F. H. LORING.

DYNAMO ELECTRIC MACHINE OF THE HOMOPOLAR TYPE.

APPLICATION FILED MAR. 13, 1911.

1,012,381. Patented Dec. 19, 1911.

Fig. 1.

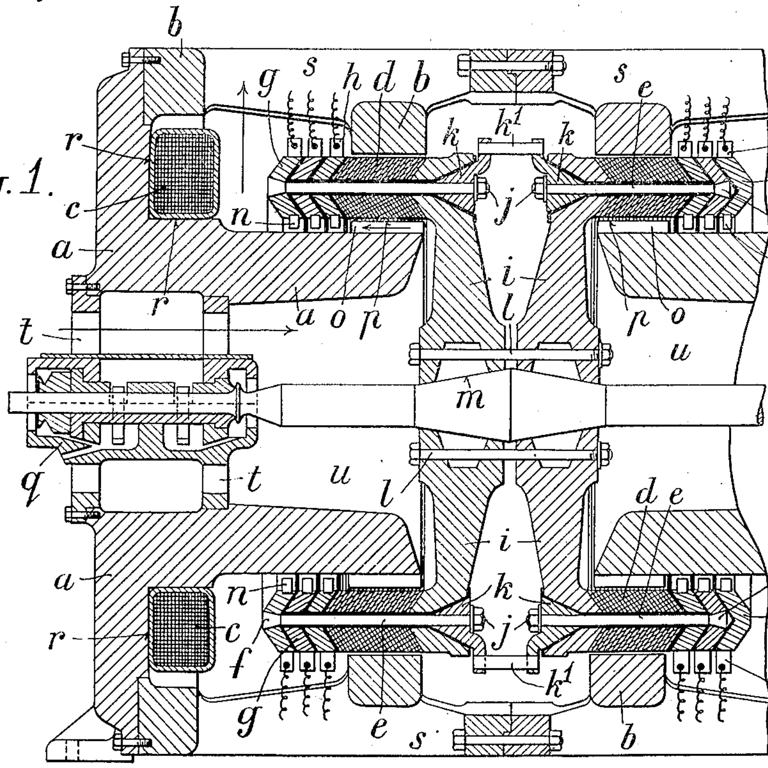


Fig. 2.

Fig. 2a.

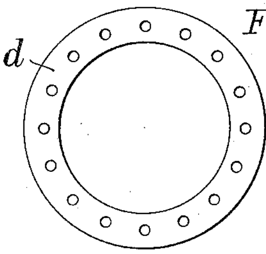


Fig. 4.

Fig. 3.

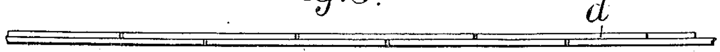
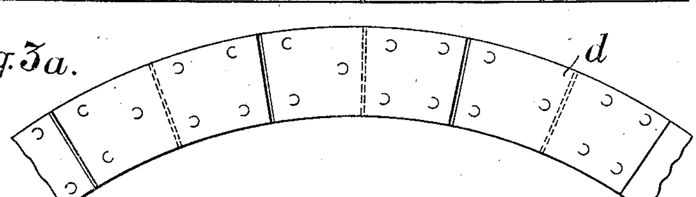


Fig. 3a.



Witnesses:

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UNITED STATES PATENT OFFICE.

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DYNAMO-ELECTRIC MACHINE OF THE HOMOPOLAR TYPE.

1,012,381. Specification of Letters Patent. Patented Dec. 19, 1911.

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To all whom it may concern:

Be it known that I, FREDERICK HENRY LORING, a citizen of the United States, residing at London, England, have invented new and useful Improvements in Dynamo-Electric Machines of the Homopolar Type, of which the following is a specification.

My invention relates to the class of dynamo-electric machines indicated by the above title, *i. e.* machines in which the conductors (taken either individually, or collectively as one) cut the lines of magnetic force in the same direction irrespective of their position in space. In machines of this class it is desirable that the armature should be of rigid construction so as to withstand high speeds; at the same time a reduction of the copper is desirable in order to effect an economy of manufacture. To secure these benefits without undue iron losses *e. g.* eddy currents in the rotating masses, due, for example, to irregularities in the polar faces, which produce variations of flux density in the rotating masses, and with good ventilation, simple machine work and straightforward methods of insulating the live from the dead parts of the machine, so that the E. M. F.'s may be added, the following constructional features have been worked out, and my invention accordingly consists in the arrangements and methods as set forth in the appended claims.

