(No Model.)

2 Sheets—Sheet 1.

W. L. VOELKER.

DYNAMO ELECTRIC MACHINE AND MOTOR.

No. 335,326. Patented Feb. 2, 1886.

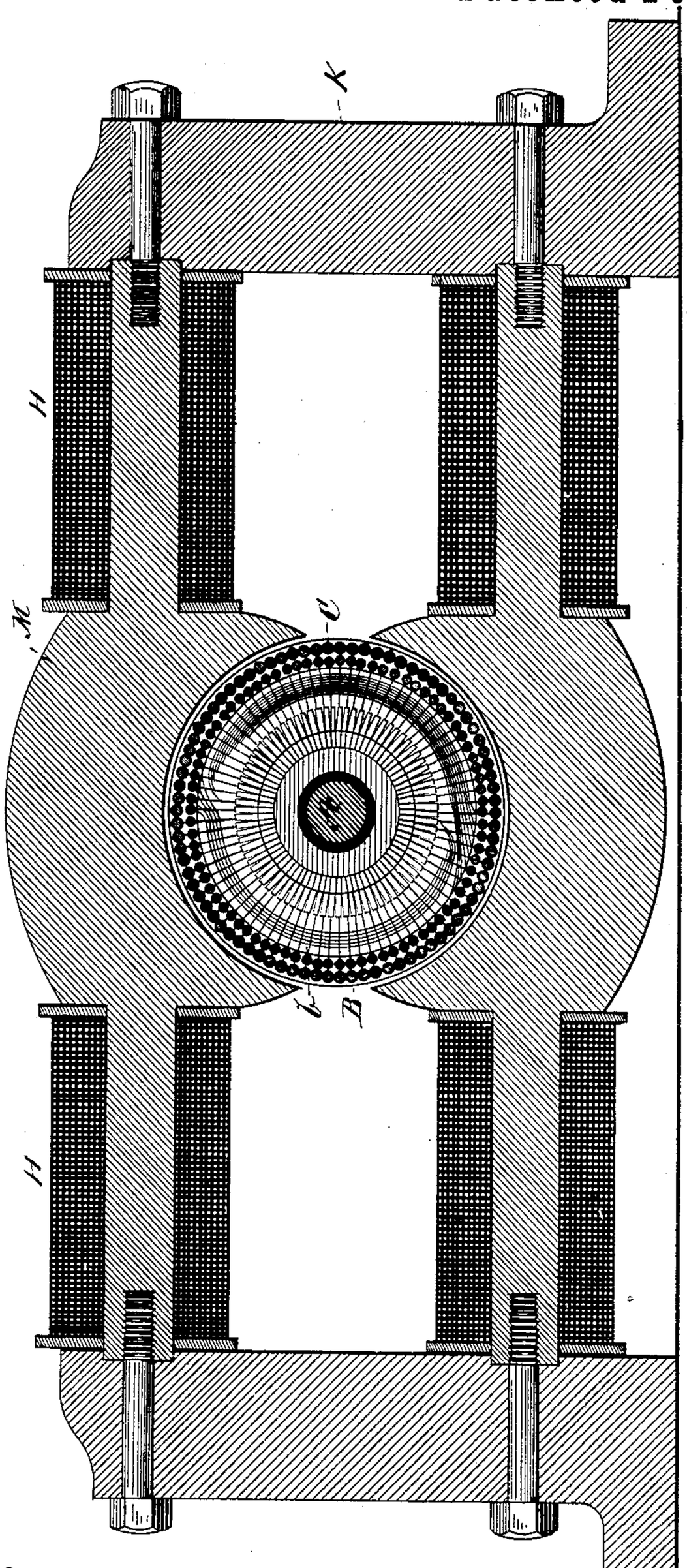

Fig. 1.

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 2.

