

(No Model.)

4 Sheets—Sheet 1.

G. W. FULLER.
DYNAMO ELECTRIC MACHINE.

No. 278,119.

Patented May 22, 1883.

Fig 1
o²

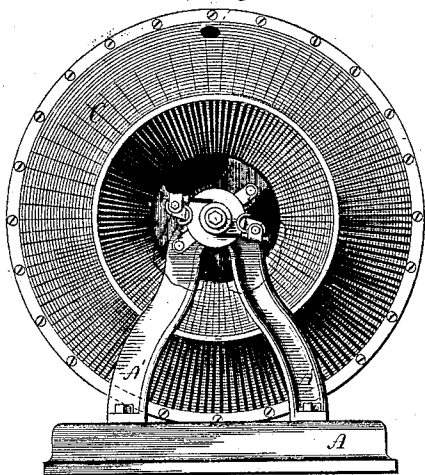


Fig 2.

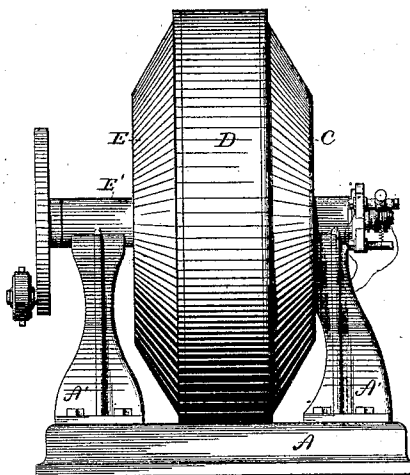


Fig 3

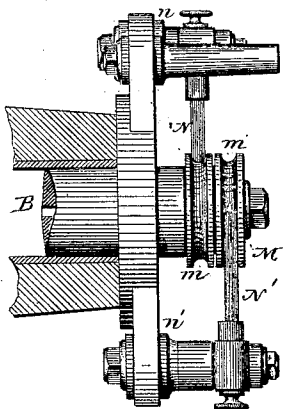


Fig 5

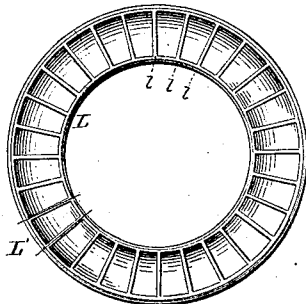


Fig 4

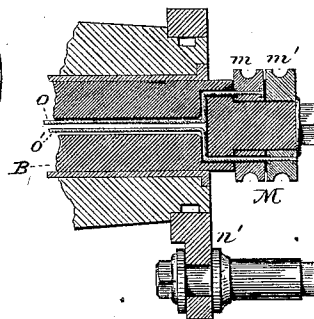
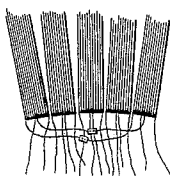


Fig 6



Witnesses
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(No Model.)

