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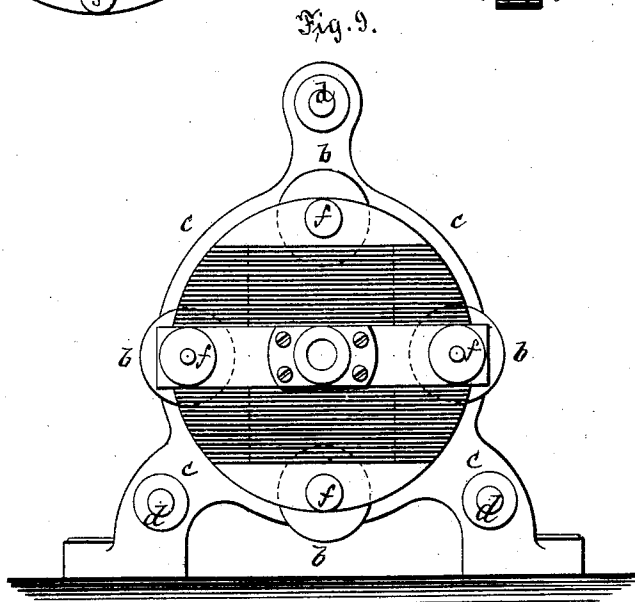
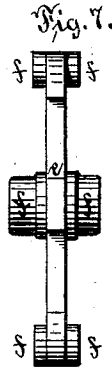
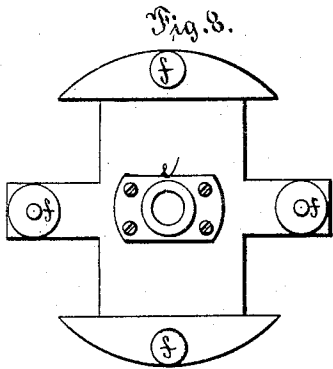
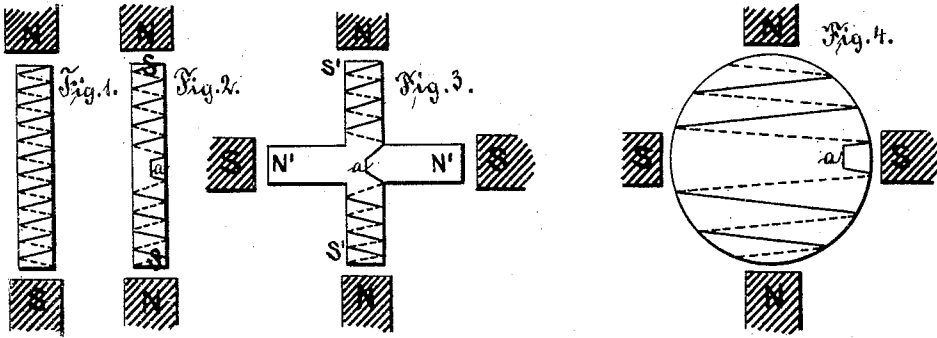
4 Sheets—Sheet 1.

J. M. A. GÉRARD-LÉSCUYER.

DYNAMO ELECTRIC MACHINE.

No. 336,636.

Patented Feb. 23, 1886.



WITNESSES:

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 ATTORNEYS.

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Fig. 5.

