(No Model.) 4 Sheets—Sheet 1.

V. A. FYNN.

DYNAMO ELECTRIC MACHINE.

No. 587,573. Patented Aug. 3, 1897.

FIG. 2.

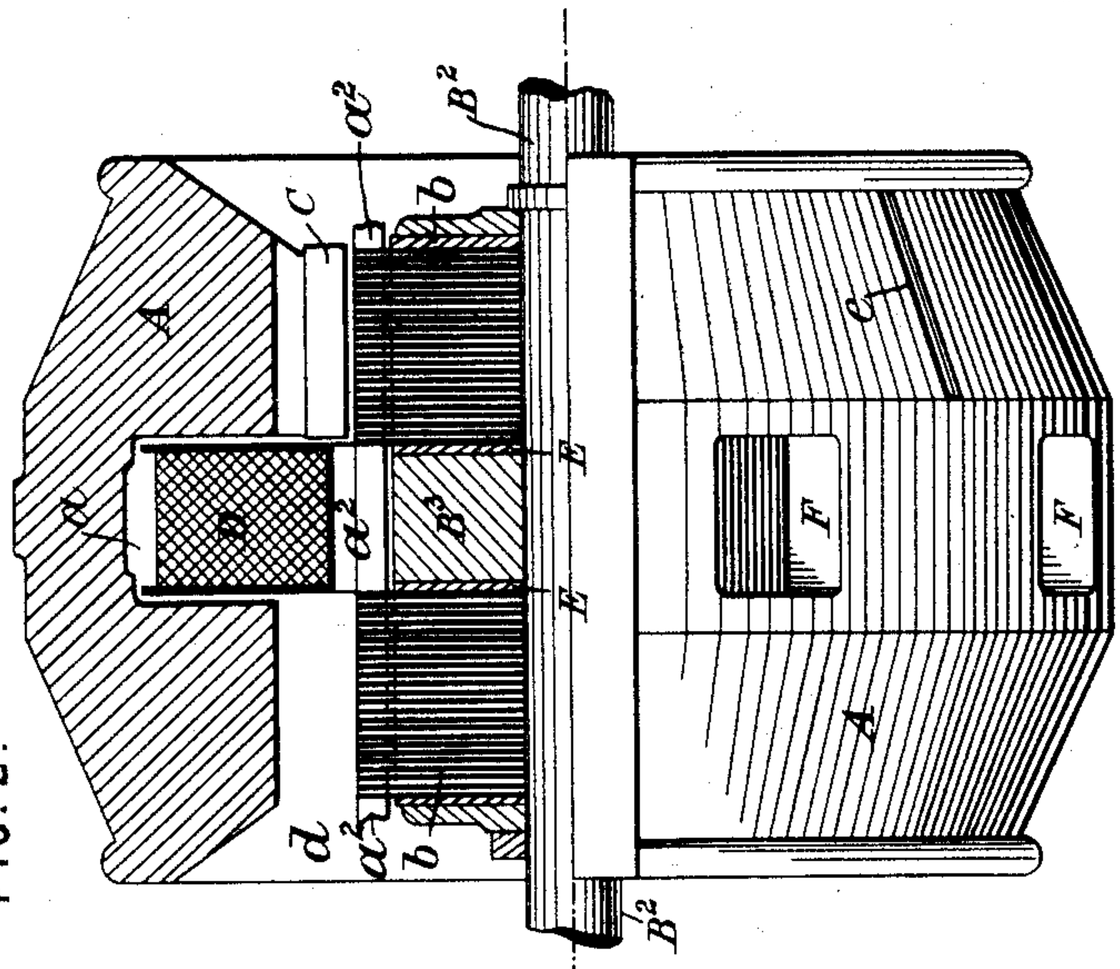


FIG. 1.