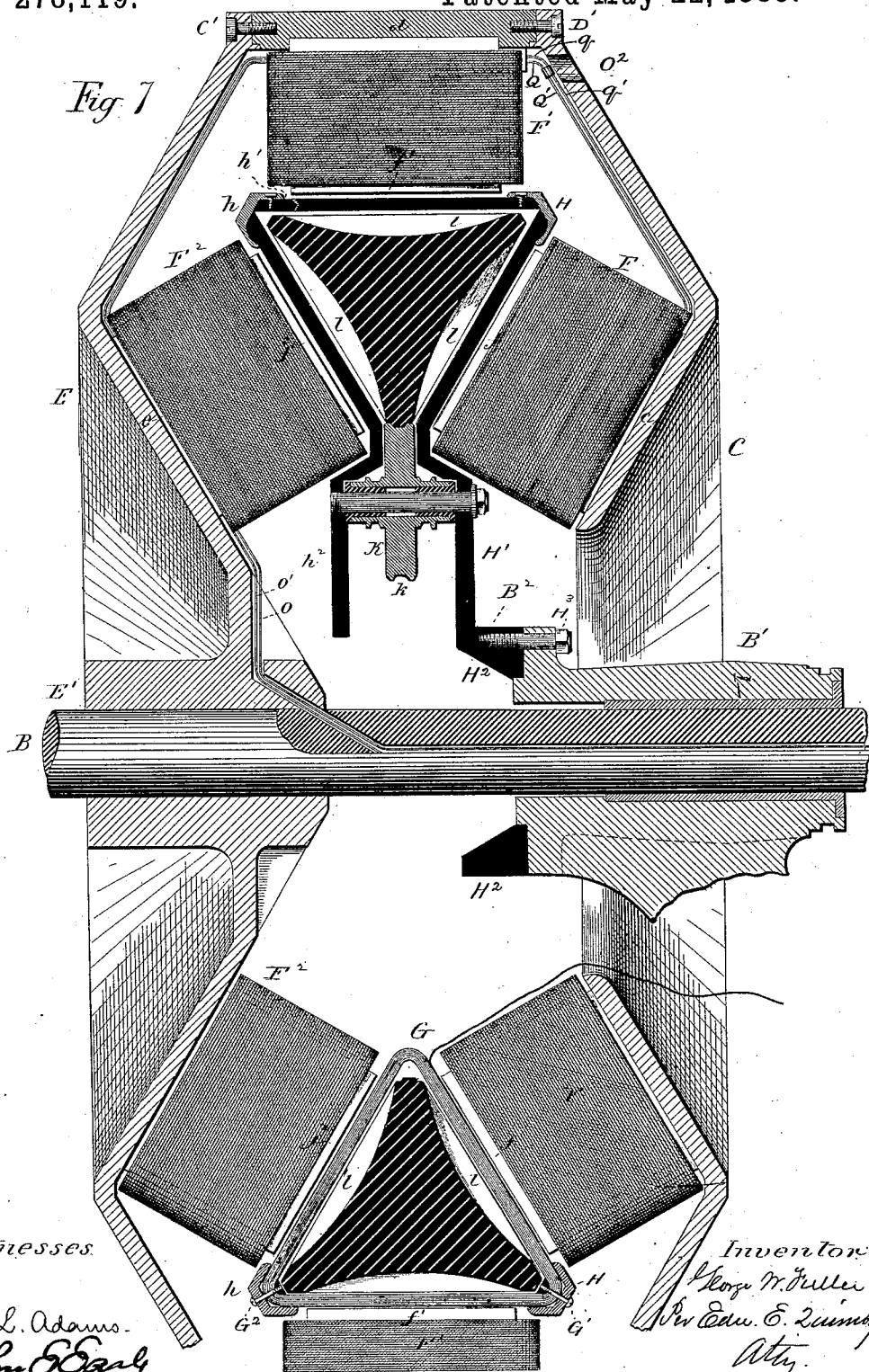
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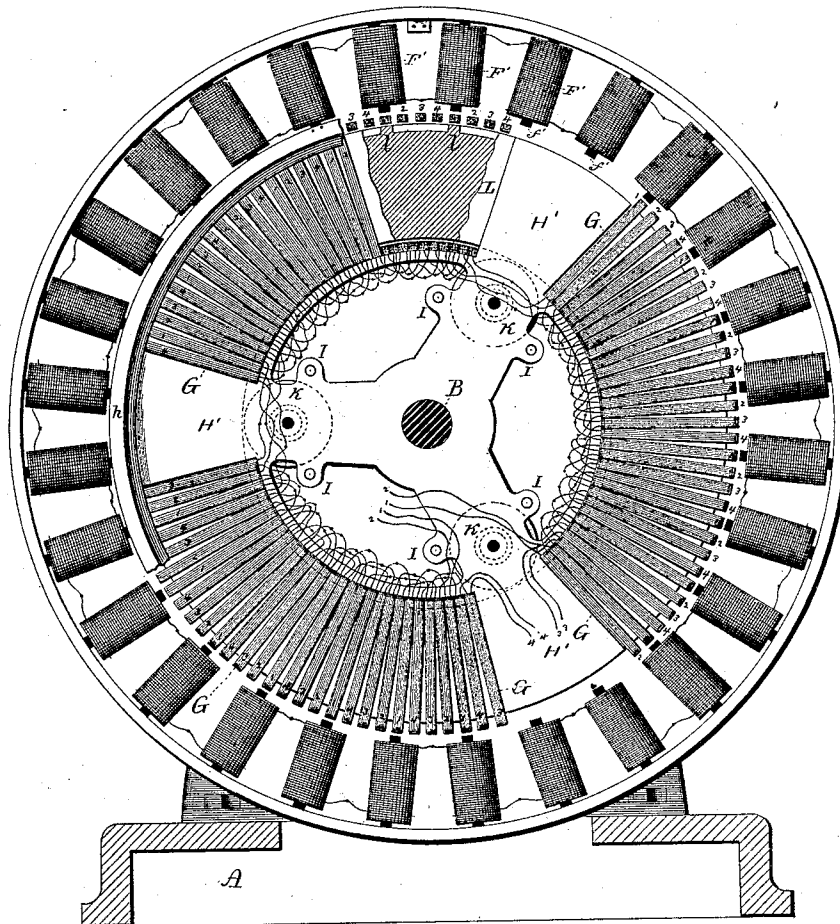
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Fig 8