In the accompanying drawings, Figure 1 is a vertical central section of a homopolar dynamo constructed according to the present invention. Fig. 2 is a transverse section and Fig. 2ª a face view of a corrugated ring forming part of the armature. Figs. 3 and 3ª are similar views to Figs. 2 and 2ª illustrating a modification. Fig. 4 is a transverse section of one of the armature conductors.

According to one example of my invention illustrated by Fig. 1, I employ a cast-steel magnetic field system (*a*, *b*) with an annular gap, one exciting coil (*c*) sufficing. A number of field coils may of course be used for compounding purposes, but since my invention is not confined to the details of the field system, further description is unnecessary. The armature which rotates in the said annular field is built up of sheet metal rings (*d*) of high permeability so shaped as to interlock. That is to say, they may be corrugated or otherwise so shaped as to nest into each other in such a manner that when pressed together they will form a laminated ring of great strength, and, considering the diameter of the armature body thus formed, it is not of excessive weight. An example of a corrugated ring (stamping) is shown in Figs. 2 and 2ª. For example, the rings may assume an S-, V-, U-, or a W-section, but of course the angle or curvature is not so accentuated as these letters indicate. In large units, the laminæ may be built up piecemeal by adopting a well known process of electrically riveting, the shaped sections being so united as to form a ring, and the lap joints may be so arranged as to avoid air gaps, or air gaps may be purposely arranged at suitable intervals for radial ventilation. Figs. 3 and 3ª illustrate this method of forming a continuous ring out of sections, which are united without protruding rivet-heads by the following method:—The plates being of thin material, say $\frac{1}{16}$ inch thick, a considerable number of small indentations are "bumped" into the plates, which, on the reverse side, are dome shaped. The plates so prepared are laid together in an annular jig, or holder, and electrically welded in spots by the heat localized at the raised portions, when the plates are connected to a source of current and forced into intimate contact by suitable pressure. The plates are preferably dished or corrugated before they are prepared for welding, although the dishing and welding may be performed in one operation. Fig. 3 shows flat plates united in this manner, the incomplete circles representing the places where the welds have taken place.

I do not limit myself to the use of a particular form of electrically-riveted system of plates, as any other system of making mechanically-sound joints may be employed, although I prefer the electrical method, since it insures a uniform thickness of material. That is to say, a pair of plates, each having a varying thickness of section owing to stretch of the metal in shaping, may be welded in such a form as to function as a single plate of uniform thickness. The laminated ring is provided with holes for clamping bolts (*e*) which function as conductors. These bolts may be of drawn copper, or tough bronze, and they are anchored on one side by taper heads (*f*) into a system of insulated interlocking, or nesting, V- (or other convenient section) rings (g) preferably of steel, from which the currents are collected by means of brushes (h). These rings press against the laminæ, and the system is held together against a disk or spider (i) mounted on a shaft after being compressed as much as possible hydraulically by the bolts (e) which are provided with nuts (j) and connectors (k), the latter in conjunction with soldered-in cables (k') serving to connect the system with a duplicate one arranged to revolve in a similar field which is mechanically integral with the first-named one. The connectors (k) are made like collets so as to insure a good gripping contact. When two armatures are thus coupled together, the two spiders or disks (i) are drawn toward each other by steel bolts (l), their hubs being bored tapering so as to draw against corresponding taper surfaces (m) forming a part of, or mechanically integral with, the shaft. The collecting rings may be provided with inwardly projecting blades (n), which act as fans to cause a forced air circulation through longitudinal grooves (o) cut or cast in the inner pole face (p). The conductors (bolts) are preferably insulated from the laminæ by strips of hard insulating material let into radial grooves, as shown by Fig. 4, the insulating material protruding slightly, say from one to two millimeters, the bare intervening metal being varnished or otherwise insulated *e. g.* curved strips of insulating material (e^2), shown in section may be used. Tubular insulation may also be used or the bolts may be enameled with porcelain. The grooves however tend to obviate eddy currents in the bolts. The bearings (q) are supported by the field system, and a large number of collecting brushes together with copper cables or rods are provided for taking off the currents, the circuits being arranged so that the E. M. F.'s are added. The inner and outer polar faces of the armature are ground to insure great truth, and the bolts are so disposed as to insure a perfect balance. Very small air gaps are provided and a comparatively intense magnetic field obtained. The machine may be separately excited, and the magnetizing coil is held against a faced portion (r) of the field-system on one side to assist the conduction of the heat therefrom into the steel parts which have a larger radiating surface. The opposite side of the coil is exposed to the air currents induced by the above mentioned fan-blades (see arrows). The field system is provided with radial openings (s) so that the collecting brushes and connecting bars or cables can be introduced. The openings also facilitate ventilation. The bearings or the parts adjacent thereto are provided with air ducts (t) which communicate with the annular space (u) between the shaft and the inner pole, this in turn communicating with the air ducts (o) in the inner pole face.