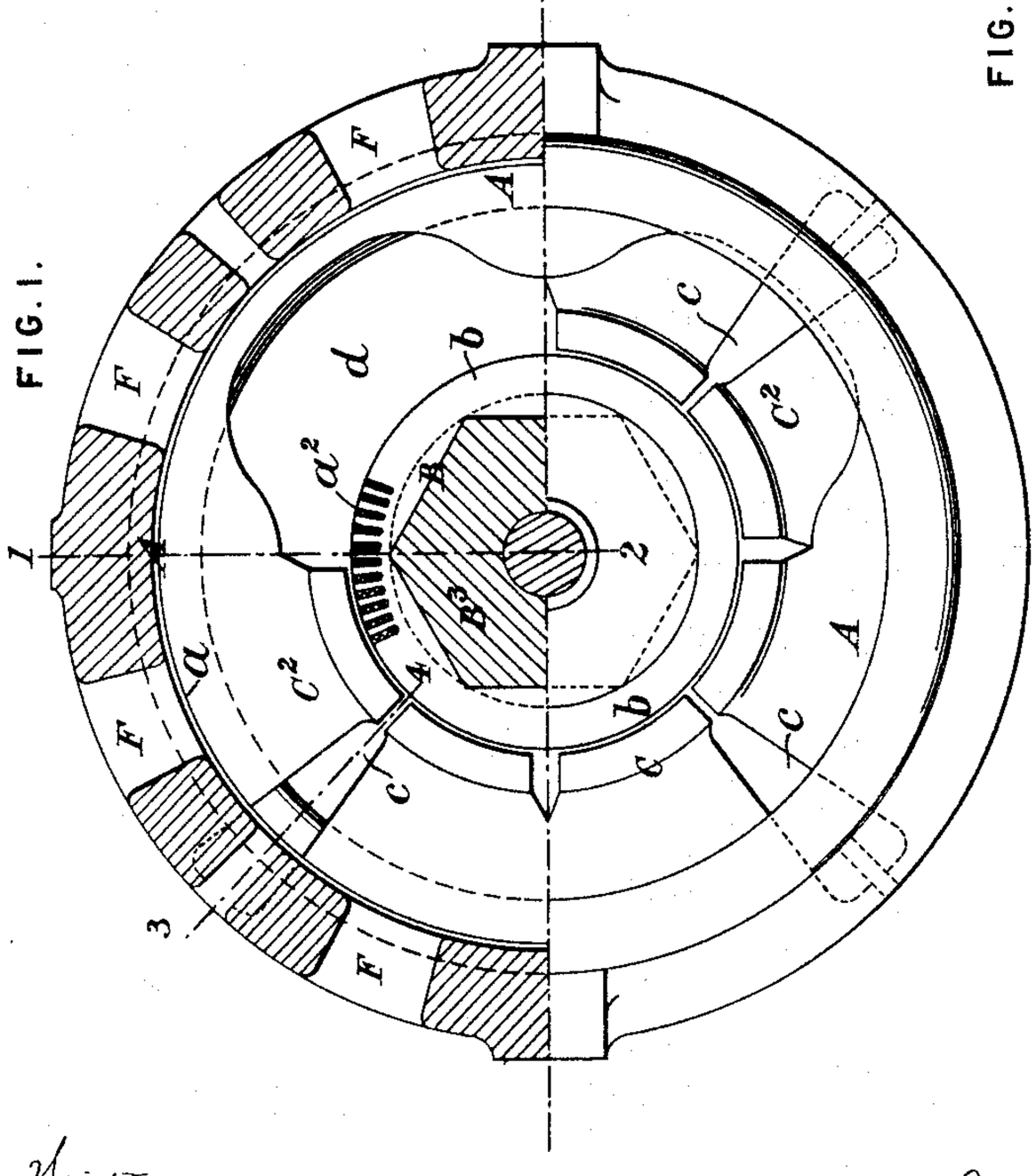
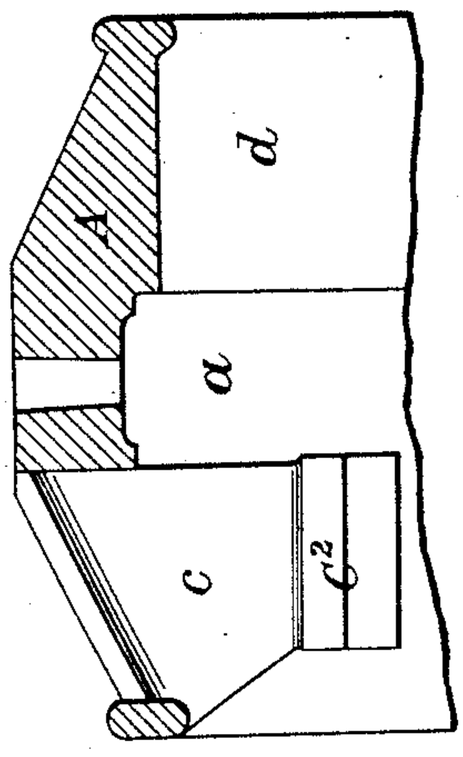


FIG. 3.