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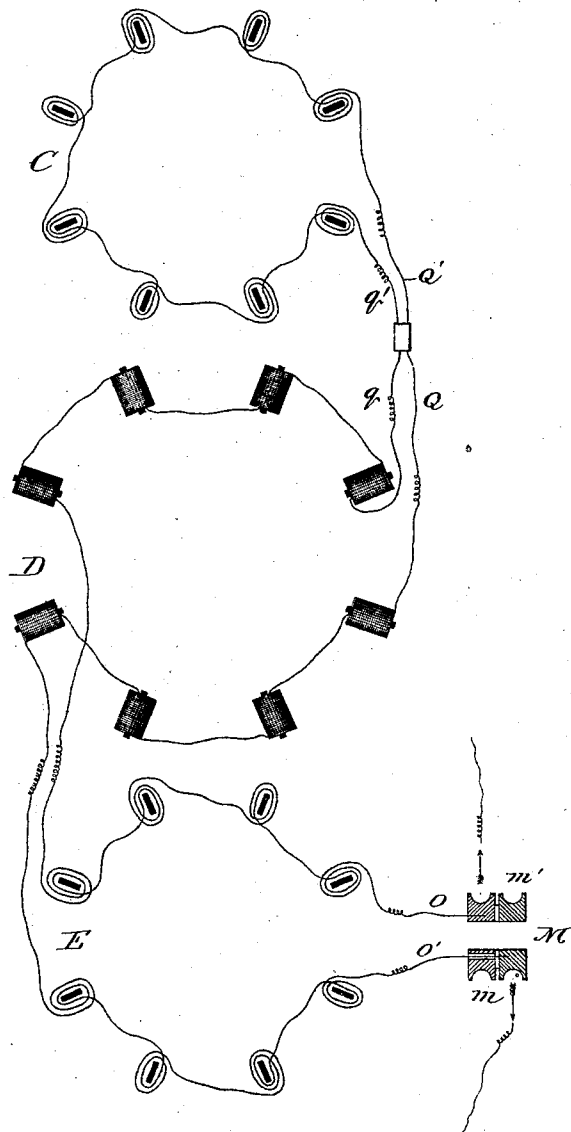
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G. W. FULLER.
DYNAMO ELECTRIC MACHINE.

No. 278,119.

Patented May 22, 1883.

Fig 9



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UNITED STATES PATENT OFFICE.

GEORGE W. FULLER, OF NORWICH, CONNECTICUT.

DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 278,119, dated May 22, 1883.

Application filed February 19, 1883. (No model.)

