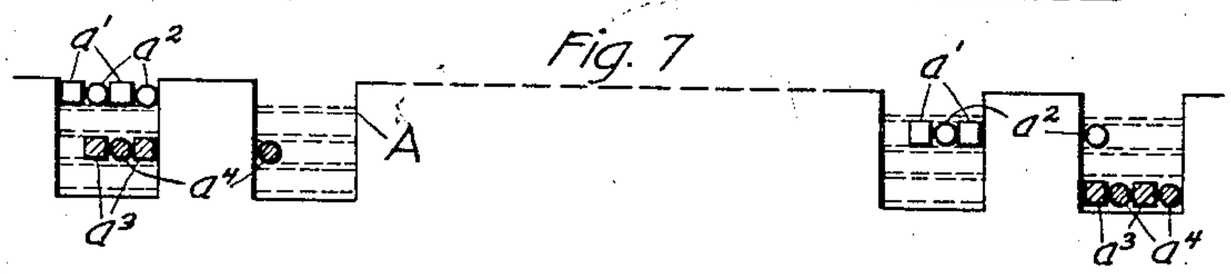
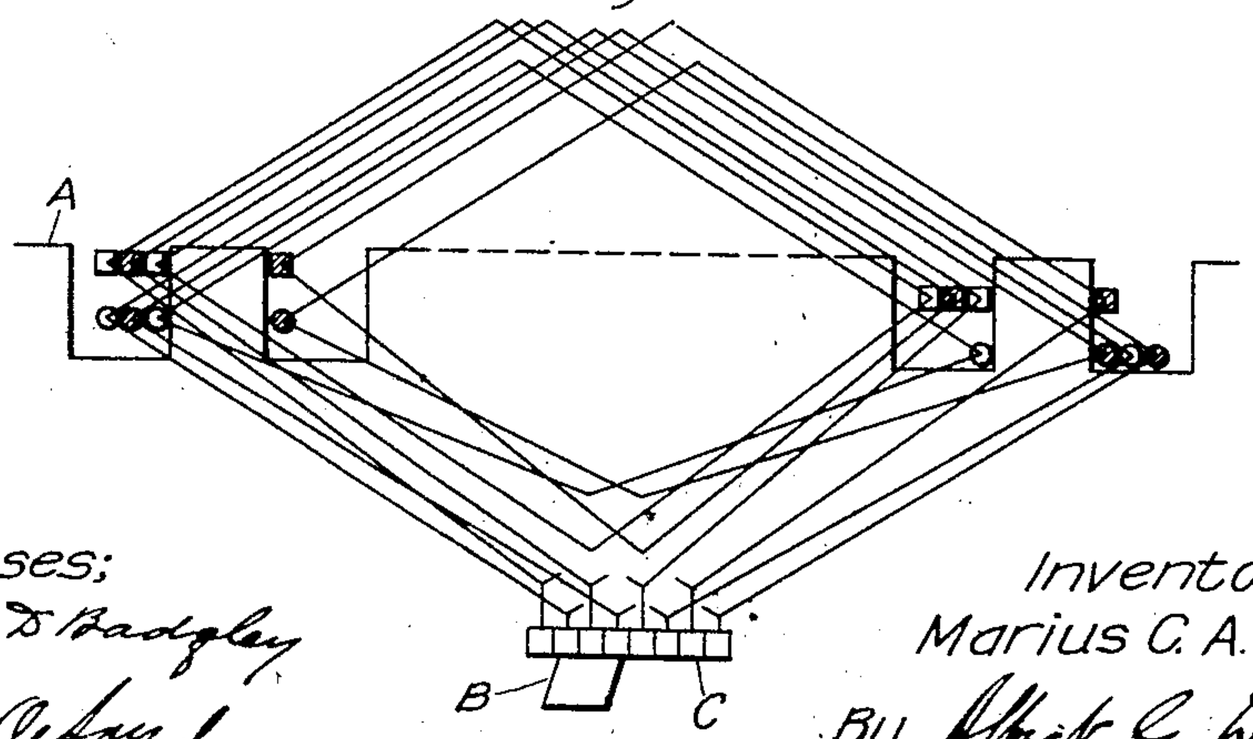


Fig. 8



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UNITED STATES PATENT OFFICE.

MARIUS C. A. LATOUR, OF PARIS, FRANCE, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

DYNAMO-ELECTRIC MACHINE.

