(No Model.) 3 Sheets—Sheet 1.

R. EICKEMEYER.

ARMATURE WINDING FOR DYNAMO ELECTRIC MACHINES.

No. 469,917. Patented Mar. 1, 1892.

Fig. 1.

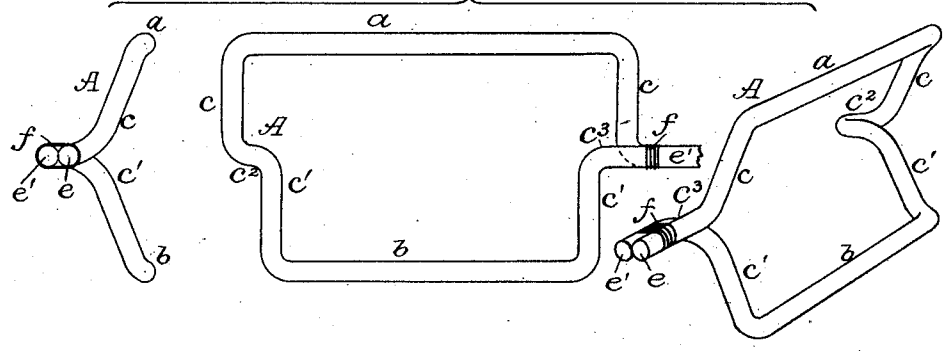
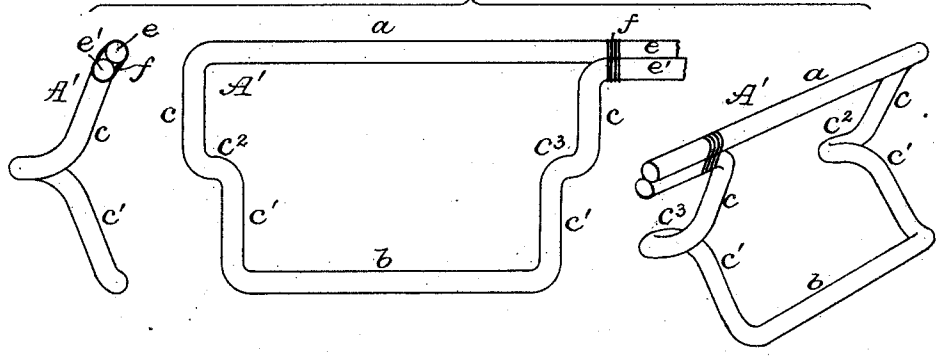


Fig. 2.



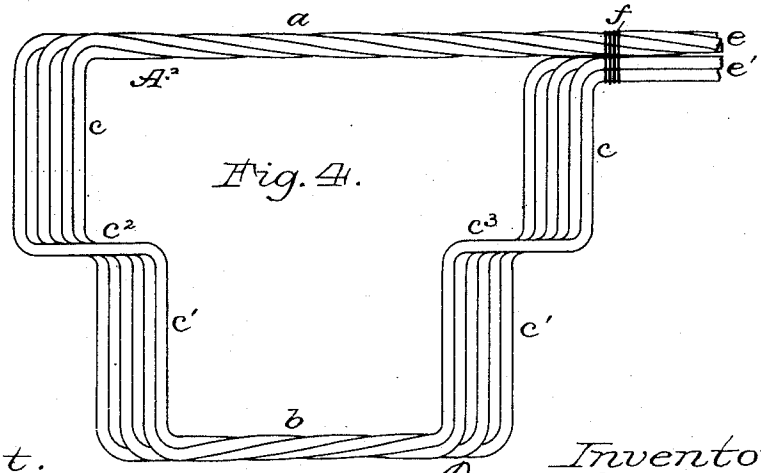


Fig. 4.

Attest.
Philip F. Larner.
Howell Battle

Inventor:
Rudolf Eickemeyer
By Wm. C. Dodd
Attorney.

(No Model.) 3 Sheets—Sheet 2.

R. EICKEMEYER.

ARMATURE WINDING FOR DYNAMO ELECTRIC MACHINES.

