(No Model.) 2 Sheets—Sheet 1.

R. EICKEMEYER.

ARMATURE WINDING FOR DYNAMO ELECTRIC MACHINES.

No. 482,825. Patented Sept. 20, 1892.

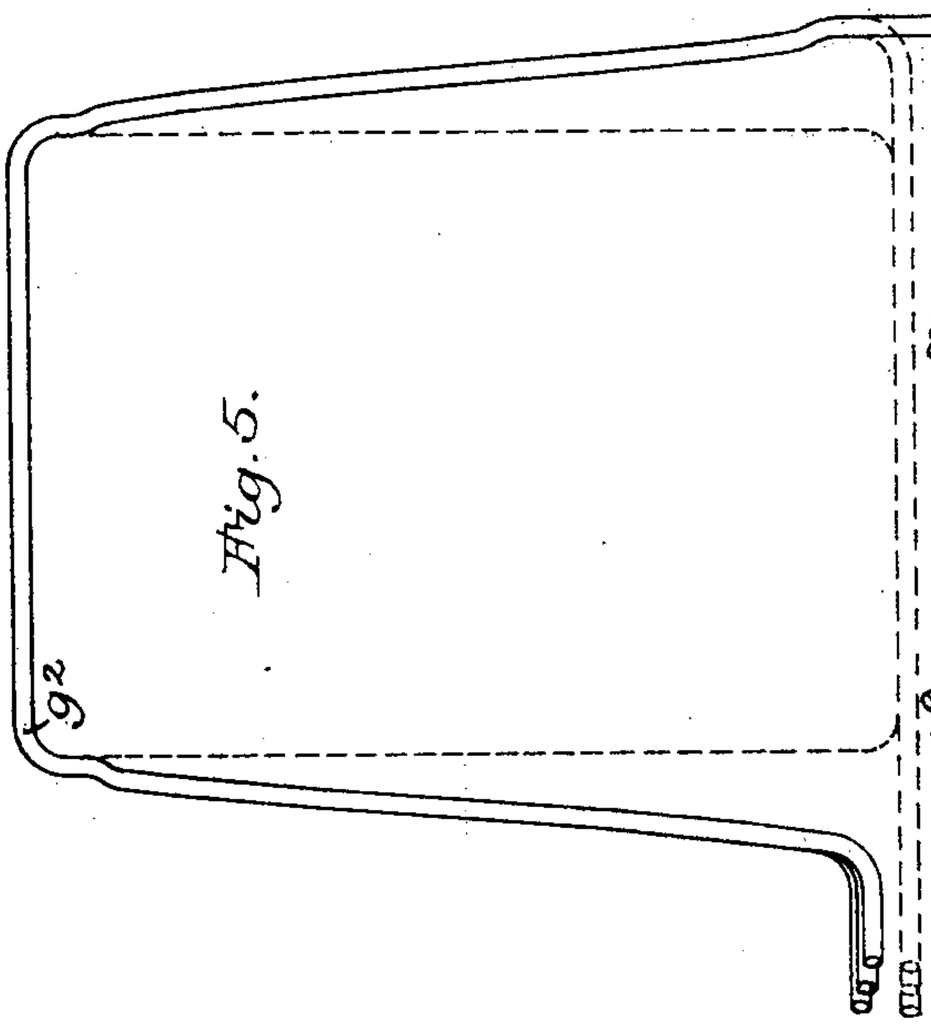

Fig. 5.

