B. G. LAMME.

DYNAMO ELECTRIC MACHINE.

APPLICATION FILED SEPT. 6, 1910.

1,031,009. Patented July 2, 1912.

Fig. 1.

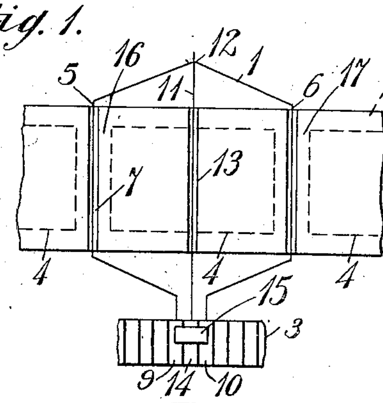


Fig. 2.

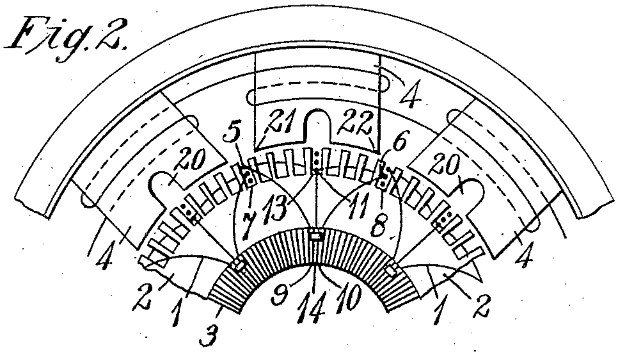


Fig. 3.

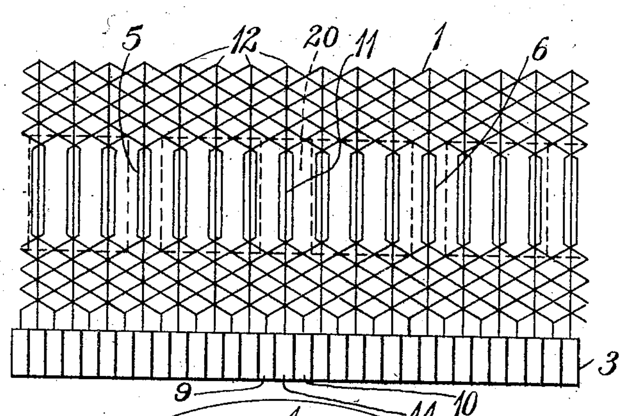
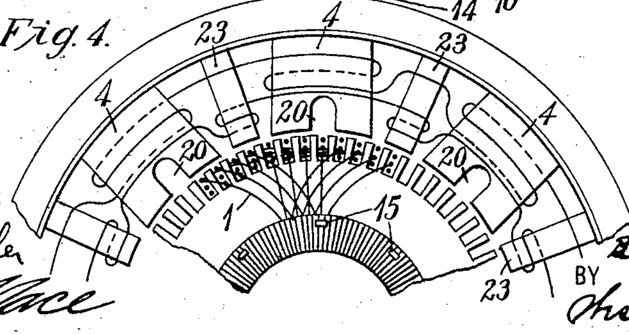


Fig. 4.



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DYNAMO-ELECTRIC MACHINE.

1,031,009. Specification of Letters Patent. Patented July 2, 1912.

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To all whom it may concern:

Be it known that I, BENJAMIN G. LAMME, a citizen of the United States, and a resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Dynamo-Electric Machines, of which the following is a specification.

My invention relates to dynamo-electric machines and it has special reference to machines of the commutator type having multiple-wound armatures.

The object of my invention is to provide a well proportioned machine of the above-indicated class that shall be adapted to operate satisfactorily under severe operating conditions and shall embody simple and effective means for increasing the number of commutator bars without increasing the number of armature ampere turns, and further means for obtaining substantially equal voltages between any two adjacent commutator bars at the instant of commutation.

In the design of very high speed or very low voltage machines, it frequently happens that the most suitable number of armature conductors is such as to give too small a number of commutator bars, using one armature turn per bar. In many cases, in very high speed machines for a given output, the desired voltage can only be obtained, either with a very low induction per pole and the required number of commutator bars, or with a higher induction per pole and a reduced number of armature conductors and commutator bars. If a low induction per pole is chosen, with a relatively large number of armature conductors and commutator bars, the ampere turns in the armature may become unduly large, so that an abnormally proportioned machine is obtained. On the other hand, if a high induction per pole is chosen, then, even with a multiple wound armature of but a single conductor per coil, there may still be so few armature conductors and so few commutator bars, that bad proportions are obtained and operating difficulties encountered. For instance: too few armature conductors per circuit, or commutator bars per pole, may lead to pulsations or irregularities in the armature current. Furthermore, such machines are likely to commutate unsatisfactorily. In such cases, an arrangement of armature winding which would double the number of commutator bars without doubling the number of armature ampere turns has been found of very considerable advantage.