No. 469,917. Patented Mar. 1, 1892.

Fig. 3

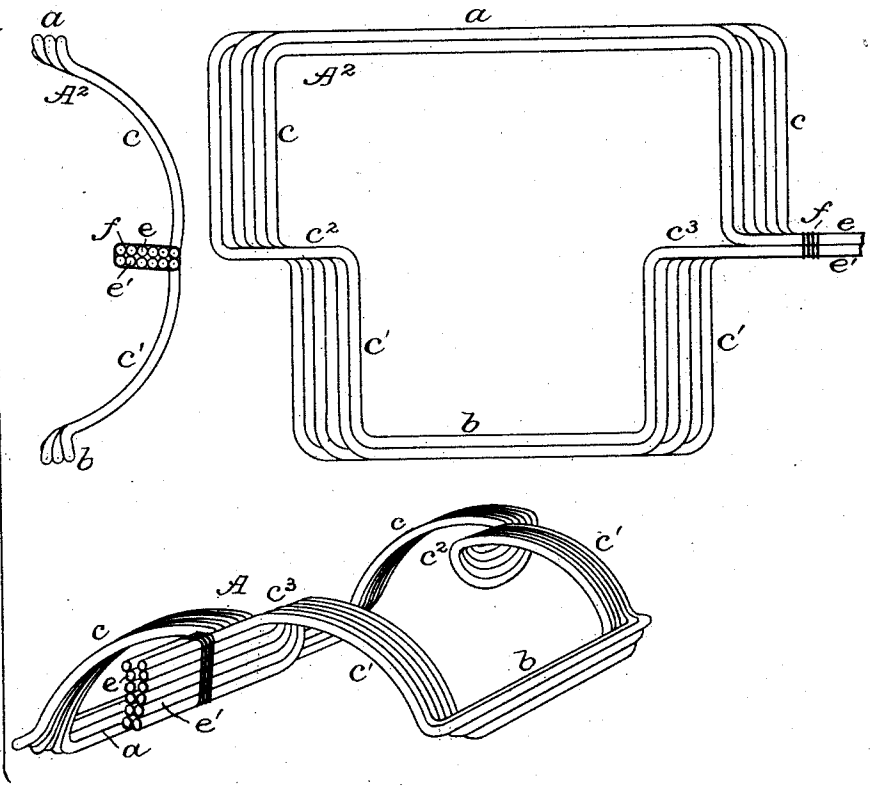
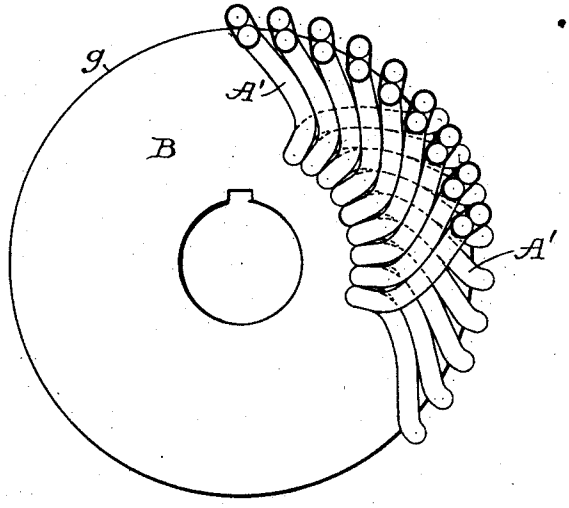


Fig. 5.



Attest:
Philip F. Larner
Howell Battle

Inventor:
Rudolf Eickemeyer.
By Mc Mond
Attorney

(No Model.) 3 Sheets—Sheet 3.

R. EICKEMEYER.

ARMATURE WINDING FOR DYNAMO ELECTRIC MACHINES.

No. 469,917. Patented Mar. 1, 1892.

Fig. 6.