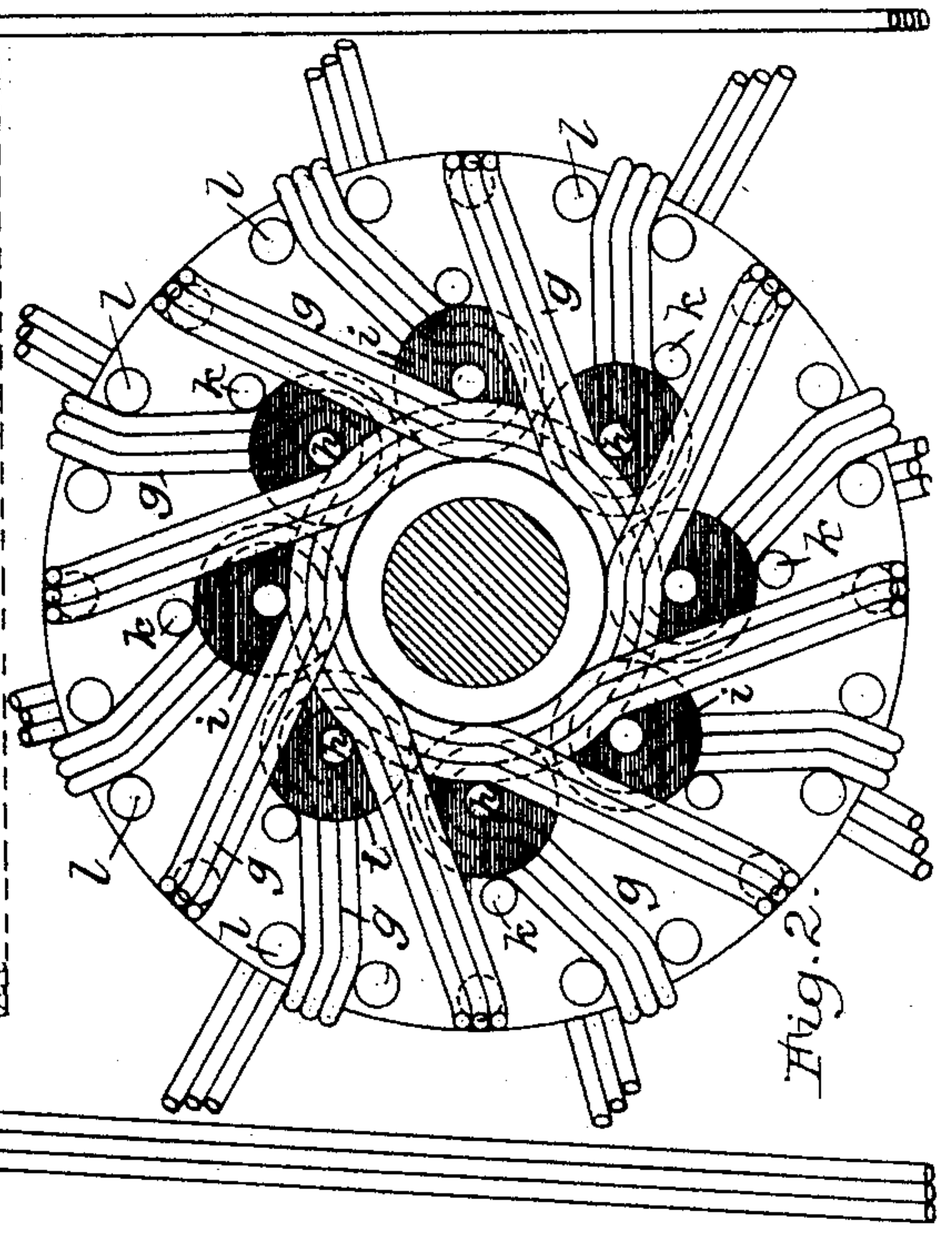

Fig. 2.

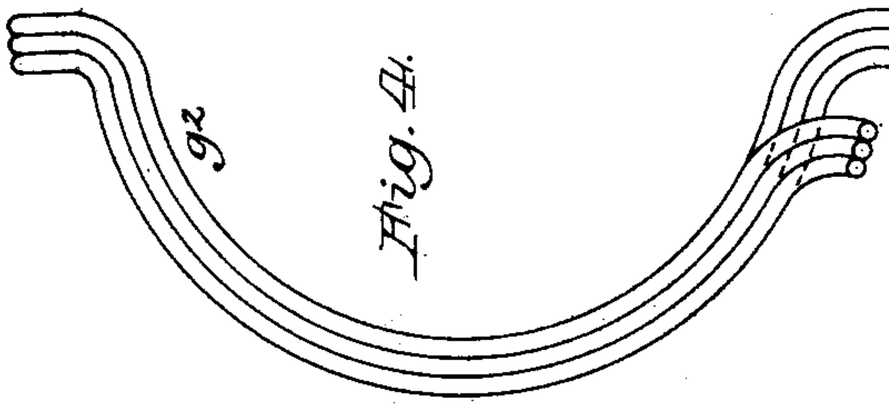

Fig. 4.

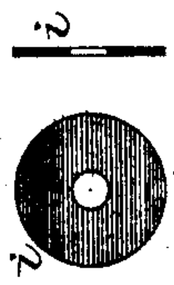

Fig. 6.