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(No Model.) 4 Sheets—Sheet 2.

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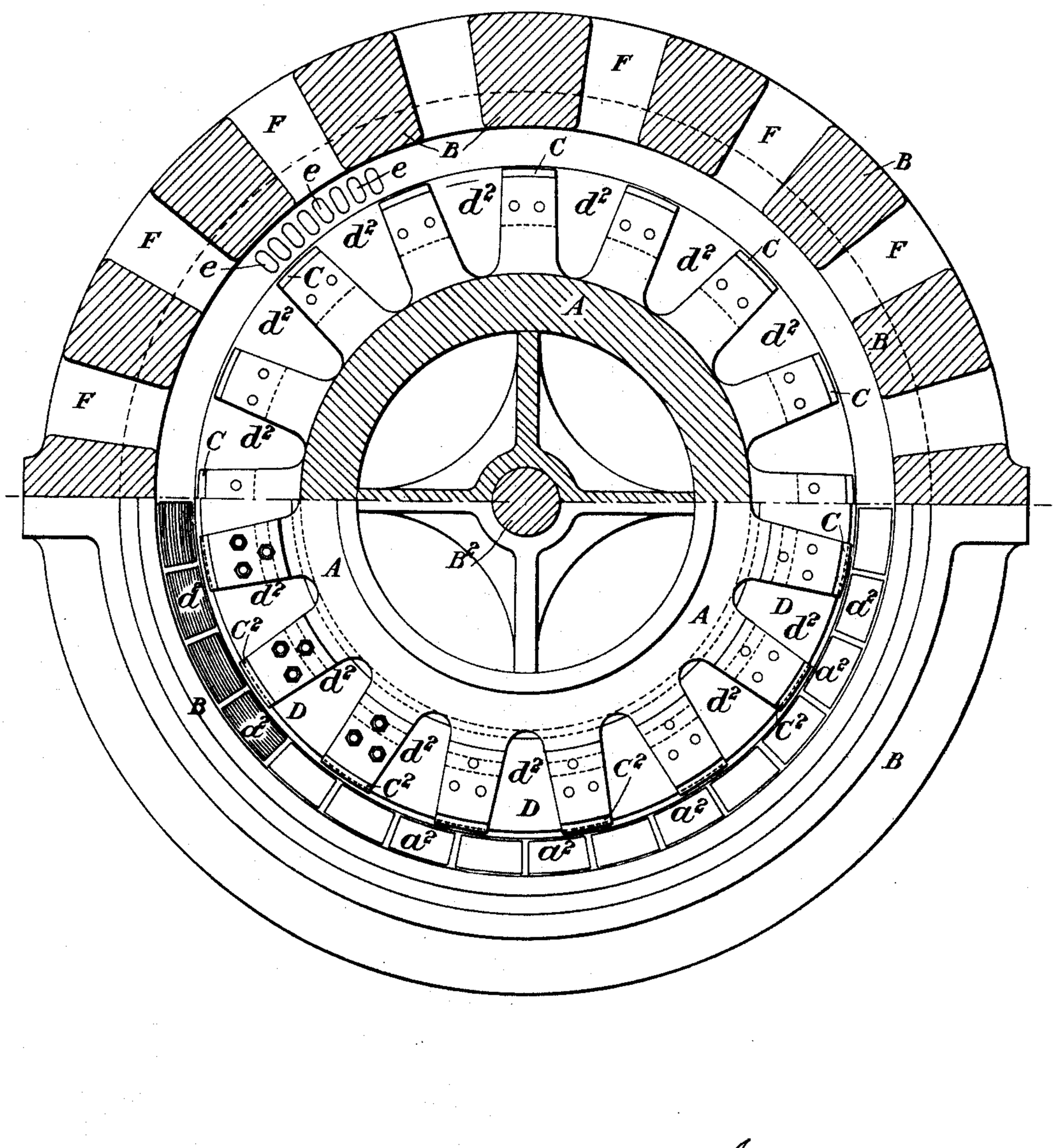
DYNAMO ELECTRIC MACHINE.

No. 587,573. Patented Aug. 3, 1897.

FIG. 4.