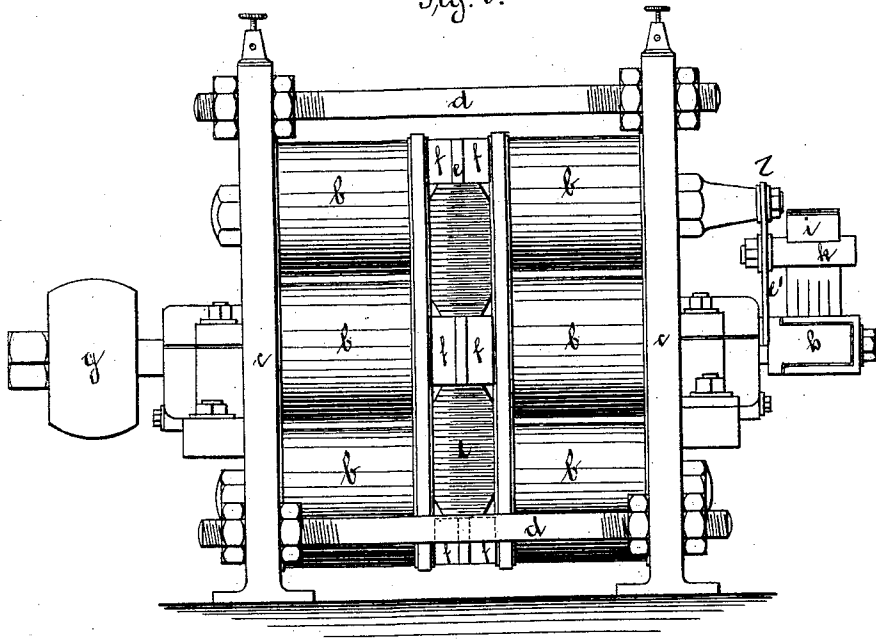
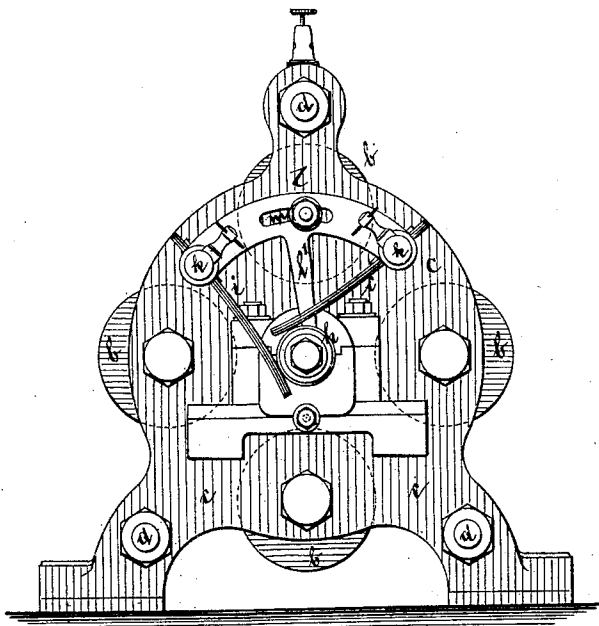


Fig. 6.



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(No Model.)

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J. M. A. GÉRARD-LÉSCUYER.

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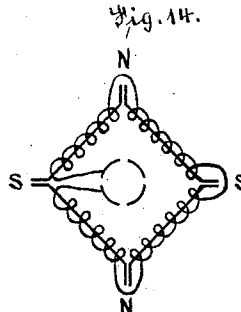
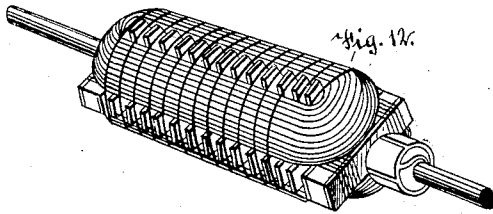
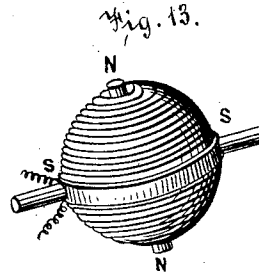
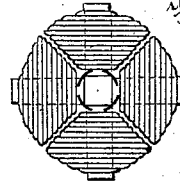
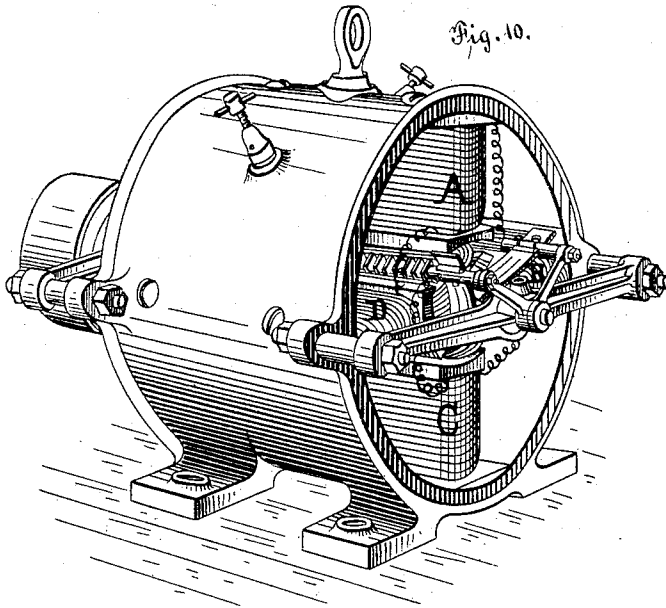