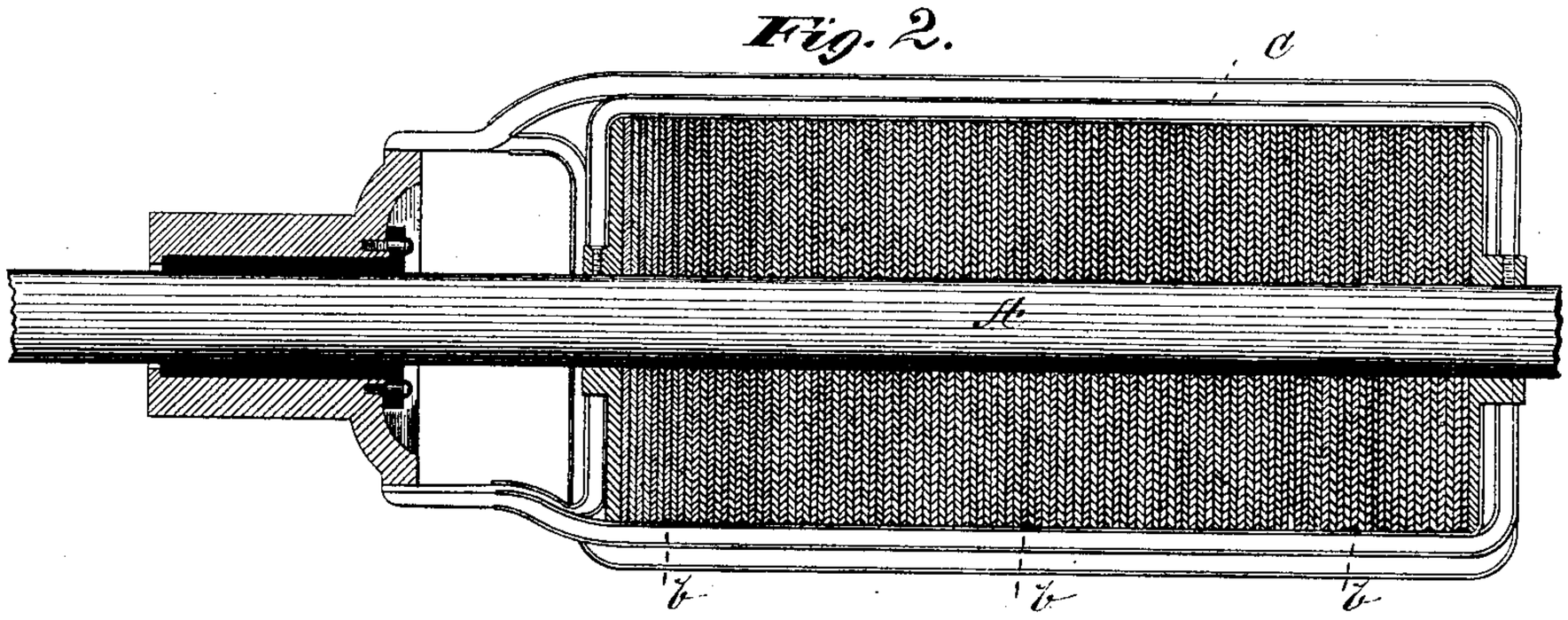

Fig. 3.

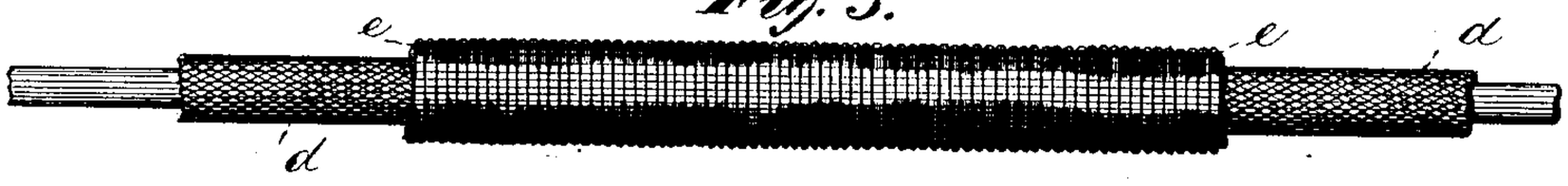

Fig. 4.

Fig. 5.

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UNITED STATES PATENT OFFICE.

WILLIAM L. VOELKER, OF MORTON, PENNSYLVANIA, ASSIGNOR TO JOHN H. IRWIN, TRUSTEE, OF SAME PLACE.

