(No Model.)

J. J. WOOD.

ARMATURE WINDING FOR DYNAMOS.

No. 406,492. Patented July 9, 1889.

FIG. 1.

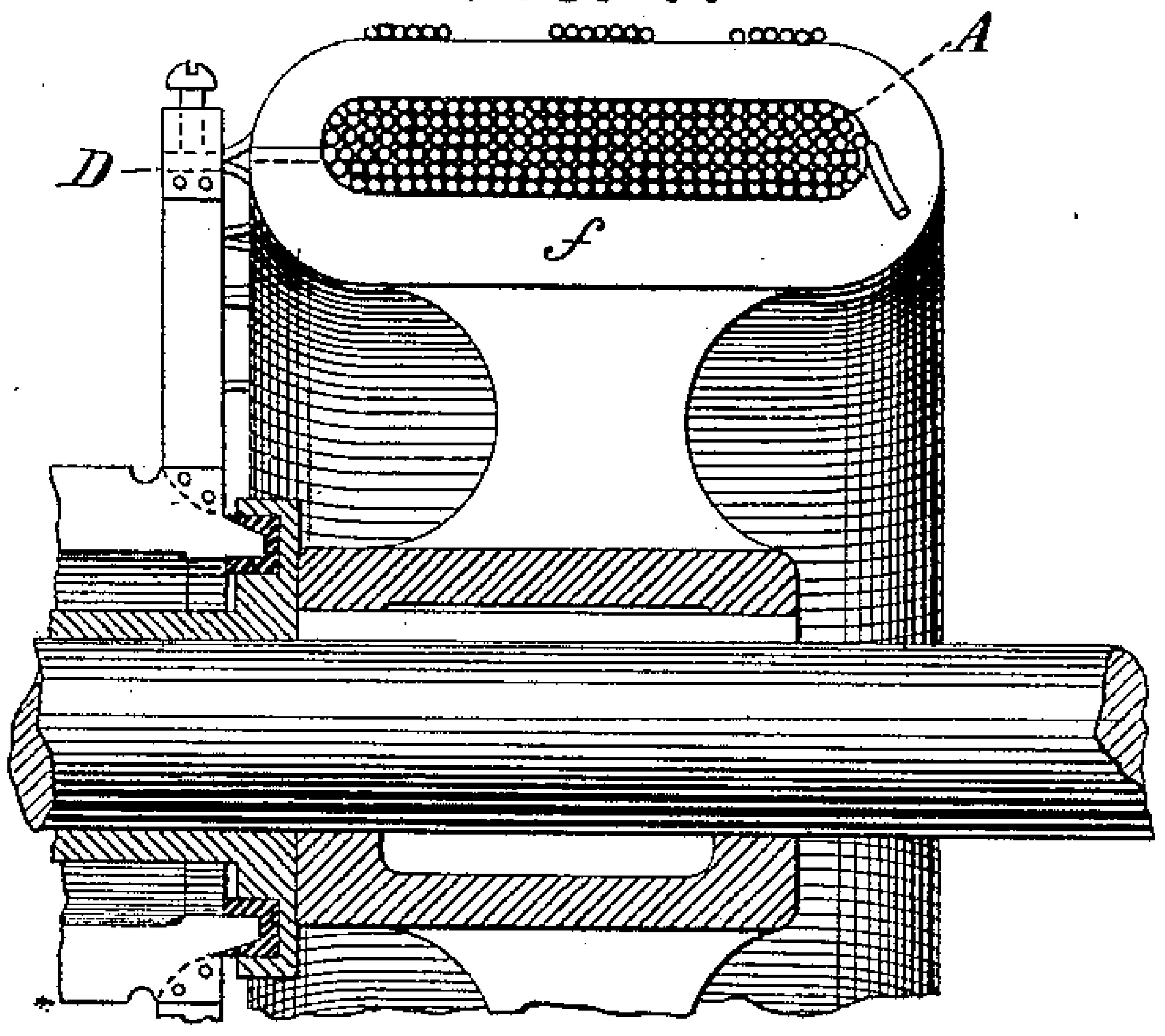


FIG. 2.