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(No Model.) 4 Sheets—Sheet 3.

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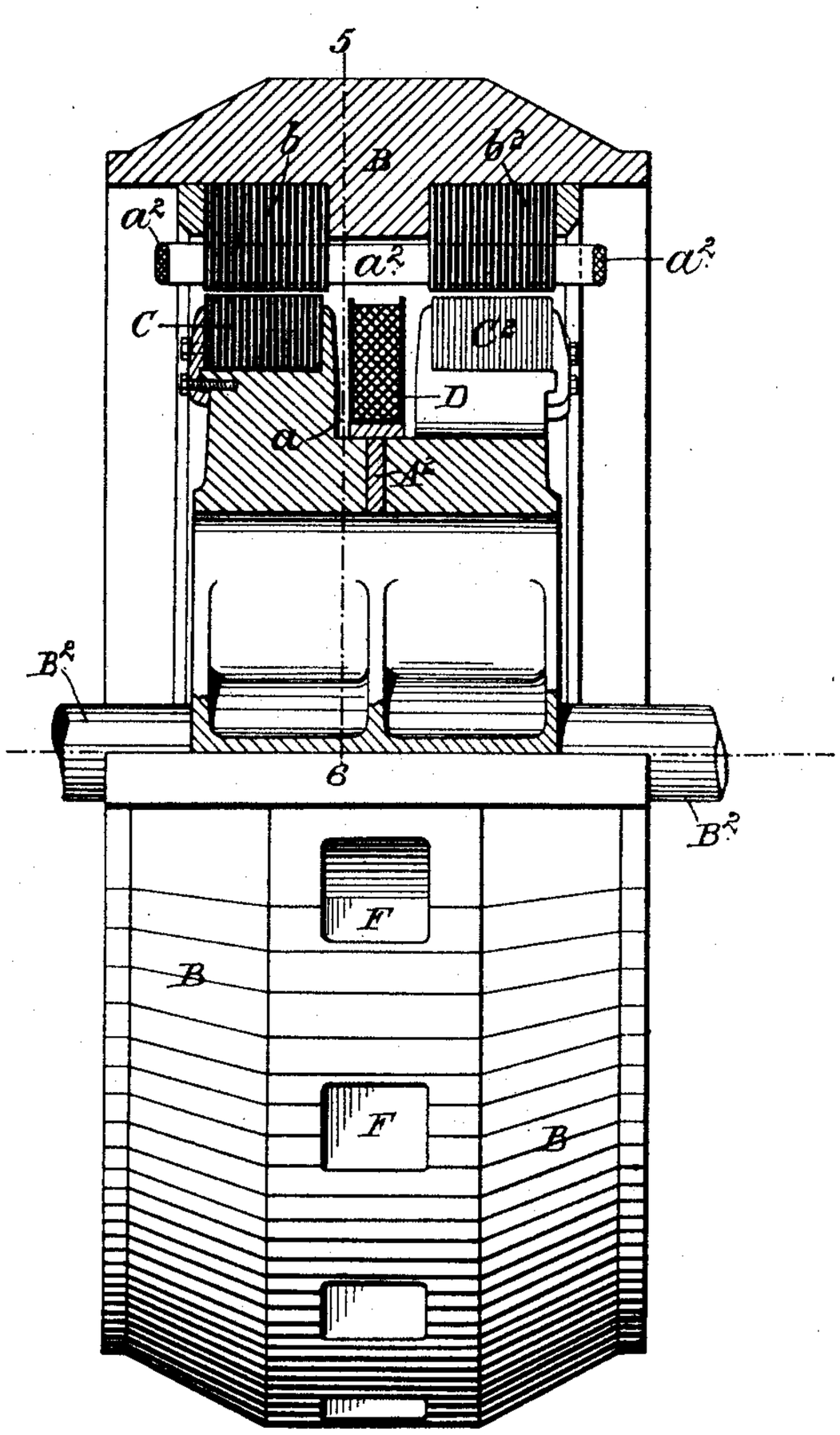
DYNAMO ELECTRIC MACHINE.

No. 587,573. Patented Aug. 3, 1897.

FIG. 5.



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4 Sheets—Sheet 4.

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DYNAMO ELECTRIC MACHINE.

No. 587,573. Patented Aug. 3, 1897.

FIG. 6.