According to my invention, I employ an armature winding of the usual multiple-wound type, and I provide additional conductors or leads which are connected to the mid-points of the several armature coils and are brought through the slots which lie midway between those that carry the outer conductors of the respective coils and are connected to auxiliary commutator bars which are located intermediate the bars to which the outer conductors are connected. Hence, it is manifest, that double the number of commutator bars is obtained, without doubling the armature ampere turns and also that the potential between adjacent bars will be substantially reduced. However, inasmuch as the middle leads are disposed in the armature slots and are, therefore, rotated under the active magnetic field produced by the main field poles, additional means are provided to reduce the electro-motive force generated in said conductors at the moment of commutation, so that the existing potential upon any intermediate commutator bar shall be approximately half of the potential between the immediately adjacent bars, when said bars are short-circuited by the brushes.

Heretofore, dynamo-electric machines have been constructed in which the mid-points of the armature coils have been connected to intermediate commutator bars, but, in such cases, the middle leads have either been disposed inside of the armature core or they have been arranged adjacent to one side of the main coil, so that, during commutation, they did not lie in an active field.

The particular advantages of my invention reside in the facts that all of the conductors of the armature coils are disposed in the usual armature slots and require no special supports; the number of commutator bars are increased without increasing the number of armature ampere turns; and, the potential between any two adjacent commutator bars is substantially equal, at the moment of commutation, so that particularly advantageous commutating conditions are obtained.

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

Figure 1 is a diagrammatic view of a portion of a dynamo-electric machine, showing a single armature coil, constructed in accordance with my invention, in its relation to the field poles at the instant of commutation. Fig. 2 is a partially diagrammatic side elevation of a portion of a dynamo-electric machine constructed in accordance with my invention. Fig. 3 is a complete diagrammatic development of a portion of an armature winding arranged in accordance with my invention, and Fig. 4 is a view similar to that shown in Fig. 2, with the exception that auxiliary commutating poles are provided intermediate the main field poles.

Referring to Figs. 1, 2 and 3, an armature coil 1 is mounted upon a magnetizable core 2 and is connected to a commutator cylinder 3, the outer conductors of said coil being located midway between a plurality of field poles 4. The armature coil 1 comprises substantially parallel outer conductors 5 and 6 disposed, respectively, in slots 7 and 8, in the magnetizable core 2, and connected to commutator bars 9 and 10, respectively. An intermediate lead or conductor 11, which is connected at one end to the main coil 1 at its mid-point 12, is disposed within a slot 13 which lies midway between slots 7 and 8 and is connected, at its opposite end, to a commutator bar 14 intermediate the bars 9 and 10. As shown, the coil is in position to be commutated and the commutator bars 9, 10 and 14 are bridged by a brush 15.

Since the intermediate conductor 11 is located in a slot in the periphery of the magnetizable core 2, an electromotive force will at times be generated in it, by reason of its movement through the magnetic fields produced by the main field poles 4. If no such electromotive force were generated, the commutator bar 14, to which the conductor 11 is connected, would always lie at a potential midway between those of the two adjacent bars 9 and 10. However, since an electromotive force is generated in the conductor 11, when moving through the magnetic field, the intermediate bar 14 is not always maintained at a mid-potential, but as this conductor and the commutator bars 9, 10 and 14 carry no current except when short-circuited by a brush, it is not important that a midway potential be maintained upon the bar 14, except at the time of commutation.

It will be observed that, at the time of commutation, the intermediate conductor 11 lies under the middle of a field pole 4 and, therefore, is generating an electromotive force when the two sides 5 and 6 of the coil 1 are passing through the neutral or interpolar spaces 16 and 17, respectively. It is at just this time that the intermediate conductor should generate the least voltage.

The side conductor 6 and the intermediate conductor 11 may be considered as a half-coil which is commutated first, while the other side conductor 5 and the intermediate conductor 11 may be considered as a second half-coil which is commutated immediately afterward. Inasmuch as this conductor cuts the active magnetic field, it has generated in it an electromotive force which assists commutation and reversal of current for one of these half-coils, and opposes the reversal in the remaining half coil, as will be readily understood. It is, therefore, desirable to reduce this electromotive force to as low a value as possible, in order to prevent the opposing action in commutating one or the other of said half-coils. In order to overcome this difficulty, I propose to cut a notch or slot 20 in the middle of each of the main field pole pieces to correspond to the positions of the intermediate conductor at the instant of commutation. By this means, a great reduction in strength of the magnetic field under the middle of the pole faces is obtained, so that the intermediate conductors generate but very small electromotive forces at this instant, and hence, satisfactory commutation may be secured. This electromotive force, however, can not well be reduced to zero value, as it is impracticable, in most cases, to obtain a zero magnetic field under the center of the main field poles. It is evident, therefore, that a weak magnetic field is obtained directly over the intermediate conductor 11 at the moment of commutation. Hence, only a very small voltage is generated therein and, consequently, good commutation may be effected.