Fig. 11.

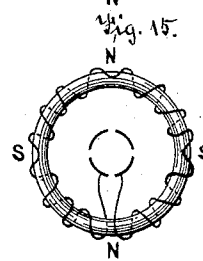
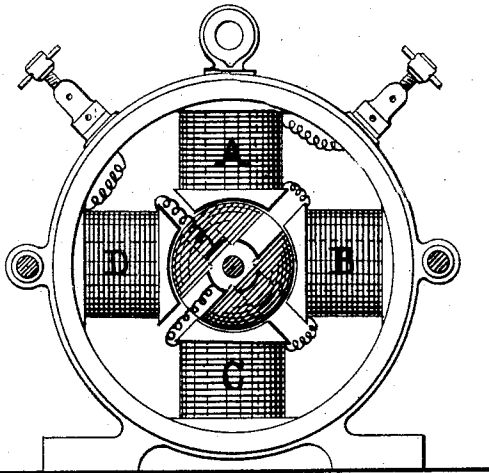


Fig. 16.

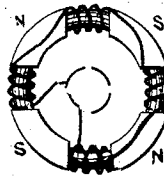
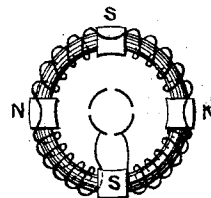


Fig. 17.



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(No Model.)

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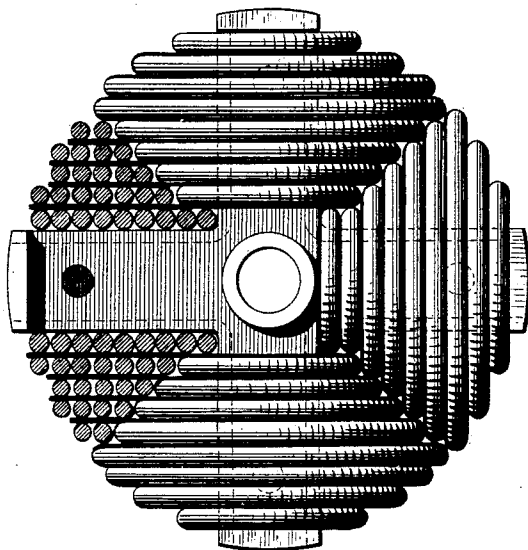
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Fig. 18.



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# UNITED STATES PATENT OFFICE.

JEAN MARIE ANATOLE GÉRARD-LÉSCUYER, OF PARIS, FRANCE.

## DYNAMO-ELECTRIC MACHINE.

SPECIFICATION forming part of Letters Patent No. 336,636, dated February 23, 1886.

Application filed December 22, 1883. Serial No. 115,402. (No model.)

*To all whom it may concern:*

Be it known that I, JEAN MARIE ANATOLE GÉRARD-LÉSCUYER, of Paris, in the Republic of France, have invented certain new and useful Improvements in Dynamo-Electric Machines, of which the following is a specification.