DYNAMO-ELECTRIC MACHINE AND MOTOR.

SPECIFICATION forming part of Letters Patent No. 335,326, dated February 2, 1886.

Application filed October 10, 1885. Serial No. 179,505. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM L. VOELKER, a citizen of the United States, and a resident of Morton, in the county of Delaware and State of Pennsylvania, have invented certain new and useful Dynamo-Electric Machines and Motors, of which the following is a specification.

My present invention has reference more especially to improvements in the construction of the field-of-force magnets in dynamo-electric machines and motors, and also to the armature-conductor that is caused to pass through the magnetic field.

The object of my present invention is to secure a field-magnet whose iron shall be well subdivided, to prevent the formation of the heat or eddy currents either in its core or in its pole-piece, but which shall at the same time have a large magnetic mass as compared with the space taken up by the diamagnetic material employed between its individual parts.

A further object of the invention is to improve the action or efficiency of that class of dynamo-electric machines in which the currents generated in the armature and carried off to do useful work are set up in lengths of armature-conductor mounted on a suitable carrier by causing said conductor to move transversely through magnetic lines of force emanated from the pole-faces of a suitable field-magnet. The more common form of machine in which this principle resides is that having what is commonly known as a "cylindrical" or "annular" armature, though another form also containing the principle, and to which, likewise, my invention is obviously applicable, is that in which a so-called "disk-armature" is employed, or one in which the wires are arranged radially on a suitable shaft and are caused to pass between the poles of the field-magnets presented to one another and in close proximity.

My invention consists, first, in building up the cores and pole-pieces of the field-magnet for a dynamo-electric machine or motor from thin sheet-iron plates mechanically coated or plated with a diamagnetic metal—such as zinc, tin, bismuth, &c.—and clamped or held together to form a compact body in which the various plates maintain their individuality and are divided from one another at their plane surfaces.

By my invention I secure all the advantages due to a magnetic subdivision of the core and pole-piece, as well as that due to a mechanical subdivision of the laminated or subdivided structure into separate parts resting in mechanical contact with one another, but, in fact, separated by the thin layers of air always present when two plane surfaces are brought together with any ordinary degree of compression. In a core and pole-piece made up in this way there is the highest magnetic efficiency, owing to the small amount of diamagnetic material and the large amount of magnetic material—such as iron—compared with the amount of diamagnetic substance.

The thin sheet-iron plates, coated or plated, as described, may be held or pressed together to form a compact body by any suitable means, though it will be sufficient if they are bound firmly together by the coils of wire wound upon them.

I am aware that it is not new to make the core for a field magnet of a number of iron plates soldered together to form a solid mass; but I have demonstrated by actual experiment that in a mass of this kind the heating effects, due to changes of magnetic condition, are very much greater than is the case if the plates maintain their individuality, so that the core or pole-piece is in fact made up of separate thin plates resting with their separate plane surfaces in contact with one another, and not, as in the case just referred to, forming a practically-continuous mass of metal, discontinuous only in the nature of the material.

In my invention, while preserving the feature of the plates of iron having a thin film of diamagnetic metal mechanically or electrically plated upon its surface, I at the same time secure a laminated or subdivided state of the body constituting the core or the pole-piece by preserving in each part a mechanical individuality, so that it shall be, in fact, separated from its neighbors, though the plane surfaces are held or pressed into contact. The core thus built up may have its ends secured in a wrought or cast iron frame-work, or be otherwise suitably united by a yoke-piece with a similar core to form the field-magnet.

My invention consists, also, in the combination, with the inductor-wire of the armature of a machine in which the currents are devel-

oped by the passage of the wire transversely through the magnetic field, of a sheath or envelope of magnetic material—such, for instance, as wrought-iron—encircling said conductor. The sheath or envelope of iron may be formed, applied, or combined with the conductor in various ways without departing from the invention.

I do not claim the application of the magnetic sheath to the conductor-wire of what is known as a "pole-armature machine," or one in which the conductor is wound upon a bar or rod of iron whose end is brought into and out of proximity with a pole-piece, so as to acquire a magnetic charge and to then discharge, and to thereby set up currents in the wire wound in planes transverse to its magnetic axis. In fact, the application of the sheath in the manner herein described would be detrimental, rather than otherwise, inasmuch as it would tend to divert the magnetic lines of force from the core, and in so far as it did so would weaken the action of the machine. Some of the ways in which this part of my invention may be carried out are herein described.