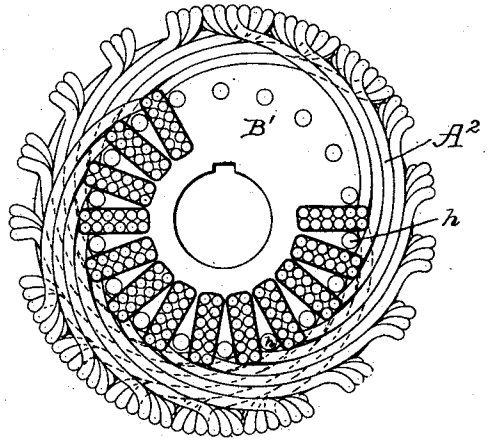
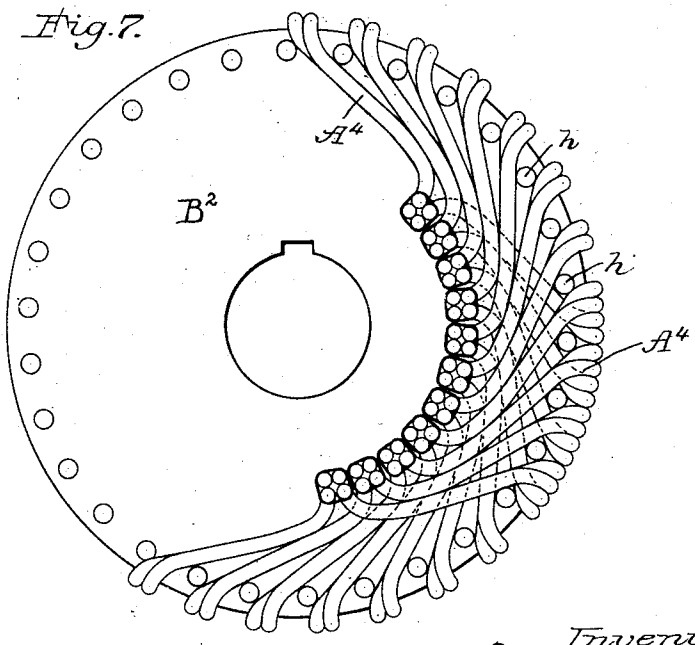


Fig. 7.



Attest:
Philip F. Larner.
Howell Battle

Inventor:
Rudolf Eickemeyer
By Wm. C. Hoad
Attorney.

UNITED STATES PATENT OFFICE.

RUDOLF EICKEMEYER, OF YONKERS, NEW YORK.

ARMATURE-WINDING FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 469,917, dated March 1, 1892.

Application filed June 1, 1891. Serial No. 394,741. (No model.)

To all whom it may concern:

Be it known that I, RUDOLF EICKEMEYER, of Yonkers, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Dynamo-Electric Machines; and I do hereby declare that the following specification, taken in connection with the drawings furnished and forming a part hereof, is a clear, true, and complete description of the several features of my invention.

My said improvements relate to armatures and their windings, and they are an outgrowth of the invention disclosed by me in Letters Patent No. 377,996, issued to me February 14, 1888. Said patent shows and describes an armature-winding each section of which involves certain novel features devised by me and with special reference to use in dynamo-electric machines of the high-tension type, in that each of said sections was a true coil embodying a single length of wire in two or more turns or convolutions.