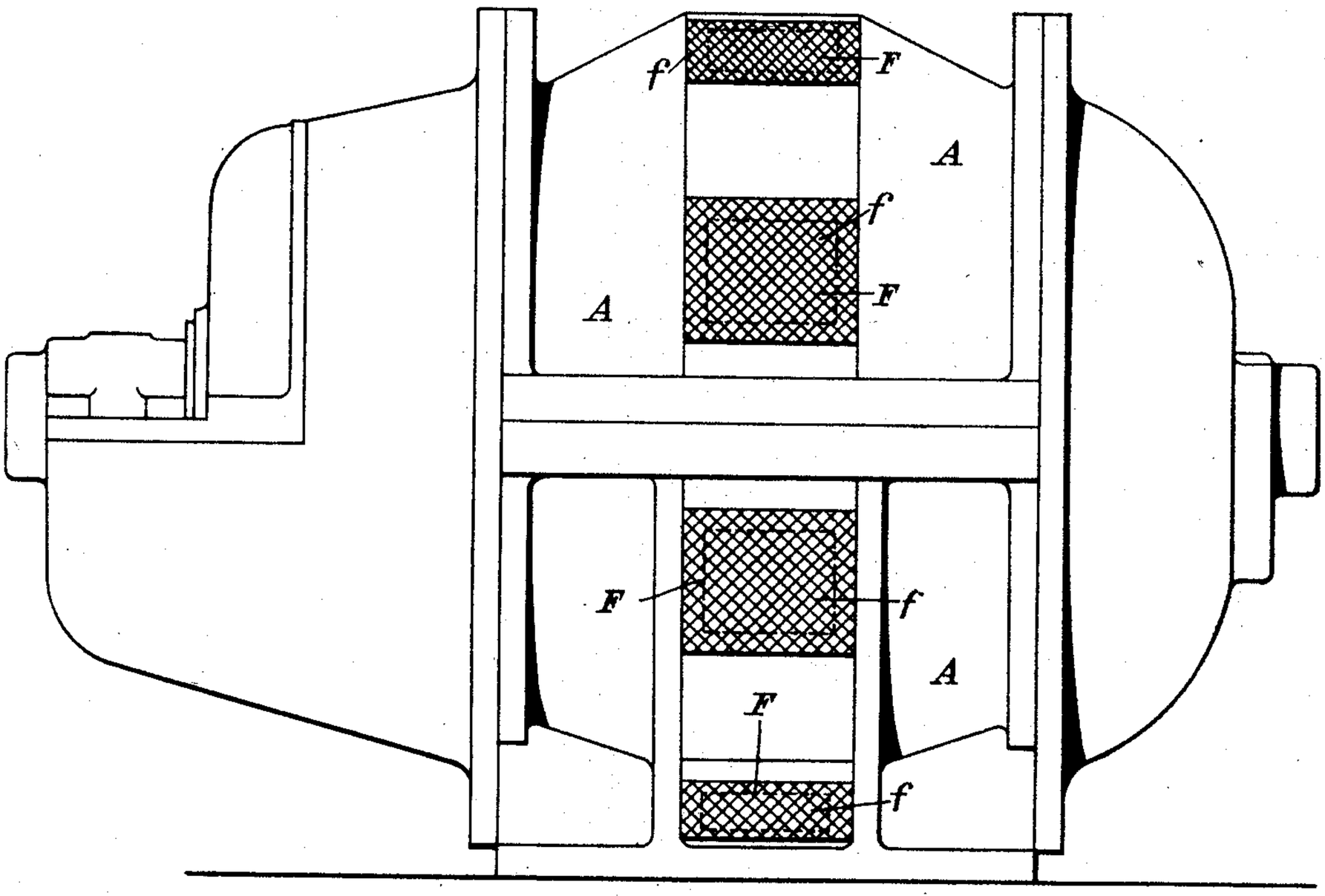
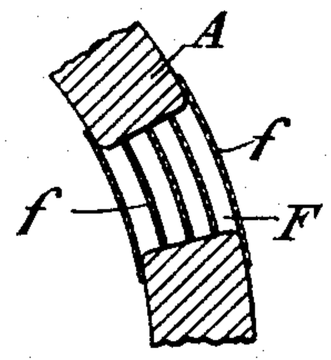


FIG. 7.



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his attorneys.

UNITED STATES PATENT OFFICE

VALERE A. FYNN, OF ERITH, ENGLAND.

DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 587,573, dated August 3, 1897.

Application filed August 3, 1896. Serial No. 601,489. (No model.) Patented in England December 20, 1895, No. 24,472.

To all whom it may concern:

Be it known that I, VALERE ALFRED FYNN, electrician to Messrs. Easton, Anderson and Goolden, Limited, of Erith Iron Works, Erith, in the county of Kent, England, a subject of the Queen of Great Britain and Ireland, residing at Bexley Road, Erith aforesaid, have invented certain Improvements in Dynamo-Electric Machines, of which the following is a specification, and for which British Patent No. 24,472, dated December 20, 1895, has been obtained.

This invention has for its object to provide dynamo-electric machines (whether alternating or direct current generators or motors,) which are economical in construction and efficient in action, cool running being insured; and it relates particularly to dynamos of the type wherein the flux varies in the laminated part of the armature-sections on either side of the exciting-coil from zero to a maximum and falls again to zero, but does not reverse its direction at any time during the operation of the machine in the same section of the armature. For this purpose the field, which is preferably stationary, (though a revolving field may be employed,) is not arranged with its alternating pole-pieces all in one plane transverse to the axis of the armature, but the pole-pieces are set so that they are alternately in different planes, the necessary space between them being provided lengthwise of the armature. The series of pole-pieces in one plane are arranged opposite the gaps between the pole-pieces of the series in the adjacent plane. The pole-pieces may be in any suitable number in each series, and any number of series may be used side by side. A single coil wound on a circular former is used for exciting. In case the field has three or four or more series of pole-pieces two or three or more exciting-coils may be employed. The pole-pieces may be laminated. All the legs or projections on the one side of the exciting-coil are, say, north poles, and all those on the other side are south poles. The disposition enables all or any desired number of the wires or conductors on the armature to be simultaneously exposed to the direct action of the poles. In a four-pole machine, for instance, each pole will span ninety degrees, or thereabout, of the armature-circumference. The neutral line can be thus made absolutely definite at "no load," and as soon as a lead is given to the brushes they can be made to come under the edge of the next pole, which then acts as a reversing-pole, and thus the lead necessary is greatly reduced.

The body of the armature may be composed of a solid block of forged iron, cast-steel, or cast-iron, or like metal, although laminations or plates may be employed therefor, if desired, the diameters thereof being uniform or not. The body is provided with a "collar" or equivalent stops on either side of the mid portion corresponding to the exciting-coil of the field, and on each end of the body outside this mid portion are slipped a number of laminated iron annular disks or rings to an extent or width corresponding to the poles of the field. The outer diameter of these disks or rings is larger than the outer diameter of the collar or equivalent stops. These annular disks or rings are preferably slotted to receive the armature-winding, but the winding can be carried on the plain edges of the disks or rings or through holes therein.

The winding (which can be of any known or suitable kind, such as a drum or a Gramme winding, for instance) can be done in the same way as on an ordinary machine. Except the end connections all the wires or conductors constituting the winding run parallel to the axis through the air-space at the mid portion of the armature-body and over or through the slots or holes in the laminated annular disks or rings on each side thereof. Thus the wires or conductors between the two sets of laminated disks or rings of the armature are exposed to the air and act as a sort of fan. The action as a fan may be increased by projections from the armature body or collar in the space between the sets of laminated disks or rings.

It is important when using fields of the above description to reduce the air-gap to the minimum, but a certain amount of resistance is necessary in the magnetic circuit. This necessary resistance in the magnetic circuit is placed in a machine constructed according to this invention in some part of the magnetic circuit where no leakage can take place, either in some portion of the field or in the armature itself.

The armature may be fitted with a commutator of the ordinary construction or with a commutator with a vertical "face" to economize space.

When the machine has to be inclosed—as, for instance, for minework—a circular cover carrying the bearings can be applied to each side. To ventilate this machine, though inclosed, openings can be provided in the field-body outward of the exciting-coil, and in order to prevent an explosion, should ignition of gas occur inside the machine, these openings can be partly or wholly filled with fine wire-gauze.

It is of importance that the amount of air inclosed should be as small as possible, and to reduce this amount the gap between the poles on each side of the exciting-coil can be filled with some suitable non-magnetic and light material.

The same general arrangement can be applied to dynamos and motors for single-phase and polyphase alternating currents as well as for continuous-current machines.