Those skilled in the art will readily understand that, since the polarity of the magnetic field is the same at both edges of the polar notches 20, shown in Fig. 2, that the magnetic fringing into the armature under said notches is such as to add to one another at all positions, so that there is no position under said polar notches which has zero field and, hence, a very slight electromotive force is generated. In most cases, the reduction in magnetic field under the middle of the pole faces is sufficiently low to secure good commutation. However, cases may arise in which a further reduction in the electromotive force than is practicable to secure by means of polar notches, may be obtained by the use of commutating poles of suitable proportions.

In Fig. 4, commutating poles 23 are provided between the main field poles 4. The other parts of the drawing are similar to those shown in Fig. 2 and bear like reference numerals.

It will be evident to those skilled in the art that the effect of any slight electromotive forces generated in the intermediate conductors under the polar notches 20, at the moment of commutation, may be eliminated by a proper design of commutating poles, so that good commutation may be secured under the most adverse operating conditions.

I desire that my invention shall not be limited to the arrangement and structural details shown and described; that modifications which do not depart from the spirit of my invention shall be included within its scope; and that only such limitations shall be imposed as are indicated in the appended claims.

I claim as my invention:

1. In a dynamo-electric machine, the combination with a field magnet having polar projections provided with centrally disposed face slots, a magnetizable core having a plurality of slots, and a commutator cylinder comprising a plurality of bars, of an armature winding comprising a plurality of coils disposed in said slots, the side conductors of which are connected to alternate commutator bars, and an intermediate conductor for each coil disposed in a slot approximately midway between the respective side conductors and connected at one end to the midpoint of said coil and at the other end to a commutator bar intermediate the bars to which the side conductors of said coil are connected, said intermediate conductors being directly beneath the slots in the polar projections at the time of commutation.

2. In a dynamo-electric machine, the combination with a magnetizable core having a plurality of slots, a commutator cylinder comprising a plurality of bars, and an armature winding comprising a plurality of coils disposed in said slots, each coil comprising two side conductors connected to alternate commutator bars, and an intermediate conductor disposed in a slot approximately midway between the respective side conductors and connected at one end to the midpoint of said coil and at the other to a commutator bar intermediate the bars to which the side conductors are connected, and a field magnet provided with means for obtaining a potential on each intermediate bar which is substantially one half of the potential between the two immediately adjacent bars at the instant of commutation.

3. In a dynamo-electric machine, the combination with a magnetizable core having a plurality of slots, a commutator comprising a plurality of bars and a set of coöperating brushes, and an armature winding comprising separate coils disposed in said slots, each formed of three equally spaced parallel conductors, the outer conductors being connected, at their extremities, to alternate commutator bars and the intermediate conductor being connected to an intermediate bar, of a field magnet provided with means for reducing the electromotive forces generated in said intermediate conductor at the instant of commutation.

4. In a dynamo-electric machine, the combination with a magnetizable core, a commutator comprising a cylinder and a set of brushes, and an armature winding comprising a plurality of coils disposed upon said core and severally comprising two side conductors and a centrally located intermediate conductor connected to separate commutator bars, of a field magnet provided with means for reducing the influence of said poles upon said intermediate conductors when the coils are short circuited by the brushes.

5. In a dynamo-electric machine, the combination with a magnetizable core having a plurality of slots, a commutator cylinder comprising a plurality of bars, and an armature winding comprising a plurality of coils, each formed of three parallel equally spaced conductors disposed in separate slots and connected to separate commutator bars, of a field magnet having a plurality of polar projections, slots parallel to the armature core slots and located in the middle of the respective pole faces, and a plurality of commutating poles intermediate said polar projections.

6. In a dynamo-electric machine, the combination with a field magnet having a plurality of pole pieces, a magnetizable core having a plurality of slots, a commutator comprising a plurality of bars and a set of brushes to coöperate therewith, of an armature winding comprising a plurality of separate coils disposed in said slots, each coil comprising two outer conductors connected to alternate commutator bars and an intermediate conductor located midway between said outer conductors and connected to an intermediate commutator bar, the pitch of each coil being such that its outer conductors lie midway between the field magnet pole pieces at the moment it is short-circuited by the brushes, and the field magnet pole pieces being provided with notches that are located midway between the pole tips and parallel to the armature core slots.

In testimony whereof, I have hereunto subscribed my name this 18th day of August, 1910.

BENJ. G. LAMME.

Witnesses:
C. W. McGhee,
R. J. Dearborn.