To all whom it may concern:

Be it known that I, GEORGE W. FULLER, of Norwich, Connecticut, have invented a certain Improvement in Dynamo-Electric Machines, of which the following is a specification.

My improvements are designed to increase the steadiness of operation and to add to the efficiency of dynamo-electric machines having annular armatures. I increase the steadiness of operation by rotating the field-magnets, and I add to the efficiency of the machine by making the armature-core independent of the coils which surround it, and keeping all parts of the armature-core in unchanged polar relations to the field-magnets. The field-magnets, by reason of their mass, serve, when in rotation, the mechanical purpose of a balance-wheel. Their momentum renders the machine less sensitive in responding to sudden changes in the energy of the force which drives it, or to sudden variations in the resistance of the working-circuit. The unchanging positions of the poles in the armature-core give time during the continued operation of the machine for the highest possible magnetization of the core, which, by concentrating the magnetic lines of force and intensifying the magnetic field or fields, adds to the energy of the electrical pulsations generated during the bisection of the lines of force by the armature-coils. This bisection, according to my invention, may be brought about either by rotating the armature-coils while holding the field-magnets and the armature-core stationary, or by rotating the field-magnets and the armature-core in one direction while rotating the armature-coils in the opposite direction, or by holding the armature-coils stationary while the field-magnets and armature-core are rotated, which latter method of operation is that which I have selected for the purposes of the present illustration of my invention.

My improvements are capable of embodiment in alternating-current machines, or in machines generating currents of constant polarity, in machines in which the armature-core loosely surrounded by the armature-coils is rotated by the magnetic attraction of rotating field-magnets, and in machines in which the armature-core is rotated by directly-applied mechanical power.

In the modification of my invention which

is herein especially described, the field-magnets are peculiarly arranged and the armature-core is rotated by magnetic force. In view, however, of the inclusion in the present case of certain generic claims, I have designated it "Case A." It describes the application of my invention to an alternating-current machine in which the armature-core is an annulus substantially triangular in cross-section, with shallow recesses extending across its periphery and its inwardly-beveled sides, whereby are formed a series of polar prominences corresponding in number and relative positions with the number and relative positions of three rotating circles of field-magnets. The armature-coils wound in triangular shape to conform to the shape of the core in cross-section, are arranged radially in conveniently-close proximity to each other, and are stationary. Gaps of sufficient width are left in the circle of stationary armature-coils to permit the bearing of the annular core upon interiorly-placed friction-rollers, by means of which the annular core is supported concentrically with relation to the axis of the rotating magnets. Three series of field-magnets the coils of which are connected in the same circuit are arranged in circles in parallel planes, with their axes respectively perpendicular to the periphery and to the two beveled sides of the annular core. The field-magnets are affixed to the interior of a suitably-formed cylinder, mounted upon and affixed to a revolving shaft provided at one end with a pulley, or preferably a crank, to which power is applied, and carrying at its opposite end a contact-maker of two parts, which are respectively connected with the ends of the field-circuit, and make contacts, respectively, with brushes connected with an outside machine by which the field is charged. It will be seen that the field-magnets are arranged radially in groups of three. Their coils are so wound and so connected that the poles of the magnets composing each group are of like polarity to each other, but are of opposite polarity to the poles of the next adjoining group on either side. The armature-core, being free to move, is, by reason of its polar prominences, dragged around by magnetic attraction as the field-magnets revolve. By the rotation of the field there is excited in each of the stationary armature-coils a succession of electrical im-

pulses alternating in polarity, and each of the stationary armature-coils may, if desired, be employed to supply an outside circuit with an alternating current; or variable numbers of stationary coils, which are subjected to the same electrical conditions at the same time, may be connected together in series and made to cumulatively supply an outside circuit. The field-magnets and rotating shell to which they are attached constitute a structure of such massiveness that it serves the purpose of a balance-wheel, which by its own momentum greatly promotes the steadiness of the machine, and hence the induction in the armature-coils of currents of uniform strength. By reason of the weight of the rotating structure the shaft may receive its motion directly from a steam-cylinder, or the machine may be affixed to the crank-shaft of an engine, and thus all intermediate shafting, belting, or gearing may be dispensed with. During the operation of the machine the magnetic attraction exerted upon all parts of the armature-core tends to centralize and sustain it, and as the core is free to move, I have, as a matter of convenience, adopted for it the designation "floating core." If the armature-core should be so fastened as to prevent its movement, the rotation of the field-magnets would cause it to become heated. By permitting it to move in obedience to the magnetic forces to which it is subjected, the machine may be rotated at a high speed without heating the armature-core.