This invention relates to improvements in dynamo-electric machines; and it consists of a new and characteristic disposition of the armature-coils and of a new construction of the armature, by which the electro-magnetic action of the same is increased, and of a new construction of the commutator.

In the drawings, Figures 1 to 4 represent different theoretical arrangements, which serve to explain the principle on which the construction of my dynamo-electric machine is based. Fig. 1 serves to illustrate the law of magnetic induction discovered by Faraday, and Figs. 2, 3, and 4 the application of the same to my construction. Fig. 5 represents a side view, and Fig. 6 an end view, of my improved dynamo-electric machine. Figs. 7 and 8 are respectively a side view and an end view of the magnetic core of the armature; Fig. 9, a side view of the armature. Fig. 10 is a perspective view of a dynamo electric machine with a cylindrical armature; Fig. 11, a vertical transverse section of Fig. 10; Fig. 12, a perspective view of the cylindrical armature. Fig. 12<sup>a</sup> is an end view of an armature wound with four coils. Figs. 13 to 17 represent armatures of different forms, but wound according to my improved method; and Fig. 18 represents a side elevation, partly in section, of an armature the coils of which are arranged with interposed plates of sheet-iron for diminishing the parasitical currents.

Similar letters of reference indicate corresponding parts.

If one end of a soft-iron rod around which is wound an insulated wire be brought close to the pole of a magnet, a current of electricity is induced in the wire, and if the same rod at its other end is approached to the opposite pole of a second magnet the intensity of the induced current is doubled; but if the two ends of the rod are approached to similar poles of two magnets, two currents of electricity are induced in the wire, which are equal in in-

tensity, but of opposite direction, so that they neutralize each other. If, however, the wire be so wound around the soft-iron rod that it starts at a point at the center of the rod, and is then wound in opposite direction around the ends of the rod, as shown in Fig. 2, then, if the rod be approached to the similar poles of two magnets, two currents equal in intensity and of the same direction are obtained. The poles of the magnets impart to the ends of the rod a polarity that is opposite to that of said poles, while in the center of the rod a pole is created the polarity of which corresponds to the poles of the inducing-magnets. This pole in the rod may be called, with reference to the winding of the wire, the "changing" or "reversing" pole. If the reversing-pole *a* of a rod wound as described is approached to two poles of opposite polarity, the magnetism of the rod is increased and an induction-current of considerably greater intensity obtained.

In Fig. 3 the rod or core is represented in the form of a cross, around two diametrical arms of which the wire is wound from the reversing-pole *a* at the center in opposite direction to the ends of the arms.

*N N* and *S S* represent the poles of the inducing-magnets; *N' N'* and *S' S'*, the poles of the cross-shaped rod. If a rod of the shape shown in Fig. 3 is rotated while the inducing-poles remain fixed, a current of electricity is induced for each quarter of a revolution. If, in the same manner, so as to diminish the speed of rotation, instead of four fixed poles, twelve or twenty-four are arranged, then for every twelfth or twenty-fourth part of a revolution an induction-current is generated in the wire. Furthermore, when the wire cuts the lines of magnetic force, a direct current is induced, whereby the effect of the first induction is enhanced. It is obvious that if for the cross-shaped rod a disk be substituted, and the same be wound from the central reversing-pole in opposite directions around the ends of the disk, as shown in Fig. 4, and the same be then rotated between alternating poles, a maximum of inductive effect is obtained. It is actually impossible to obtain a greater effect in proportion to the energy of the inducing-current, even if the number of reversing-poles *a* of the

induction-coils be increased. This can readily be explained by the influence of the poles, which induce a weaker current, but of opposite direction, in the return portion of each convolution of the coil. This current diminishes the strength of the directly-induced current, so that if it be about thirty per cent. of the latter an induction-current remains which represents not more than seventy per cent. of the total energy.