The armature wire or conductor is preferably provided with the usual insulating sheath or cover, and the wrapping or sheath of iron is applied to the exterior of the latter. The wire or conductor thus sheathed is wound or applied directly to the armature core or carrier without further insulation, and in the proper way to be carried transversely through the magnetic lines of force emanating from the field-of-force pole-piece, after the manner of the inductor-wire in the armature of a machine having a cylindrical or annular armature, and to thereby, through cutting of such lines of force by the lengths of conductor transverse to the lines of rotation, develop the effective currents that are conveyed to the commutator and to the outside circuit to do useful work. When the armature-conductor thus provided with its sheath is applied to the iron cylindrical body of an ordinary machine—such as a Gramme or Siemens machine—the armature-carrier, with its conductors, forms a nearly true armature for the field-magnets, and produces an intensely-saturated magnetic field for the electric conductor to pass through. The magnetic exposure of the conductor being thus largely increased, and the effective magnetic lines of force emanating from the field-of-force pole-pieces being brought to bear with greater directness upon said conductor, it is possible to develop powerful electric currents or mechanical energy with a greatly-reduced weight of copper wire, and an efficient machine may be produced having a very low internal resistance and small weight of armature.

The magnetic sheath may be applied to the armature-conductor in various ways. One of the ways is by wrapping the conductor with a spiral of thin iron wires or with a single iron wire; or it may be formed by covering the conductor with thin iron washers or beads, or small iron rings placed thereon side by side; or it may be constructed of an iron spiral cut to the length of the armature-core and slipped upon the conductor as the latter is being wound upon the core. The iron sheath might be applied in other ways, however, as will be presently observed, when the conductor, sheathed as described, is applied to the armature core or carrier in the manner set forth and shown. The iron mass of the sheath is subdivided in planes substantially parallel or coincident with the magnetic lines of force. This feature, so far as my experience goes, I find to be of advantage. I do not, however, wish to be understood as limiting myself to this particular form of the sheath.

In the accompanying drawings I have illustrated my invention as applied to a machine wound after the Siemens fashion.

Figure 1 is a longitudinal section of the machine, the armature being shown in cross-section, and one of the thin plates making up the field-magnet core and pole-pieces in side elevation. Fig. 2 is a longitudinal section of the armature, showing the conductors in place. Fig. 3 is a detailed view showing a short length of armature-conductor furnished with an encircling sheath or envelope of iron. Fig. 4 shows another way of applying the sheath. Fig. 5 is a plan of the field-magnet with the coils broken away from a portion of the upper side thereof.

A indicates the armature-shaft, and B a cylindrical armature core or cylinder on which the wire is applied in the usual way in lengths parallel to the armature-shaft, so as by the rotation of the armature to be carried transversely through the magnetic lines of force emanating from the pole-pieces of the field-of-force magnet. As will be observed, the iron on the wire assists in directing the magnetic lines of force directly, and in a natural and proper way for this class of machines, from the pole-pieces to the core on which the wire is applied and toward the opposite pole piece.

The core may be constructed in any desired manner, as, for instance, from thin sheet-iron disks *b b*, secured together upon the armature-shaft.

C indicates the armature-conductor applied in two layers to the exterior of the armature-core and connected to the commutator D in any desired way. This conductor is preferably of copper, and is preferably furnished with the usual insulating-sheath, exterior to which is the iron sheath of my invention.

In Fig. 3 the insulating-sheath is indicated at *d*, and the iron-wire sheath—such as before described—is indicated at *e*. In Fig. 4 the iron sheath is shown as consisting of iron beads or rings strung upon the conductor. I do not limit myself to this particular way of applying the sheath, but, as before indicated, prefer the same, inasmuch as the sheath is subdivided in planes substantially coincident with the magnetic lines of force.