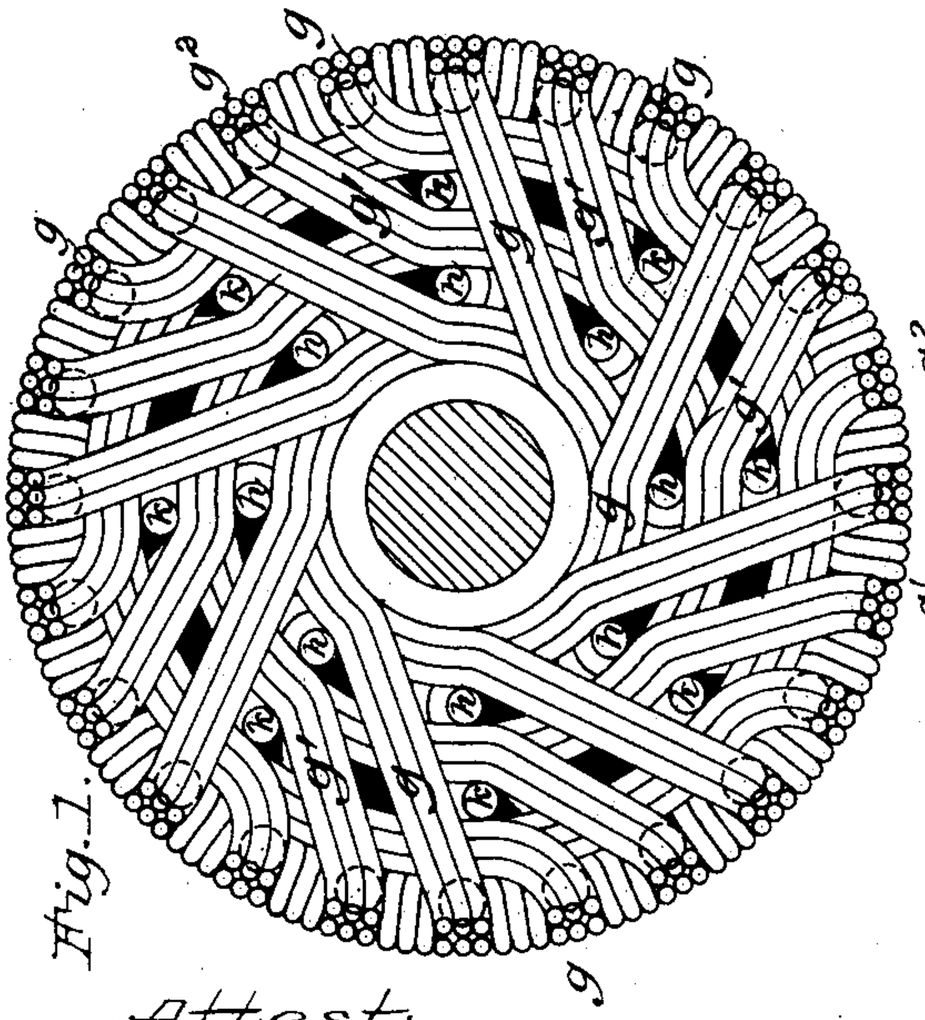

Fig. 1.