No. 841,545. Specification of Letters Patent. Patented Jan. 15, 1907.

Application filed June 29, 1906. Serial No. 323,975.

To all whom it may concern:

Be it known that I, MARIUS C. A. LATOUR, a citizen of France, 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 of the coramutator type, and is particularly applicable to alternating-current motors, although not limited to this particular application.

As is well known in the art commutation in alternating-current machines is attended by difficulties which are not present in direct-current machines, since in the former type an armature-coil when short-circuited by a brush in commutation is subjected to an alternating flux, which induces short-circuit currents in the coil, which result in sparking and excessive heating. This difficulty is most pronounced at starting when the flux is at a maximum. In order to avoid these short circuits in alternating-current machines of the commutator type, it has been proposed heretofore to wind the armature with a plurality of independent windings and to connect these windings to successive commutator-segments. With such an arrangement and with brushes of a certain width no short-circuit currents are produced. For instance, if three independent windings are employed each segment is separated from the nearest segments connected to the same winding by two other segments, so that if a brush is used of a width not greater than two segments the brush can never bear on two segments at the same time which are connected to the same winding. While this arrangement theoretically improves commutation by avoiding the production of short-circuit currents, it has been found in practice that certain difficulties arise. In every machine the number of slots has a certain maximum value, above which it cannot be carried without reducing the size of the teeth to such an extent as to increase the reluctance of the magnetic circuit unduly. The number of slots is usually made as great, or nearly as great, as is compatible with good design in order to secure the maximum distribution of the winding, and consequently the minimum reactance. When a plurality of independent windings are employed it is clearly necessary either to sacrifice this distribution or else to distribute each winding in every slot. The latter is the preferable course and the one that has been employed heretofore. It, however, is subject to the following objection: The coils of the several windings in a given slot necessarily have induced voltages of the same phase since they are in the same position on the armature-core; but these coils are connected to successive commutator-segments, so that the induced voltages at the commutator-segments do not correspond in phase with the angular positions of the segments. The result, as far as commutation is concerned, is precisely the same as though the brush were shifted back and forth every time a slot passes the brush. It is evident that the best conditions for commutation are not obtained.

In a former application, Serial No. 242,088, filed by me January 21, 1905, I described an arrangement for two windings by which the above difficulty is avoided. The arrangement described in that application consists in making one winding of coils having a width greater by one slot than the coil width of the other winding. By thus proportioning the coils two coils of the respective windings having one side in the same slot will have their other sides separated by the distance of one slot, so that the median lines of the coils are displaced by half a slot. With this arrangement the phase of the induced voltage at each commutator-segment corresponds to the angular position of the segment; but it is obvious that this arrangement cannot readily be extended to more than two windings.

In a later application, Serial No. 275,745, filed by me August 25, 1905, I described a second arrangement of windings applicable to more than two windings. The arrangement disclosed in this later application consists in connecting the commutator-leads of one or more of the windings to intermediate points on the coils of the winding, so that the portion of that winding included between two adjacent commutator-leads comprises portions of two different coils in two adjacent sets of slots. By properly connecting the leads it will be seen that the phase of the induced voltage at each lead may be made to correspond exactly with the angular position of the commutator-segment to which it is connected and that this method may be ex-

tended to any number of windings. It will, however, be noted that in order to extend it to more than two windings it is necessary that each coil should have more than two turns.

My present invention consists in still another arrangement by means of which four windings of only two turns per coil may be arranged and connected to give the desired progression of phase at the commutator.

My invention consists in forming one or more of the windings of coils arranged with the conductors forming one side of a coil in a single slot and the conductors forming the other side of the coil distributed in a plurality of slots. By the term "coil" in the above statement I mean the portion of the winding between adjacent commutator-leads, and it is with this meaning that I shall employ the term "coil" in the following specification and in the appended claims.

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

Figures 1 to 4 show diagrammatically the arrangements of four different windings arranged in accordance with my invention. Fig. 5 shows the four windings combined. Fig. 6 shows a modified arrangement of the winding shown in Fig. 3. Fig. 7 shows the combination of the winding of Fig. 6 with the windings of Figs. 1, 2, and 4; and Fig. 8 shows the same arrangement as Fig. 5, but with the end connections and commutator-leads shown.