The accompanying drawings, illustrating my invention as embodied in a dynamo-electric machine of the kind described, are as follows:

Figure 1 is a front elevation. Fig. 2 is a side elevation. Fig. 3 is a side elevation, upon an enlarged scale, of the contact-maker and contiguous parts. Fig. 4 is an axial section of the contact-maker and the end of the shaft upon which the contact-maker is mounted, and contiguous portions of the bearing of the shaft, showing the method of effecting the electrical connection with the free ends of the circuit, which includes the rotating field-magnets. Fig. 5 is a side elevation of the annular floating core. Fig. 6 represents a portion of five stationary coils, showing the method of connecting them when they are each composed of a double system of coils. Fig. 7 is an axial section of the machine, showing the method of constructing the revolving shell which supports the field-magnets, and the method of supporting the floating armature and the inner frame to which the stationary coils are affixed. Fig. 8 is a front elevation, partly in section, of the interior of the machine, with one side of the revolving shell and the circle of field-magnets supported thereon removed. Fig. 9 is a diagram displaying the three circles of field-magnets in the same plane, for the purpose of illustrating a method of appropriately connecting their coils in a single circuit.

The machine is supported upon a substan-

tial base, A, to which are bolted the standards A', at the top of which the shaft B of the machine has its bearings.

The rotating shell which carries the field-magnets is composed of three principal parts, viz: the corrugated annular plate C, the short cylinder D, and the annularly-corrugated disk E, provided with a hub, E', which is keyed to the shaft B. The outer edges of the plate C and the disk E are secured, respectively, to the opposite ends of the short cylinder D by means of the screws C' and D'. It will be seen that in cross-section the relative angles of the inner faces *c*, *d*, and *e* of the shell, to which the three circles of field-magnets F, F', and F² are respectively affixed, are those of the sides of an equilateral triangle. The field-magnets are concentrically arranged in equidistant groups of three, the members of each group occupying the same radial plane.

The armature-coils G, which are stationary, and are wound in the form of triangles, are concentrically arranged flatwise in radial planes in three groups, as shown in Fig. 8. The three sides of each stationary coil occupy the most intense parts of the magnetic field—that is, the parts immediately adjoining the paths of movement of the poles *f*, *f'*, *f*² of the rotating field-magnets. The stationary coils are supported in position by means of the screw-clamps G' G², which confine the outer corners of the coils to the rings H and *h*, respectively, of the stationary armature-frame composed of the three radial arms H' H' H', the outer portions of which occupy the spaces between the three groups of stationary coils. The radial arms H' are united to a central hub, H², which is secured by means of the screws H³ to the inner end of the front journal-box, B', of the shaft B. The ring H is secured to the outer edges of the arms H', and the ring *h* is partially supported in position by being screwed to the rear ends of the three suitably-curved plates *h'*, the front ends of which are secured to the ring H or to the outer ends of the arms H', respectively. Three arms, *h*², extend radially inward from the ring *h* at the three points immediately opposite the arms H', to which the arms *h*² are secured by means of suitably shouldered bolts inserted through the ears I, formed on the sides of the arms H', respectively, and corresponding ears formed on the arms *h*². The shape in cross-section of the arms H' and *h*² is exhibited in Fig. 7, from which it will be seen that the bends in them are such as to afford clearance on either side for the inner circles of rotating field-magnets F and F². The arms H' and *h*² afford the bearings for the friction-rollers K K K, the peripheries of which are provided, respectively, with the grooves *k*, for engaging the inner edge of the floating core L, which is an annulus, substantially triangular in cross-section, made with a removable sector, L', to permit the core L, in the process of constructing the machine, to be inserted through the triangular armature-coils

G, by which the core is segmentally inclosed. The three faces of the core L are transversely recessed to form the equidistant polar prominences *l*, which correspond in number and relative positions with the number and relative positions of the poles of the field-magnets.