The field-of-force magnet H is made up from thin sheet-iron plates, one of which is indicated at M in side elevation, Fig. 1. These plates are coated mechanically, electrically, or in any other desired way, with a thin film of a diamagnetic metal—such as before specified—and are held or pressed together in contact with one another to form a compact mass, as before described, which mass consists of separate thin plates both mechanically and magnetically subdivided. The core thus formed is secured in position in the frame K by screws or otherwise, the ends of the cores resting in slots cut in the frame, as indicated in Fig. 1. The portion of the frame K in which the cores rest forms the usual magnetic yoke for the field-magnets, and the lower portion of the same is provided, as is common, with means for holding the whole structure to a foundation. A similar subdivision of the pole-pieces is secured by constructing the core and pole-piece from thin plated iron sheets, and is of great advantage in reducing the tendency to development of currents therein, while at the same time but a small amount of space is taken up by the diamagnetic material, and the magnetic mass is therefore large. I also find that the heating of the pole-piece is most effectually prevented when it is made up of separate plates pressed together with their plane surfaces in contact with one another, and from experiments have demonstrated that such heating is imperfectly avoided if said pole-piece is formed of a solid continuous metallic mass made by soldering the thin plates together. In such latter case it would appear that the beneficial results resulting from the magnetic subdivision produced by the thin layers of diamagnetic metal are but imperfectly realized.

I am aware that it has been before proposed to make a core and pole piece for a field-magnet from tinned iron plates soldered together; but in such case there is in effect a continuous solid mass of metal, and there is not present the mechanical subdivision that exists when a series of tinned sheet-iron plates are simply held together with their plane surfaces in contact, so that there is a mechanically-subdivided armature made of separate plates or bodies, and so far as my experiments have gone I have demonstrated that there is a marked difference in efficiency and action. Advantages are also obviously obtained in the same direction by means of subdivision of the core for the magnets, and with, at the same time, very little impairment of the magnetic mass.

What I claim as my invention is—

1. In a dynamo-electric machine or motor having a cylindrical armature or its equivalent, as described, the combination, with each individual section of armature-conductor that passes transversely through the magnetic field, of a sheath or envelope of magnetic material surrounding the same entirely, as and for the purpose described.

2. In a dynamo-electric machine or motor having all of its inductor-wire arranged, as described, to pass transversely through the magnetic lines of force emanating from the field-of-force pole-piece, the combination, with each said inductor-wire, of a sheath of magnetic material entirely surrounding the same, as and for the purpose described.

3. In a dynamo-electric machine or motor, the combination, with the individual portions of armature-conductor located between a body of iron and a field-of-force pole-piece, of a surrounding sheath or envelope of iron for each individual portion, as and for the purpose described.

4. In a dynamo-electric machine or motor, the combination, with an armature-conductor upon the exterior of a magnetic body, and between the same and a field-of-force pole-piece, of a surrounding sheath of magnetic material subdivided in planes substantially parallel with the lines of force emanating from the field-of-force pole-piece.

5. The combination, in a dynamo-electric machine or motor, of an armature carrier or body of magnetic material, and armature-conductors lying between said body and the field-of-force pole-piece, so as to intercept the lines of force passing from the pole-piece to the body, and individually sheathed or enveloped in a magnetic material, as and for the purpose described.

6. In a dynamo-electric machine or motor, the combination of an armature body or carrier of magnetic material, an armature-conductor applied to the same between said body and the field-of-force pole-piece, and an iron spiral surrounding said conductor.

7. In a dynamo-electric machine or motor, a field-of-force magnet whose cores and pole-pieces are formed of a number of separate sheet-iron plates having mechanically or electrically plated surfaces plated with a diamagnetic metal, the whole being held or pressed together with their plane surfaces in contact, and forming a compact mass of separate or individual plates, which mass is both mechanically and magnetically subdivided, as described.

8. In a dynamo-electric machine or motor, a field-magnet whose pole-pieces are formed of a series of separate tinned iron plates held together with their separate plane surfaces in contact with one another, as and for the purpose described.

Signed at Media, in the county of Delaware and State of Pennsylvania, this 5th day of October, A. D. 1855.

WILLIAM L. VOELKER.

Witnesses:

CHAS. F. R. HEUCKEROTH,

J. E. T. RUTTER.