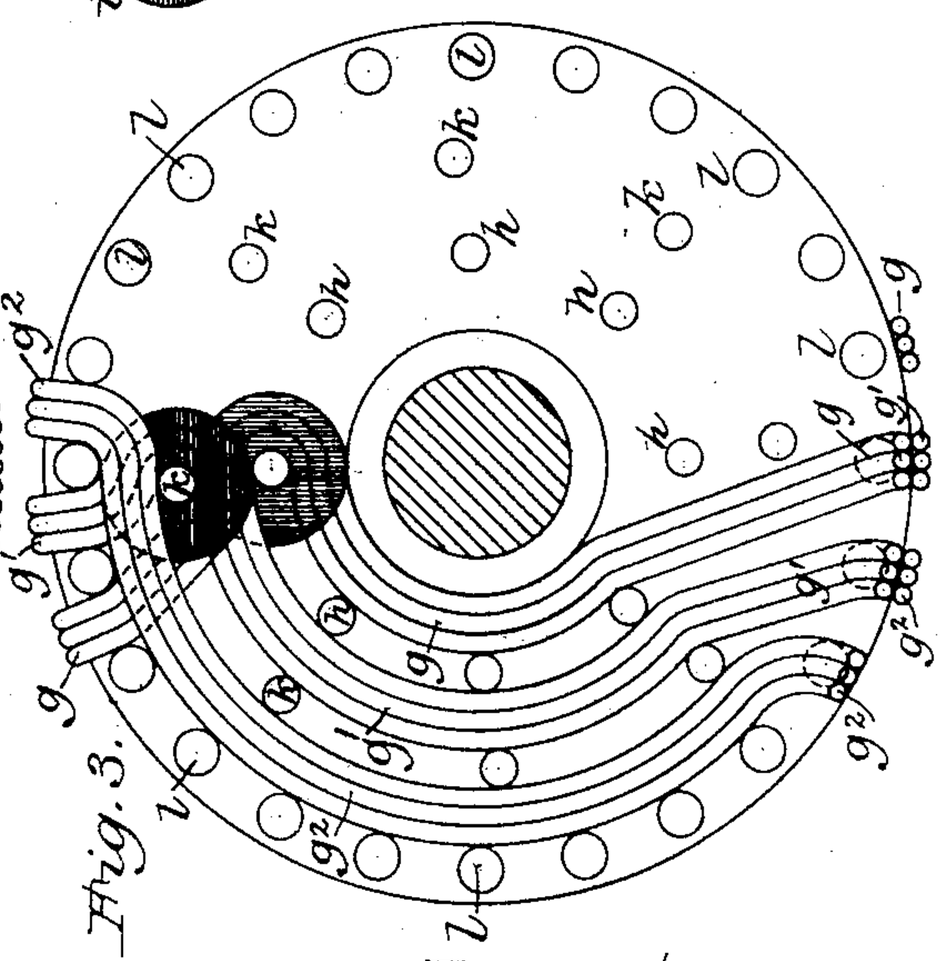

Fig. 3.

Attest:
Howell Lartte
Henry B Deale

Inventor:
Rudolf Eickemeyer
By Wm Lemmon
Attorney

(No Model.) 2 Sheets—Sheet 2.

R. EICKEMEYER.

ARMATURE WINDING FOR DYNAMO ELECTRIC MACHINES.

No. 482,825. Patented Sept. 20, 1892.

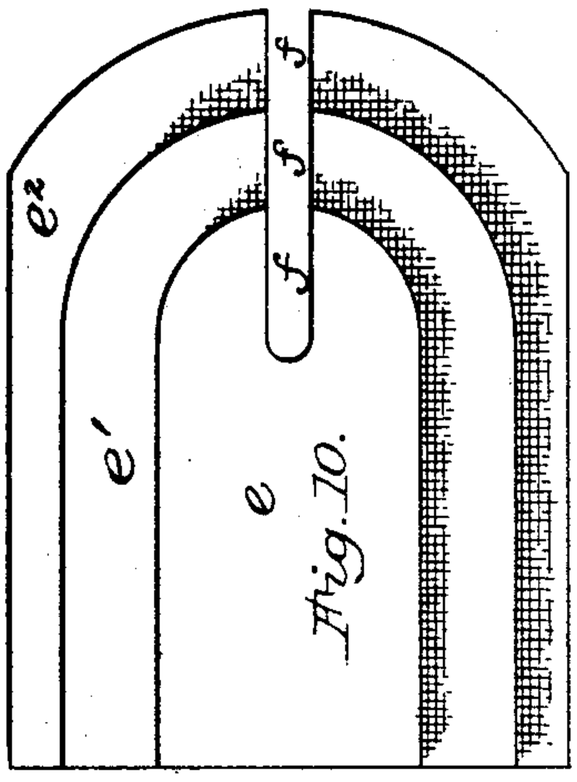

Fig. 10.

Fig. 7.