On reference to Fig. 8 it will be seen that the armature-coils G of each group are symmetrically placed, so that when one coil is interposed between the three poles of one group of field-magnets another coil is at the same time interposed between the three poles of the next adjoining group of field-magnets, and so on. The spaces between the members of each group of field-magnets constitute a series of radially-related magnetic fields, having an orbital motion by virtue of the rotation around a common center of the magnets by which the fields are excited. The field-magnets are so wound and connected that each field is of the opposite polarity from the field which adjoins it on either side. The polar prominences upon the faces of the floating core, by reason of their closer proximity to the poles of the field-magnets, are more forcibly attracted than the recessed parts of the core, the result of which is that the core is dragged around by the magnetic attraction of the field-magnets and the parts of the core where the polar prominences are situated are polarized by induction, and retain their respective polarities without change during the operation of the machine. By this organization of the machine the stationary armature-coils are successively subjected to the action of magnetic fields, alternating in polarity, and a single coil may be employed to supply an outside circuit with an alternating current, or variable numbers of coils may be connected together and made to act cumulatively in supplying the same outside circuit. Thus, for example, four independent outside circuits may be supplied with alternating currents by the mode of connecting the stationary coils shown in Fig. 8, in which the four circuits and the systems of coils embraced in each circuit are indicated, respectively, by the Figs. 1, 2, 3, and 4. In this case each circuit includes a series of twenty-two coils, and the connections are made by joining the first convolution of one coil to the first convolution of the next preceding coil of its series, and its last convolution to the last convolution of the next following coil of its series, the first convolution of the last-mentioned coil being joined to the first convolution of the next following coil of the series, and so on. The relatively-opposite polarities of the adjoining fields render this mode of connection necessary in order that simultaneous electrical impulses induced in opposite directions in adjoining coils of the series may be made to flow cumulatively into the outside circuit which the series supplies.

It will be obvious that eight independent circuits might be established by connecting together every other coil of each of the de-

scribed series, in which case the last convolution of each coil would require to be joined to the first convolution of the next coil in its series, and so on, the principle governing the mode of connecting the coils in the last case being the reverse of that previously described, because the several coils included in each of the said eight circuits would be simultaneously acted upon by fields of like polarity.

The stationary coils G, instead of being formed of one continuous wire, may be composed of two independent wires wound in similarly-shaped convolutions, and superposed, as indicated in Fig. 6, which shows one method of connecting systems of double coils. This modification doubles the number of independent coils, and correspondingly increases the number of possible independent circuits which the machine is capable of supplying with alternating currents. The field-magnets which are connected in series in a single circuit are excited by a current from an outside source, transmitted by means of the contact-maker M, composed of the two insulated disks *m* and *m'*, carried upon the shaft B. These disks have their peripheries grooved, to respectively receive the brushes N N', supported upon the arms *n n'*, with which the wires of the outside circuit are respectively connected.

The ends of the field-circuit wires O and O' are connected, respectively, with the contact-disks *m* and *m'*, as shown in Fig. 4, and are carried through a hole extending longitudinally partly through the center of the shaft B, thence outwardly through one side of the shaft, and through the hub E' to the field-magnets in the interior of the machine, as shown in Fig. 7. In joining the coils of either of the circles of field-magnets the connections must be so made that the exciting-current will flow in one direction through the coil of one magnet and in the opposite direction through the coil of the next adjoining magnet in the circle, and so on, as is well understood by those who are familiar with dynamo-electric machines.