In the drawings, A represents the slotted armature-core.

a' represents a coil of one winding. This coil is shown as comprising two turns, both arranged in the same slots in the usual manner.

a^2 represents a coil of a second winding. The conductors forming the left-hand side of this coil are arranged in the same slot, while the conductors forming the right-hand side of the coil are distributed in two adjacent slots. It will be seen that the phase of the induced voltage in the coil a^2 as compared with that of coil a' is displaced by an amount corresponding to one-quarter of the distance between adjacent slots.

In Fig. 3, a^3 shows a coil of a third winding. This coil has the conductors of both sides distributed between two adjacent slots. The combination of coils a' and a^3 would give an arrangement precisely the same as was shown for two windings of two-turn coils in my former application, Serial No. 275,745, above mentioned. It will be seen that the induced voltage in the coil a^3 is displaced by an amount corresponding to one-fourth of a slot with respect to that of coil a^2 and one-half a slot with respect to coil a'.

Fig. 4 shows a coil a^4 of the fourth winding, which is arranged similarly, but oppositely, to the coil a^2. The phase of the induced voltage in this coil is displaced by an amount corresponding to three-fourths of the distance between adjacent slots from that of coil a'. Consequently if these four coils are connected to successive commutator-segments the phase of the induced voltage of each commutator-segment will correspond to its angular position.

Fig. 5 shows the four windings combined in the same slots. In this figure the conductors of the four windings are indicated as in Figs. 1 to 4 in order to distinguish them by an unshaded square, an unshaded circle, a shaded square, and a shaded circle, respectively.

Referring to Fig. 3, it will be seen that the two inner conductors may each be moved out one slot or the two outside conductors moved in one slot without changing the phase of the induced voltage, since the median line of the coil will not be changed.

Fig. 6 shows the two inside conductors moved out one slot, and it will be observed that the combination of Figs. 1 and 6 gives the same winding arrangement as disclosed in my earlier application, Serial No. 242,088, above referred to. If the arrangement of Fig. 6 is employed in place of that of Fig. 3, the four windings may be combined, as shown in Fig. 7.

In Fig. 8 I have shown the end connections and commutator-leads for the windings of Fig. 5. C represents the commutator, to successive segments of which the several windings are connected. B represents a commutator-brush which for an alternating-current motor, in order to avoid short-circuits, is preferably given a width insufficient to bridge adjacent segments connected to the same winding—that is, for four windings a width something less than three segments.

I have spoken of the application of my invention in particular to alternating-current motors; but I desire it to be understood that in its broader aspects it is not thus limited. It is sometimes advantageous in direct-current machines to employ a plurality of windings in the same slots. My invention is applicable to such machines, and when so applied brushes of the width usual in direct-current machines would be employed.

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 a dynamo-electric machine of the commutator type, a plurality of armature-windings carried in the same slots and connected to successive commutator-segments, at least one of said windings having its coils

arranged with the conductors forming one side of a coil in a single slot and the conductors forming the other side of the coil distributed in a plurality of slots, whereby the phase of the induced voltage at each commutator-segment corresponds to the angular position of the segment.

2. In a dynamo-electric machine of the commutator type, a plurality of armature-windings carried in the same slots and connected to successive commutator-segments, at least one of said windings having its coils arranged with the conductors forming one side of a coil in a single slot and the conductors forming the other side of the coil distributed in a plurality of slots, whereby the phase of the induced voltage at each commutator-segment corresponds to the angular position of the segment, and brushes bearing on the commutator of a width insufficient to bridge adjacent segments connected to the same winding.

3. In a dynamo-electric machine of the commutator type, four armature-windings carried in the same slots and connected to successive commutator-segments, two of said windings having their coils arranged with the conductors forming one side of a coil in a single slot and the conductors forming the other side of the coil divided between two adjacent slots, whereby the phase of the induced voltage at each commutator-segment corresponds to the angular position of the segment.

4. In a dynamo-electric machine of the commutator type, four armature-windings carried in the same slots and connected to successive commutator-segments, two of said windings having their coils arranged with the conductors forming one side of a coil in a single slot and the conductors forming the other side of the coil divided between two adjacent slots, whereby the phase of the induced voltage at each commutator-segment corresponds to the angular position of the segment, and brushes bearing on the commutator of a width insufficient to bridge adjacent segments connected to the same winding.

In witness whereof I have hereunto set my hand this 19th day of June, 1906.

MARIUS C. A. LATOUR.

Witnesses:
HANSON A. COXE,
JACK BAKER.