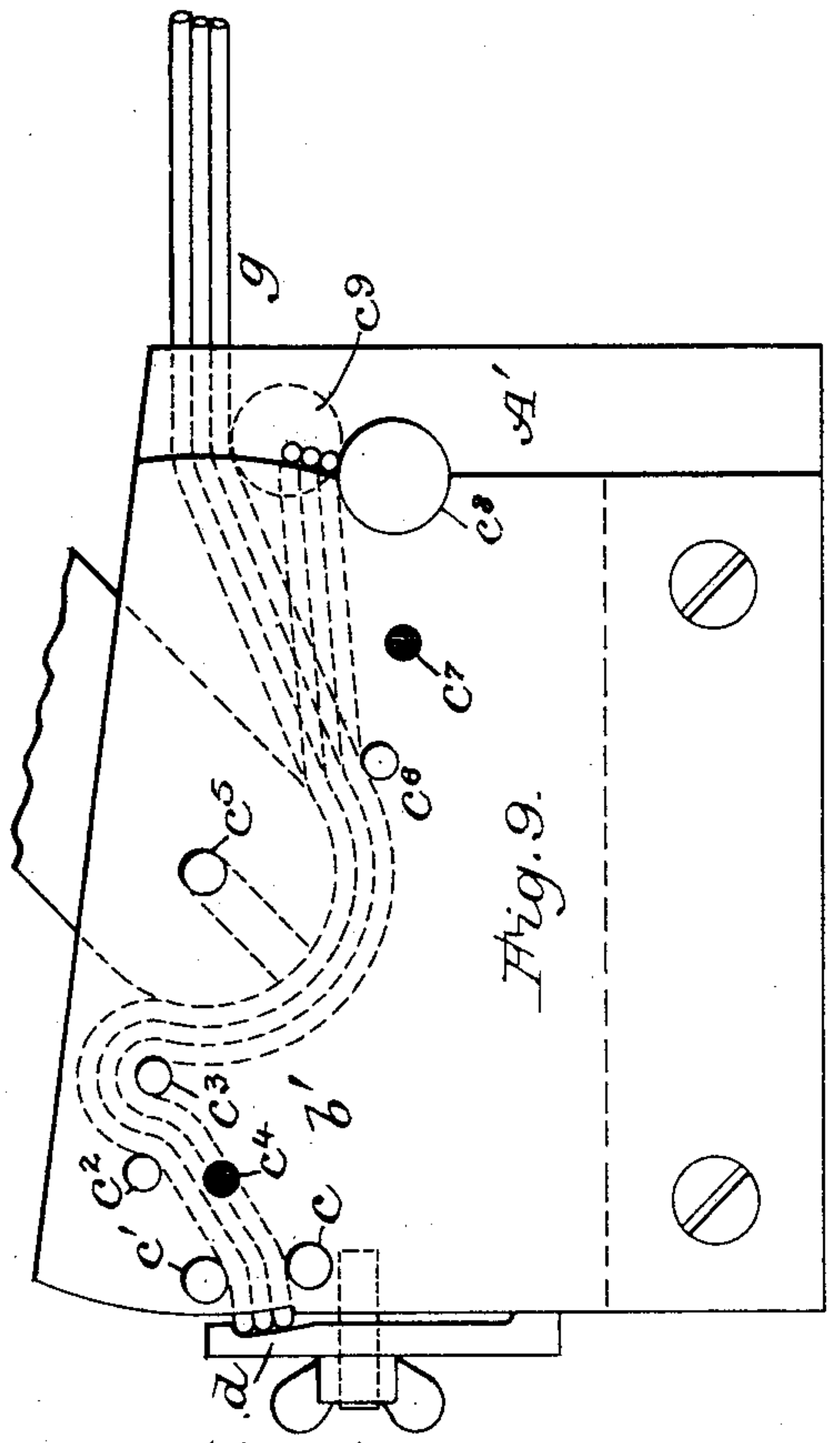

Fig. 9.