In connection with the theoretical explanations just given, the construction of my improved dynamo-electric machine (shown in Figs. 5 to 9) can be readily understood.

The magnetic field of the machine is formed by four electro-magnets, *b b*, which are secured to upright standards *c c*, that are rigidly connected by strong screw-bolts *d*. The number as well as the disposition of the electro-magnets may be increased, according to the size of the machine and the object for which the same is intended. The armature, which revolves with great velocity in the magnetic field of the electro-magnets, is made in the shape of a recessed disk, *e*, that is wound at opposite ends and provided at four equidistant points of its circumference with cylindrical projections *f f*, which form the poles of the armature according to the principle illustrated in Figs. 3 and 4. The commutator is arranged outside of the supporting-standards *c c*, at one end of the armature-shaft, while the opposite end carries the pulley *g*, to which the driving-belt is applied. The contact-brushes *i i* are arranged at right angles to each other, and are applied to binding-posts *K* at each end of a segment, *l*, which rests by a central arm on the shaft of the machine.

To regulate the position of the contact-brushes *i*, the segment *l* is adjusted by a slot, *m*, on a fixed post of the standard *c*, whereby the segment is moved around the shaft.

In place of a disk shaped armature, an armature of cylindrical shape may be used, the core of which has a cross-section in the form of a cross. With this disposition considerable simplicity of construction, greater strength, saving in material, and an increased utilization of the magnetic effect are obtained.

In Figs. 10, 11, and 12 a dynamo-electric machine with a cylindrical armature is shown, in which the supporting-frame of the machine is made in the shape of a cylinder, which carries the radial field-magnets *A B C D*, and at the ends transverse horizontal braces that are provided at the center with bearings for the shaft of the armature. The cores of the electro-magnets *A, B, C, and D* are in this case first cast in one piece, and form a cross with a cylindrical opening in the center. The central opening is carefully turned out, so that its diameter is slightly larger than the exterior diameter of the armature. The outer ends of the cores are then turned off to the inner diameter of the supporting-cylinder. The cores are then separated from each other on a planing-machine, wound with wire, and

attached to the supporting cylinder or drum. The core of the armature is made in the shape of a cross, wound at opposite sides with longitudinal coils, having a reversing-pole, the pole ends being turned off so as to fit into the central space between the inducing electro-magnets, while having the required play for rotation.

The manufacture of the different parts is easy and simple, as the greater part of them can be performed on a lathe.

The principle of construction described, which is in all cases based on the principle of winding the coils with a reversing-pole, can be practically embodied in different forms, either by changing the form of the armature or by altering the winding of the coils on the same.

While the form of the armature in Fig. 9 is disk-shaped, the exterior form of the armature shown in Fig. 12 is in the shape of a cylindrical roller or drum, in which the wire is wound in two longitudinal coils at opposite sides of the diametrical center portion. These coils may be connected for intensity or quantity, as desired.

To receive currents of high intensity, the wire of the armature can be wound also in two other ways: First, a layer of wire is first wound around one of the arms of the cross-shaped armature, then a layer of the same thickness on the diametrically-opposite arm. The wire is then returned to the first arm and a second layer wound thereon, then passed to the second arm, and so on, alternately layer by layer, until coils of the required size are obtained, the different layers of which are connected in series for intensity-currents. The second method of winding the armature consists in arranging a coil on each arm of the cross-shaped core, as shown in Fig. 12<sup>a</sup>, which four coils may be connected for intensity or quantity currents, or the coils may be wound alternately in layers and the different layers or sections connected for intensity-currents.

I have observed that the heating of the cores of the armature, which takes place in all dynamo-electric machines, and which has been heretofore attributed to the so called "Foucault currents," can be attributed, in a great measure, to the induction of the wire itself, as in the same currents of opposite direction or so-called "parasitical" currents are generated, the intensity of which is large enough so as to increase in some cases the resistance of the armature to three times its normal resistance. To obviate this serious objection, there are interposed between the layers of the coil thin plates or layers of sheet-iron, as shown in Fig. 18, which act by their magnetic property in the nature of screens or shields, and which diminish or prevent almost entirely the formation of the parasitical currents, so that the heating of the armature disappears thereby entirely.