In the former case it will be advantageous to construct the machine with a stationary armature (constructed as described for the direct current, omitting the commutator) and a revolving field of the type described. The exciting-coil may either be stationary or it may revolve with the field.

It is obvious that, without departing from the spirit of this invention, the disposition of armature and field may be inverted or otherwise arranged with respect to each other, and also that either the field or the armature, or both, may be rotated, and in any case the exciting coil or coils may be either stationary or may revolve. For instance, an armature constructed with an air-space and two sets of laminated disks or rings on either side of an air-space can be arranged as an annular armature, the field consisting of a revolving body with pole-pieces alternately in different planes transverse to the axis of rotation and with an exciting-coil between the two series of pole-pieces.

I am aware that devices have been patented for inclosing the commutator of such machines as are intended to work in a mine. Explosions, however, may arise from coal-dust, for instance, or other inflammable and conducting substance, producing a short circuit either on the armature or fields, and I therefore inclose the whole of the machine, as above described. The holes filled with gauze will allow sufficient circulation of air to help to cool the machine. The dynamo-electric machines referred to above in this specification and which I am about to describe, more particularly referring to the annexed drawings, belong to a class characterized by the peculiar manner in which the electromotive force is induced.

The magnetic flux varies in the laminated part of the armature-sections on either side of the exciting-spool from zero to maximum and falls again to zero, but does not reverse its direction at any time during the operation of the machine in the same section of the armature unless, of course, the direction of exciting-current be accidentally or purposely reversed. When the dynamos are constructed with two such armature-sections, (as will generally be the case and as is also illustrated here,) then the flux passes these two sections, of course in opposite directions, but each separate section always in the same direction.

In the dynamo constructed according to my invention, although the current reverses its direction as well as varies its intensity in the coils wound on laminated sections of the armature, the magnetic flux through portions (exposed to the influence of the poles as these revolve) of the laminated parts or sections varies in intensity, but does not reverse its direction through such parts or sections. The object is to avoid reversal of direction of magnetic flux in those laminations and only to allow the lines to pulsate or vary with time their total number through portions of those laminations, thus exposing the latter to exactly half a magnetic cycle, and consequently reducing the iron losses to half the amount that would otherwise occur.

It will be seen that the armature is divided into two distinct sets of laminations at either side of the exciting-spool, one set being exposed to the action of, say, a number of north poles and the other set being exposed to the action of a number of south poles. It will be seen that the magnetic flux, as explained above, varies its intensity with time in portions of each of these sections, but does not reverse its direction in each section—that is, does not in each section go through a complete magnetic cycle, but it passes the sets or sections in opposite directions—and as the spools are wound through both sets of laminations the flux will pass through the same portions of the spools in the same direction. Considering, however, the total effect, the flux will only vary its intensity in each set of laminations, whereas it will vary its intensity and also reverse its direction in the spools, which are so wound as to embrace both sets of laminations.

Figure 1 of the accompanying drawings represents, partly in end elevation and partly in transverse section, a four-pole continuous-current dynamo-electric machine made according to this invention, the exciting-coil being omitted for the sake of clearness. Fig. 2 shows the same machine partly in side elevation and partly in longitudinal section, the section being taken on the line 1 2, Fig. 1; and Fig. 3 is a longitudinal section on the line 3 4, Fig. 1. Fig. 4 represents, partly in end elevation and partly in transverse section on the line 5 6, Fig. 5, an alternate-current machine constructed according to this invention with a stationary armature and a rotary field. Fig. 5 is a part side elevation and part longitudinal section of the same.

Fig. 6 shows in side elevation a direct-current machine suitable for use in mines and like places, it being provided with ventilating-openings covered with and containing wire-gauze. Fig. 7 is a section through one of the ventilating-openings, showing the wire-gauze therein.

Referring to Figs. 1, 2, and 3, A represents the body of the stationary field-magnet of a direct-current machine, and B the rotary armature. The field has four poles C C^2, arranged in pairs in different planes transverse to the axis of the armature, a space *a* being provided between the two pairs of poles C and C^2 lengthwise of the armature, in which space is arranged an exciting-coil D. In each pole C C^2 is a gap *c* to prevent a cross-field being formed by the current circulating through the armature-conductors and tending to demagnetize the poles C C^2. Each pole extends to about ninety degrees of the circumference of the armature, leaving the spaces *d* between the poles in each plane. This arrangement of the poles C C^2 enables any desired number of the wires or conductors on the armature to be simultaneously presented to the direct action of the poles, and the neutral line can be made absolutely definite at "no load," and as soon as a lead is given to the brushes they can be caused to enter beneath the edge of the next pole, which then acts as a reversing-pole and reduces the lead.