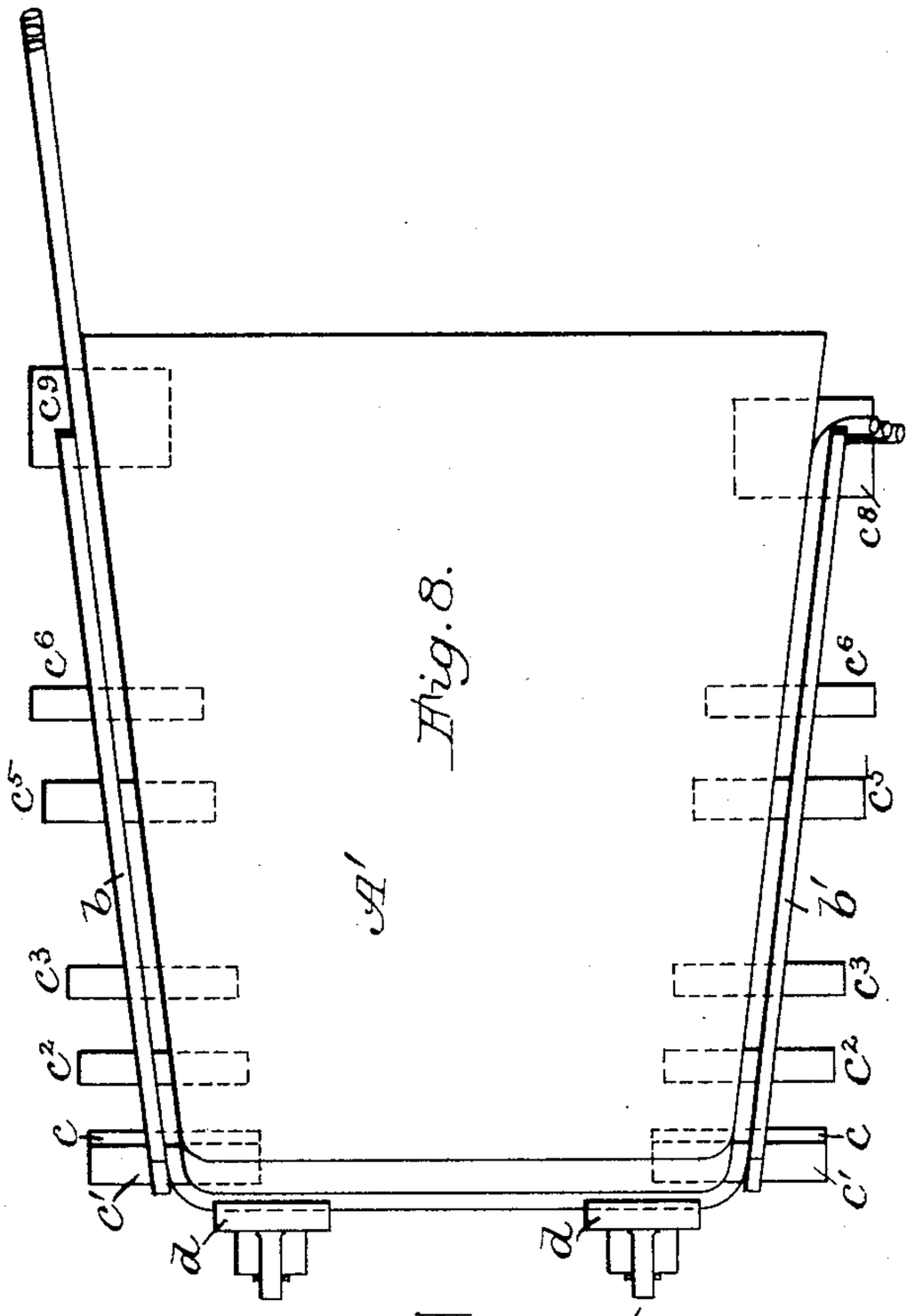

Fig. 8.

Attest:
Howell Battle
Henry B Deale

Inventor:
Rudolf Eickemeyer
By Munn & Co
Attorneys.

UNITED STATES PATENT OFFICE.

RUDOLF EICKEMEYER, OF YONKERS, NEW YORK.

ARMATURE-WINDING FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 482,825, dated September 20, 1892.

Application filed September 3, 1890. Serial No. 363,810. (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 Armature-Windings for Dynamo-Electric Machines; and I do hereby declare that the following specification, taken in connection with the drawings furnished and forming a part of the same, is a clear, true, and complete description of my invention.

My said improvements pertain to applying to the cores of dynamo-electric-machine armatures of what may well be termed "strand" winding, as distinguished from the equally-old forms involving the continuous coiling of wire, and also as distinguished from the more recent forms of coil-windings which are completely formed or wound prior to assembling them on an armature-core—such, for instance, as were devised by me and disclosed in my Letters Patent, No. 377,996, dated February 14, 1888. A strand-wound armature in the main resembles the old bar-armatures, and it involves no coiling of the conducting-wire; but the wire is cut in more or less uniform and comparatively short lengths, and then, whether in single lengths or in multiple form, as in groups of lengths, it is applied to and bent and made to conform to the proper surfaces of the armature-core. As in the bar-machines with end connections, each strand or group of strands has a length which substantially equals the distance across the two ends of an armature-core and twice the length of said core, with only such additional length as may be desirable for making suitable commutator connections.

The object of my invention is a strand-winding composed of insulated wire which may economically and with great facility be applied to armature-cores, and in which the strands, whether single or multiple, may be of uniform length and firmly secured to the core at the ends, and in which the strands, whether single or multiple, may be well separated from each other at the ends for allowing the free circulation of cooling currents of air. Whether my novel strands be of the single or multiple variety, they are applied by me to an armature-core in three or more sets or series, and each set covers its appropriate portions of the face of an armature. The strands in all of these sets are of the same length; but the strands in any one set are unlike in form the strands of the other sets with respect of those portions which lie on the ends of an armature-core between the hub and an adjacent edge of the periphery. In other words, the strands of the first-applied set are each on the ends of the core bent backwardly or toward its middle and then extended substantially radially to the peripheral edge of the core. The strands of the second set each have their corresponding portions bent backwardly, but to a lesser extent than the first, and are then extended radially, and in the third set the strands are not bent backwardly at all, but extend radially to the edge of the core. Each of these strands at the described backwardly-bent and radial portions is secured firmly on the core by means of pins or studs, and on the studs of the first and second sets suitable disks or washers of insulating material are mounted for separating the strands from each other in planes substantially parallel with the ends of the armatures, thus affording the cooling spaces referred to. In the matter of contour these strands are of a "keystone form," as in a certain complete detachable coil-winding devised by me, and described in my application, Serial No. 276,990, filed June 13, 1888, and so, also, in my present strand-winding with respect of the peculiar bending at the ends of the core, somewhat similar to certain detachable and complete coil-windings which have been described in my application for Letters Patent, Serial No. 334,668, filed December 23, 1889.