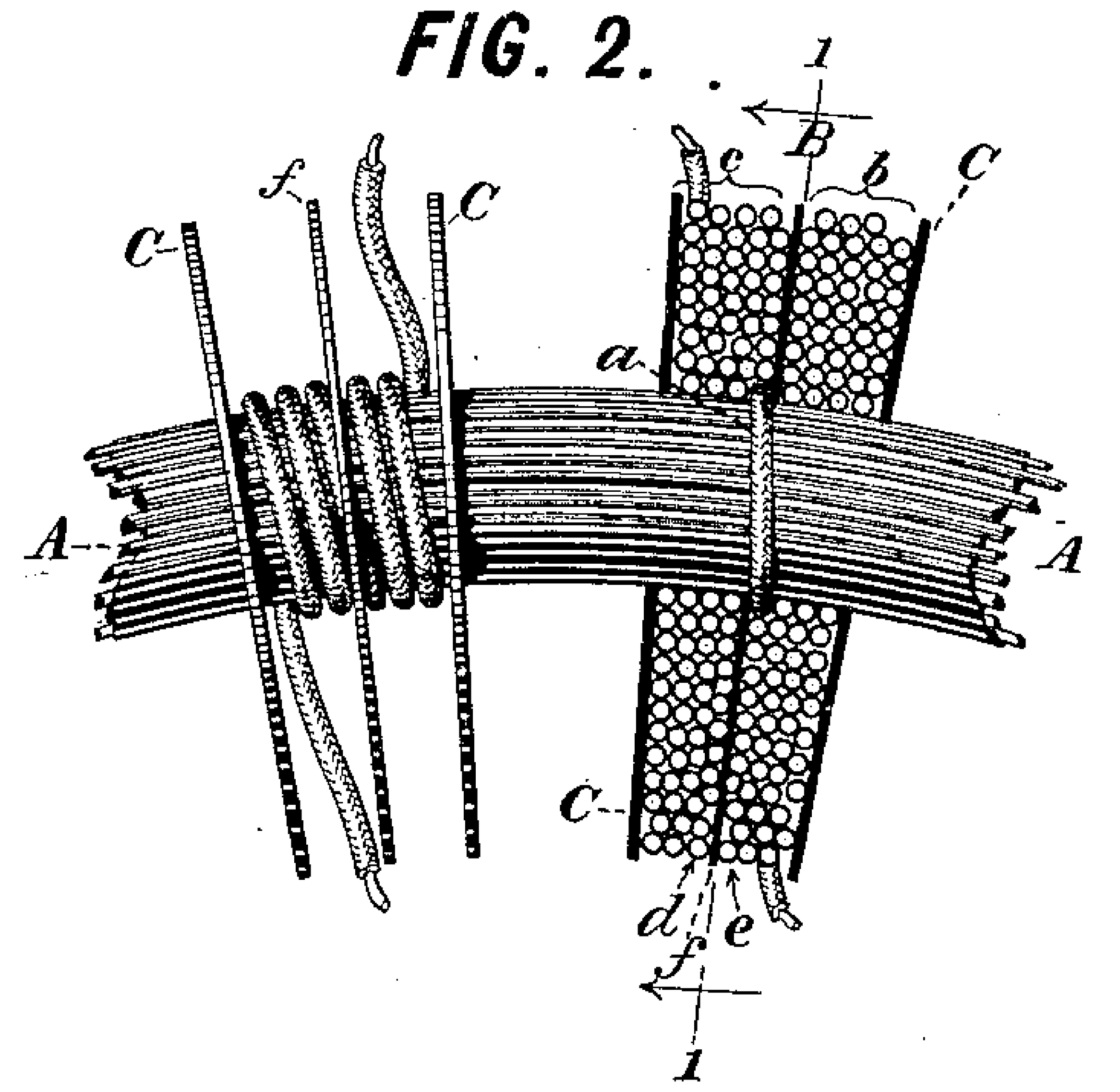


FIG. 5.