My present invention is restricted to armature-windings adapted to low tension or quantity machines, each section of the winding embodying a single turn of one, two, or more wires, the latter, when grouped into multiple or compound conductors, serving merely as parallel divisions of such single conductors, as are common to the well-known bar-armatures. In the bar-armatures of the well-known Siemens and Halske type the connecting-bars at the ends of the armature are of the same cross-sectional area as the main or longitudinal portions of the bars; but the contour of the cross-section is changed from a substantially square form to that of a flattened web in order to provide for their occupation of minimum space adjacent to the axis of the armature. The Siemens and Halske connecting-end bars were also bent in two separate curves, and at their junction, near the axis of the armature, each connecting-bar was offset, so that one portion thereof might underlie and the other portion thereof overlie appropriately corresponding portions of other adjacent connecting-bars; but in said winding the offsets were in the same direction, and hence each two bars thus connected were of the same length, and, moreover, one end connecting-bar was located at one end wholly at one side of the armature shaft or axis, and the corresponding end bar at the opposite end of the armature was located at the opposite side of said shaft or axis. In other words, each conductor and the two end bars connected therewith constituted a turn or loop, which not only surrounded the armature-core longitudinally, but also surrounded the axis of the armature. Whether said old style of winding be composed of bars or grouped wire, no one section of winding can be completed prior to applying it to the armature-core, and however or to what extent it may have been preliminarily formed it must be opened, so that, like a basket, the core may be inserted endwise therein, and thereafter each section of the winding must be closed in upon the face of the armature and upon one end thereof preparatory to appropriately connecting them with the commutator-bars.

Now in accordance with my invention one, two, or more strands or wires are completely developed into form and the ends are or may be permanently connected mechanically and thereafter without change or distortion assembled upon the core of the armature, and any one of the several sections may, on being disconnected from its appropriate commutator-bars, be readily removed and replaced without material disturbance of the other sections and without changing its form, and also without severance of the mechanical connection at its two ends. My winding-sections, embodying one or more bars, strands, or wires in parallel, embody in combination three features of construction unlike those in any winding known to me prior to my invention. First, mine have a long side and a short side as compared with the old sides, which were of equal length; second, offsets at the ends, which are in opposite directions as compared with the old offsets, which were in the one direction, and, third, the two ends of each section are wholly at one side of the armature-axis as compared with the old arrangement, in which one end is at the one side and the other end at the other or opposite side of the said axis. My windings being completely formed can be and are mechanically united, constituting loops which are closed at all

points as compared with the old winding, in which no two bars or groups of wire are or can be previously mechanically united at their ends and kept in that condition during their assemblage on the armature-core.

To more particularly describe my invention, I will refer to the accompanying drawings, in which—

Figures 1 and 2 in side, end, and perspective views illustrate two of my single-wire conductors or loops, respectively, with terminals near the axial line and at the periphery. Fig. 3 in side, end, and perspective illustrates a conductor having six strands, those at the sides of the coil being arranged substantially in rectangular cross-section. Fig. 4 in side view illustrates a six-strand conductor, in which at the sides the strands are twisted together. Fig. 5 in end view illustrates a six-pole armature-core partially clad with my single-wire conductors, Fig. 2. Fig. 6 in end view illustrates a core partially clad with the six-strand conductor, Fig. 3. Fig. 7 in end view illustrates a multipolar armature-core partially clad with my double-strand conductor.

The single-strand conductor A (shown in Fig. 1) is in one of the simplest forms. The heavy wire of which it is composed is in one length and constitutes a single loop or section having a single turn. It is bent into the form shown on a "former" similar to that disclosed in my Letters Patent, No. 377,996, and it has a straight long side *a*, a straight short side *b*, and both end portions of the conductor are curved in two lines, as at *c* and *c'*, these at each end occupying different planes, and at the junction of the two curves they are bent or offset in opposite directions on a line parallel with the side portions, as at c^2 c^3. In this conductor the terminals *e e'* project from the central portion of one end, and these are mechanically united, as at *f*, by means of suitable bands or strong binding-twine, thus forming a mechanically-closed armature-section of winding embodying a single turn of wire and which can be produced complete and in exact counterparts capable of being successively applied to an armature-core without disturbing the mechanical connections and without distortion of any one of the sections. The single-strand conductor A′ (shown in Fig. 2) has the same long side *a*, short side *b*, curved ends *c c'*, and the offsets c^2 c^3 in opposite directions; but the mechanical union at *f* is located at the wide side of the conductor, thus placing the terminals *e e'* at the peripheral line of the armature. The conductor A^2, Fig. 3, is composed of six lengths or strands of wire, and these are massed or grouped and bound together, the several wires at the sides *a* and *b* of the loop being in this instance arranged three wide and two deep, as shown, and at the curved ends of the loop the several wires are arranged in a flat web, this change in the shape of the cross-section being substantially the same as the variations between corresponding portions of the conductors in the old Siemens and Halske machines. In this conductor the curves *c c'* at the end are as before described and the offsets c^2 c^3 are in the same direction as in the conductor first described. The mechanical union *f* in this case is located near the middle of the coil at the end, thus placing the terminals *e e'* quite near the central or axial line of the conductor, or, in other words, in line with the offsets c^2 c^3. The conductor A^3 of Fig. 4 is also composed of six separate wires, and it differs from the conductor A^2, Fig. 3, in that at its long side *a* and short side *b* the strands of wire are twisted or spiraled, and also in that the mechanical union *f* is located at one end of the long side for placing the terminals *e e'* at the peripheral line of the armature. The spiraling feature is a well-known expedient in single-turn wire-wound low-tension machines for reducing the heating tendencies, all of the wires being progressively exposed to the magnetic lines practically simultaneously and under similar conditions.