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

Figure 1 in end view illustrates an armature-core completely clothed with my novel strand-winding in multiple strands. Fig. 2 in a similar view illustrates the first or inner set of the strands applied to an armature-coil. Fig. 3 in a similar view illustrates a group of three strands, one of each set. Fig. 4 illustrates in edge view one of the strands of the outer or third set. Fig. 5 illustrates said strand in plan view. Fig. 6 in two views illustrates one of the separating disks or

washers. Figs. 7, 8, and 9 illustrate tools for bending and shaping the strands preparatory to their application to an armature-coil, and in each figure a multiple strand is shown. Fig. 10 illustrates three templets, which are used for developing what may be termed the "varied axial bends" required in the three sets of strands.

I will first describe the operation of preparing the strands in form suitable for application to an armature-core. The wire in sufficient quantity is cut into uniform lengths, and it is then bent upon, and by aid of, a pattern-block A, Fig. 7. This block has two inclined sides a and a straight end a', one end being narrower than the other, and it has a lateral projection a^2 at one of the sides. At the junction of said projection with the side there is a groove or slot large enough to receive one, two, or more wires, so that they will lie one above the other, and said projection at one of its extremities, at a^3, is slightly rounded. A strand B when made to conform to the sides a and the end a' will have the requisite keystone contour. If it is to be a multiple strand, the several pieces of wire thus bent are tied together, as by twine, so that thereafter they may be handled as if one piece of wire. This same block A, or another similar thereto, as at A', Figs. 8 and 9, has detachable side plates b b', which are counterparts, and each is so applied to the lower portion of the block as to leave intervening spaces from the top downward between the sides of the block and the plates, said spaces being a little wider than the diameter of the wire and its usual insulating-jacket, the whole forming an effective bending-frame. Both plates are provided with holes, which register with corresponding holes in the block A' for the reception of detachable pins. Said holes are designated c, c', c^2, c^3, c^4, c^5, c^6, c^7, c^8, and c^9, said letters of reference being also applied to their respective pairs, and no distinction is or will be made between the pins and their holes in the one plate and those corresponding therewith in the other or opposite plate. At the narrow end of this forming-frame there are two vertical clamps d, each having a thumb-screw, the faces of the clamps being recessed a little for properly grasping a strand. Three templets are used for imparting to the strands what may be termed their "axial bends" at their curved portions or paths around the hub of an armature. As these axial bends vary in each set of strands, each set has its own templet, and these are shown as if lying in a flat pile in Fig. 10. The templet e is the smallest. The medium in size is designated e' and the largest e^2, and all of these have curved ends and a central longitudinal slot f. With these tools the strands of the three sets are formed in each instance as follows, viz.: In Fig. 9 a strand of the inner or first set g is shown as when formed for application to an armature-core. The strand initially bent, as on block A, Fig. 7, may be so bent on the frame, Figs. 8 and 9, if desired; but a separated block A is deemed preferable. A strand from the block A is placed in the frame, Figs. 8 and 9, with its inclined sides in the spaces or slots between the side plates and the block A', and then firmly secured at the end by the clamps d. The lower edges of the bent strand at its sides near the clamp then rest upon the pins c. The pins c' and c^2 are then inserted, and the sides of the strand are then so elevated as to impart thereto the slight bends incident to a forced contact with said pins. The pins c^3 are then inserted and the sides of the strand are forced downwardly until they are in contact with the pins c^6, the templet e being used for that purpose. The pin c^5 and the rounded end and the slot f are so proportioned and arranged as to secure the exact axial bend desired in the strands of this set. The large pins c^8 and c^9 serve as abutments for gaging the desired variation in direction between the axial bend and the two terminals or extreme ends of the strand, and the pin c^9, serving for the long terminal, is located somewhat higher than the pin c^8. The pins are then removed, the clamps loosened, and the strand g is then readily detached from the frame. Now for forming a strand g' of the second or middle set the same lengths of wire are used, and this strand has precisely the same initial contour as the first, it having been first made to conform to the block A. The strand is placed in the frame, as before described, and clamped while resting on the pin c. The pin c' is then inserted and the pin c^2 left out. The strand is then bent upwardly until pins can be inserted in the hole c^4, and then the strand is bent downwardly until in contact with pins in the holes c^7, the pins c^6 being already removed. The pins c^5 being put into place, the templet e' is then used for imparting the axial bends, the pins c^8 and c^9 serving, as before, to properly locate the terminals of the strand, and the so-far-completed strand is removed from the frame. The same kind of initially-bent wires are used for the strands g^2 of the third or outer set. The wires are clamped as before, resting on the pins c, and the pins c', although not necessary, may then be inserted. The pins c^2, c^3, c^4, c^6, and c^7 are not used. The pins c^5 are inserted and the templet e^2 employed for imparting the axial bend, the pins c^8 and c^9 serving as before. Now, referring to Fig. 2, the several strands g of the first or inner set are shown in proper position, and they are applied successively one after another, and each is secured in position by the pins h, which occupy the inner curve of the backward bends, which were determined by the pins c^3 in the forming-frame. On each pin h there is a thin disk or washer i, preferably composed of some suitable insulating material, such as varnished paper-board. These specially-bent portions of the strands lie closely adjacent to the surfaces of the ends of the armature-core; but the two terminals of the strands flare outwardly, as