As has already been observed, the several circles of field-magnets must be so connected that the magnets of each group will present poles of like polarity to each other, but of opposite polarity to that of the adjoining groups on either side. The connection between the rear circle of field-magnets supported upon the disk E and the middle or outer circle of magnets supported upon the cylinder D, and the connection with the wires leading to the contact-maker, can easily be made before the annular plate C is secured in position. To effect the connection with the front circle of field-magnets supported upon the annular plate C, an aperture, O², is provided in the edge of the plate C, or at any other convenient point through or near which the ends Q q of the wires leading from the middle circle of magnets are led, so that they can be appropriately coupled to the ends Q' q' of the wires leading

from the front circle of field-magnets after the plate C is affixed in place.

A mode of connecting the field-magnets is illustrated in Fig. 9, which is a diagram representing as projected on the same plane the three series of field-magnets, which in the machine are arranged in circles in parallel vertical planes. It is not deemed necessary to show the entire number of magnets contained in each circle, inasmuch as eight—the number shown—suffices to illustrate the mode of connection. The coils of each series of field-magnets are connected together in the same way as the stationary coils of a series are connected together—that is, by joining the first convolution of one coil to the first convolution of the next preceding coil of its series and its last convolution to the last convolution of the next following coil of its series, the first convolution of the last-mentioned coil being joined to the first convolution of the next following coil, and so on.

In the diagram the three parts C D E of the rotating shell upon which the field-magnets are supported are not represented, and the letters C D E appearing upon the diagram serve merely to indicate the circle of field-magnets which the three parts of the rotating shell respectively support.

The shell carrying the field-magnets may be rotated by means of a belt acting upon a pulley affixed to the shaft B; or a crank may be fixed on the rear end of the shaft B for engagement by the pitman of a steam-engine by which the machine may be driven.

In the present machine the floating armature-core is an annulus, and the stationary armature-coils surround it segmentally.

My invention of the floating armature-core is also applicable to armatures of cylindrical form which are traversed exteriorly by the armature-coils. This mode of applying my invention I intend to make the subject of specific claim in another application for patent.

I claim as my invention—

1. In a dynamo-electric machine, the combination of the external system of annularly-arranged field-magnets with armature-coils the convolutions of which loosely surround an annular core of magnetic material which passes through all the armature-coils, and all the parts of which core sustain unchanging polar relations to the field-magnets, substantially as and for the purpose set forth.

2. The combination, in a dynamo-electric machine, of armature-coils with rotating field-

magnets, and an armature-core capable of rotation independently of the said armature-coils, as and for the purpose set forth.

3. The combination, in a dynamo-electric machine, of systems of rotating field-magnets and stationary armature-coils with an annular armature-core adapted to rotate independently of the coils which surround it, and having formed upon its face or faces transverse polar prominences, substantially as and for the purpose set forth.

4. In an alternating-current dynamo-electric machine, three systems of field-magnets supported, respectively, in three circles upon the interior of a rotating shell, and forming a series of radially-arranged groups, each composed of three magnets, the three magnets of each group being of like polarity to each other, but of opposite polarity to that of the adjoining groups, and presenting their poles in close proximity to and parallel with the three sides, respectively, of triangular coils transversely surrounding an endless bar or annular core, and supported upon a stationary frame, and connected with one or more operative circuits, in combination with contact-makers and brushes electrically connected with the coils of the field-magnets for conducting a current from an outside source to excite the field-magnets.

5. In combination with the described systems of rotating field-magnets and stationary armature-coils, an annular armature-core supported or suspended as to be free to rotate, and having formed upon its faces transverse polar prominences, as and for the purpose set forth.

6. In combination with parallel systems of rotating field-magnets, and with stationary armature-coils, the floating armature-core supported upon and centralized by the interiorly-placed friction-rollers K K K, journaled in the stationary armature-frame suitably connected to and held in position by the front standard, A', of the machine, as and for the purpose set forth.

7. The stationary armature-coils G, affixed to the rings H and h of the stationary armature-frame secured to or forming a part of the central hub, H², as and for the purpose set forth.

GEO. W. FULLER.

Witnesses:

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J. H. SHUMWAY.