Figs. 13 to 17 represent a series of theoretical

dispositions of armatures of different forms, which are based on the before-mentioned principle of the reversing-pole. It is obvious that the described alternating winding of the layers can be used in each of these armatures.

Fig. 13 represents a perspective view of an armature of spherical shape, in which the reversing-pole S is formed by a disk that is integral with the shaft of the armature. A cylindrical iron rod extends centrally and at right angles to the disk, and forms the active poles N N at its ends. The pole-faces of the inducing electro-magnets are made of concave hemispherical shape, so as to inclose the spherical armature. The armature and pole-faces may also be made in the shape of a spheroid or ellipsoid.

Fig. 14 represents a cross-section of an armature in the form of a parallelepipedon, the sides of which are made of layers of sheet-iron, which are riveted together at their overlapping edges, or of correspondingly-shaped layers of iron wire, which form the cores of four coils, as shown.

Fig. 15 shows a ring-shaped armature, which is continuously covered with wire, so that no part of the iron core can be seen. This ring can be extended in the direction of its geometrical axis, so as to form a hollow cylinder, around which the wire is wound, S S being the reversing-poles, and N N the active poles. This armature differs in principle from the Pacinotti ring, in which the wire has to be wound on the core in the same direction into a number of coils, which are connected in two series by thin collector-plates, the currents being taken off from the plates by two brushes. These brushes have to be parallel to each other, and have to be located in a proper position to the axis of the active poles, so as to collect the current, while they receive no current at all when the brushes are located in the neutral axis.

The construction shown in Figs. 14 and 15 is entirely different. Only two terminal wires, which leave the ring, are placed in contact with the sleeve-sections of the collector, which consists of four sleeve-sections that are connected in pairs. The brushes are arranged at right angles to each other, and, whatever be their position, they take up the current, except when they are placed in the direction of the two neutral axes, which are located intermediately between the axes of the active and reversing poles. While in the Pacinotti ring the brushes have to be shifted for an angle of ninety degrees when they are to be placed on

the neutral axis of the same, in the present construction the brushes have to be only moved for an angle of forty-five degrees, so as to be placed on one or the other of the neutral axes. Furthermore, the Pacinotti ring is composed of semicircular magnets, which abut at their ends, having the same polarities, while the ring in my construction consists of four quadrantal magnets, the abutting ends of which have the same polarities.

Fig. 16 represents a disk-shaped armature of certain thickness, which is provided with four segmental pole-faces, S S and N N. The inducing electro-magnets have to be arranged in this case so as to face the pole-faces of the armature, in the same manner as in Figs. 5 and 6.

Fig. 17 represents also a ring, the coils of which are interrupted by intermediate enlargements of the ring. If this ring is extended so as to form a hollow cylinder, it forms an armature with four polarized faces and four longitudinally-wound wire coils.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. In a dynamo electric machine, an armature the coils of which are wound in a reverse direction to each other on the core, so as to form a central reversing pole or poles, and terminal poles the polarities of which are similar to each other but opposite to the polarity of the reversing pole or poles, substantially as set forth.

2. In a dynamo-electric machine, the combination of inducing electro-magnets having diametrical poles with similar polarity, an armature the coils of which are wound in a reverse direction to each other on the core, so as to form a central reversing pole, and terminal poles the polarities of which are similar to each other but opposite to the polarity of the reversing-pole, substantially as set forth.

3. In a dynamo-electric machine, an armature the coils of which are wound in layers at alternately-opposite sides of the reversing-poles, said layers being separated by interposed sheet-iron plates, to prevent or diminish the parasitical magnetic currents, substantially as set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

J. M. A. GÉRARD-LÉSCUYER.

Witnesses:

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G. NUSSBAUM.