In order that the separate stampings which are corrugated or V-shaped, for example, shall lie in hard contact both at the inner and outer periphery, it is necessary that each stamping should be of uniform general thickness. This may be accomplished in several ways. The plates may be dished when red-hot by special tools, which insure a uniform cross-section, or raised portions may be bumped on the plates, which will correct the inequalities due to stretch, *e. g.* as when they are shaped in the cold. Still another method consists in so-called electrically riveting together a pair of plates so that the riveted portions will be of uniform thickness and thus tend to equalize the variations due to the dishing operations.

The generator armature may be arranged to be driven vertically instead of horizontally as here shown.

I claim:—

1. A homopolar dynamo-electric machine comprising a field-magnet, annular polar surfaces in a magnetic circuit of said magnet, an annular armature movable between said polar surfaces and consisting of a plurality of laminæ formed of material of suitable magnetic permeability, which laminæ have recesses on one side and corresponding projections on the other side and are nested one into the other, a rotary shaft, a supporting frame on said shaft, conducting bolts connecting said laminæ and said supporting frame and extending transversely to the direction of the magnetic flux, and means for collecting the current generated in said bolts.

2. A homopolar dynamo-electric machine comprising a field-magnet, annular polar surfaces in a magnetic circuit of said magnet, an annular armature movable between said polar surfaces and consisting of a plurality of laminæ formed of material of suitable magnetic permeability, which laminæ have recesses on one side and corresponding projections on the other side and are nested one in the other, a rotary shaft, a supporting frame on said shaft, conducting bolts connecting said laminæ and said supporting frame and extending transversely to the direction of the magnetic flux, collecting rings connected to the ends of said bolts and pressing against said laminæ, and brushes bearing against said rings.

3. A homopolar dynamo-electric machine comprising a field-magnet, annular polar surfaces in a magnetic circuit of said magnet, an annular armature movable between said polar surfaces and consisting of a plurality of laminæ formed of material

of suitable magnetic permeability, which laminæ have recesses on one side and corresponding projections on the other side and are nested one in the other and are spot-welded to one another, a rotary shaft, a supporting frame on said shaft, conducting bolts connecting said laminæ and said supporting frame and extending transversely to the direction of the magnetic flux, and means for collecting the current generated in said bolts.

4. A homopolar dynamo-electric machine comprising a field-magnet, annular polar surfaces in a magnetic circuit of said magnet, an annular armature movable between said polar surfaces and consisting of a plurality of laminæ formed of material of suitable magnetic permeability, which laminæ have recesses on one side and corresponding projections on the other side and are nested one in the other, a rotary shaft, a supporting frame on said shaft, conducting bolts connecting said laminæ and said supporting frame and extending transversely to the direction of the magnetic flux, collecting rings connected to the ends of said bolts and pressing against said laminæ, inwardly-projecting fan-blades on said collecting rings, and brushes bearing against said rings.

5. A homopolar dynamo-electric machine comprising a field-magnet having two magnetic circuits, annular polar surfaces in said magnetic circuits, two annular armatures movable between said polar surfaces and consisting of a plurality of laminæ formed of material of suitable magnetic permeability, which laminæ have recesses on one side and corresponding projections on the other side and are nested one in the other, a rotary shaft, a supporting frame which is adapted to engage with one end of each annular armature and is mounted on said shaft, conducting bolts mechanically connecting said laminæ and said supporting frame, which bolts are electrically connected together at their inner ends and extend transversely to the direction of the magnetic flux, collecting rings electrically and mechanically connected to the outer ends of said bolts and brushes bearing against said rings.

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Witnesses:

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