The body of the armature may be composed of a solid block of metal, but it is preferable to construct it, as shown, of laminations or plates *b*, reaching down to the shaft B^2 of the armature, a collar B^3 being formed on or fixed to the shaft, which collar separates the two parts of the armature, coinciding, respectively, with the two pairs of poles C and C^2, gun-metal disks E being interposed between the sides of the collar B^3 and the two sets of laminated plates *b* to form an additional resistance in the magnetic circuit of the machine.

The collar B^3 may, if desired, be built up of laminated disks. The plates *b* are of greater diameter than the collar B^3 and have in their peripheries notches, or holes near their peripheries, to receive the windings a^2 of wire, which windings cross the space between the two sets of laminated plates *b*, as shown in Fig. 2, the portions of the windings in the said space being exposed to air and act as the vanes or blades of a fan to distribute the air inside the machine.

In the body of the field-magnet ventilating-holes F are provided, through which air can circulate to keep the machine cool.

If the armature be provided with a commutator, it will yield direct current, or if provided with slip-rings it will deliver monophase or polyphase alternate currents, according to the manner of winding and connecting.

When the machine is required for use in mines, it is necessary to close the ends in casings and to cover the ventilating-openings F in the body of the field-magnet with wire-gauze and also to place in the said ventilating-openings wire-gauze, as shown at *f* in Figs. 6 and 7, to prevent explosions.

Referring to Figs. 4 and 5, A is a rotary field and B a stationary armature of an alternate-current machine. The body part of the armature B is a solid casting with ventilating-openings F therein and provided with laminated parts *b* b^2 directly exposed to the action of the poles C and C^2 of the field, an exciting-coil D being arranged in the space *a* between the said two sets of poles C C^2. The poles C C^2 may be solid or built up of laminated plates, as shown, air gaps or openings d^2 being provided between each two adjacent pole-pieces of each set and the pole-pieces of one set being arranged opposite the gaps or openings between the pole-pieces of the other set.

The windings a^2 of the armature pass through holes *e* or notches in both laminated parts *b* b^2. The field is divided by a brass or like metal plate A^2, forming an additional resistance in the magnetic circuit.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. In a dynamo-electric machine, the combination with an armature, of a field-magnet having its poles arranged alternately in different planes, each pole embracing a section or portion only of the armature lengthwise of its axis, one portion or section of the armature being acted upon by south poles only, and the other by north poles only, so that the magnetic flux through each section of the armature varies its intensity without reversing its direction therein, substantially as described.

2. In a dynamo-electric machine, the combination of an armature composed of two laminated rings or sections, and a field-magnet having its two sets of poles arranged alternately in different planes transversely of the shaft, the poles of the same polarity acting upon the same armature ring or section, substantially as described.

3. In a dynamo-electric machine, the combination of an armature composed of two laminated rings or sections arranged side by side and separated by a collar, and a field-magnet having its two sets of poles arranged alternately in different planes transversely of the shaft, the north poles being in the plane of one of said rings or sections, and the south poles in the plane of the other ring or section, substantially as described.

4. In a dynamo-electric machine, the combination of an armature composed of two rings or sections arranged side by side, a field-magnet having its two sets of poles arranged alternately in different planes, the north poles being in the plane of one of said rings or sections, and the south poles in the plane of the other ring or section, and a single exciting-

coil arranged between the two planes, substantially as described.

5. In a dynamo-electric machine the combination with an armature composed of two rings or sections and a winding whose coils each embraces both rings or sections, of a field-magnet having its two sets of poles arranged alternately in different planes transversely of the shaft, the poles of like polarity acting upon the same armature ring or section.

6. A dynamo-electric machine having the field pole-pieces arranged in different planes, and provided with a gap or gaps, such as formed by plates of gun-metal or brass, interposed in a portion or portions of the field or the armature where no leakage can take place, and forming an additional resistance in the magnetic circuit, substantially as hereinbefore described.

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

VAL. A. FYNN.

Witnesses:
H. D. HOSKINS,
WM. JOHN WEEKS.