is incident to their keystone contour. The strands of the second or middle set g' are next in like manner applied to the core, the inner curves in their backward bends being occupied by the pins k, and on each of these pins a disk i is mounted, as on pins h. The third or outer set of strands g^2 is applied in the same manner; but they are locked in position near the periphery of the dome by and between the pins l, as is also true of the corresponding portions of the strands g and g', as clearly indicated in Fig. 3, wherein one each of the strands of the three sets are shown in their relative positions on the armature-core and securely pinned or locked. It will be observed that the pins k serve as supports for the strands g' and that the disks i serve not only to well insulate the strands from each other at points where their paths cross, but they also secure good spacing for cooling currents of air. When all of the strands of the three sets have thus been progressively applied to the armature-core, the long projecting terminals are bent by hand (or otherwise) lengthwise of the face of the core, and are then connected with their appropriate terminals, as is common either in single or in multiple strand winding, for a desired connection with the bars of a commutator-hub. It will be seen that the locking-pins serve to lock the strands against all rotative strains, and also that said pins also lock said strands against all possible radial expansion, and that both of these locking effects are complete and of special importance during the final bending down and connecting of the long terminals of the strands.

It will be obvious that each one of the several operations described in the forming of the strands is so simple and the uniform results of each step are so absolutely assured that persons of ordinary intelligence may be relied upon to prepare the strands, as well as to assemble them upon armature cores, thus leaving only the commutator-hub connections for the performance, if need be, by persons of higher skill.

I believe I am the first to devise an armature-winding in which separate strands, whether single or multiple, are thus made into sets each differing from the others in form and assembled on a core and each firmly locked as to rotative strains on a core, as well as the first to so form the strands that they could be locked on the core, not only with reference to rotative strains, but also as to radial or expansive strains at the end of the core, incident to centrifugal forces.

The value of a set of my novel strands and their locking-pins will be apparent when it is considered that one set thus locked securely to the core will serve as a perfect abutment as against rotative strains for ordinary strand-winding applied in the usual manner, so as to occupy intervening spaces on the face of the armature not covered by the locked set, and it will be equally apparent that this locking effect is not dependent upon any special form of strand.

As to the number of sets of strands required in each of my complete armature-windings, it is obvious that said number will vary according to the space each strand will occupy on the face of the armature, whether said strand be single or multiple.

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

1. In an armature-winding for dynamo-electric machines, the combination, with an armature-core, of strands or lengths of insulated wire, each having one turn around appropriate portions of the core divided into separate and distinct sets, the strands in each set being shaped at the ends of the core in a predetermined form unlike the strands of the other set, and each set having locking-pins at the ends of the core, substantially as described.

2. In an armature-winding composed of strands of insulated wire crossing both ends of the core and covering appropriate portions of its face, the combination of locking-studs for securing said strands on the core and disks on said studs for separating the strands in planes parallel with the ends of the core.

3. In an armature-winding, the combination, with an armature-core, of specially-bent strands or lengths of insulated wire in single turns crossing at the ends of the core and covering appropriate portions of the face of said core and locking-pins which confine the strands at the ends of the core against centrifugal and rotative displacement, substantially as described.

4. A winding for dynamo-electric-machine armatures, composed of strands or lengths of wire which are bent into various forms and constitute separate sets or series of strands, the strands of each set having a form peculiar to themselves, and all of said strands secured in place by pins in holes in the ends of the armature-core.

RUDOLF EICKEMEYER.

Witnesses:
R. EICKEMEYER, Jr.,
CARL OSTERFELD.