Now, referring to Fig. 5, it will be seen that an effective covering of the face *g* of the six-pole armature-core B can be secured by the use of a single set of counterpart conductors A′, each, as shown in Fig. 2, consisting of a single length of wire. These conductors, all complete, are thus successively assembled, and any one of them can be readily removed and replaced without distorting it or materially displacing any of the others, and the mechanical union near its terminals can be always retained. This capacity for assemblage and detachment depends, first, upon the fact that the short side of any one conductor can slip into and occupy the long side of any other conductor, and, secondly, upon the fact that the two ends of each conductor are wholly at the one side of the axial line of the armature.

The differences between my low tension or quantity winding and those forms known prior to my invention have substantial value in single-wire conductors; but they have greater value in multiple or compound conductors embodying two or more lengths or strands of wire, preferably and usually insulated.

In Fig. 6 I illustrate the application to a bipolar armature-core B′ of the six-strand conductors A^2 of Fig. 3, the terminals *e e'* being located at the offset-points adjacent to the shaft of the armature. In this instance, as before, each conductor is always mounted as a mechanically-closed loop, and no distortion is involved in assembling the conductors on the core and any one of them can be detached and replaced without distortion of the others or their material displacement. The winding-sections are firmly locked to the core by the use of studs *h* in holes in the ends of the core, and these also contribute greatly to convenience in assembling the conductors. The core may be grooved and splined on its face or simply grooved to receive the sides of the

sections, if desired. In all cases the usual banding is applied peripherally to the armature after assembling the sections.

In Fig. 7 I show the application to a multipolar core B^2 of the conductors A^4, each embodying two lengths or strands of wire and each having the before-described long side, short side, correspondingly-curved end, and offsets in opposite directions, as in the conductors before described, and any one of my sections, with sometimes a slight shifting of position at the sides, may be used on a multipolar armature, if, as in this case, each section can occupy at its sides the proper segmental positions on the periphery of the core.

It will be readily seen, although the mechanical union at the terminals of my sections will greatly lessen labor during their assemblage on an armature-core, that if the said union be not made that the sections can be retained in form with care and assembled with facility, especially when the sections involve considerable bulk in metal.

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

1. A winding-section for low-tension armatures, composed of bendable metal in one or more separate lengths or strands and shaped in the form of a loop having a straight long side, a straight short side, and correspondingly-curved ends which are offset centrally in opposite directions.

2. A low-tension armature-winding composed of sections each in one or more separate lengths of bendable metal united mechanically at its ends and having a short side and a long side and end portions which are centrally offset in opposite directions and are correspondingly curved.

3. The combination, with an armature-core, of a series of low-tension counterpart and separable winding-sections, each composed of several separate lengths of wire mechanically united at the terminals and constituting a mechanically-closed loop, each having offsets at the end in opposite directions, a long side and a short side, and correspondingly-curved ends, which are both located at one side of the axial line of the core.

RUDOLF EICKEMEYER.

Witnesses:
STEPHEN D. FIELD,
LESLIE M. SAUNDERS.