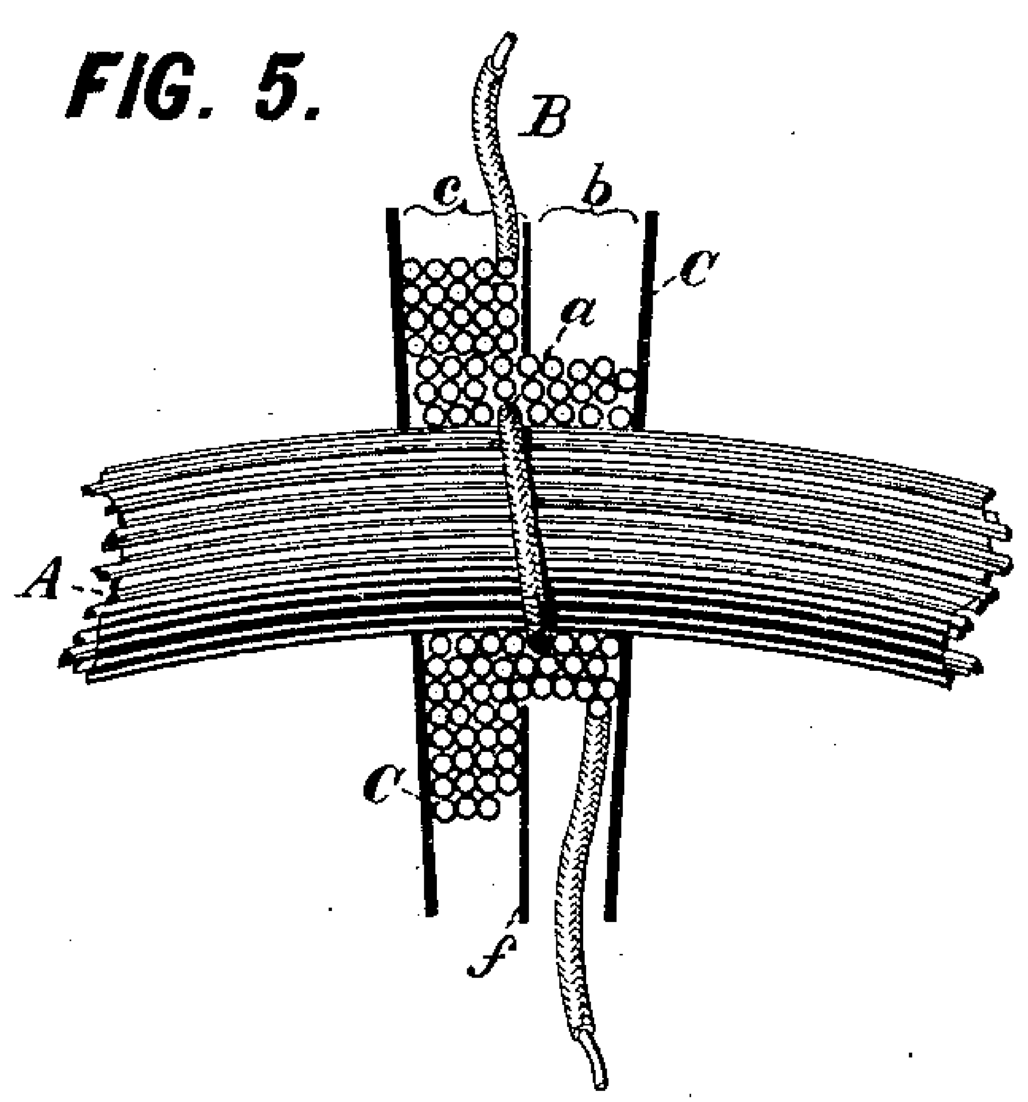


FIG. 3.

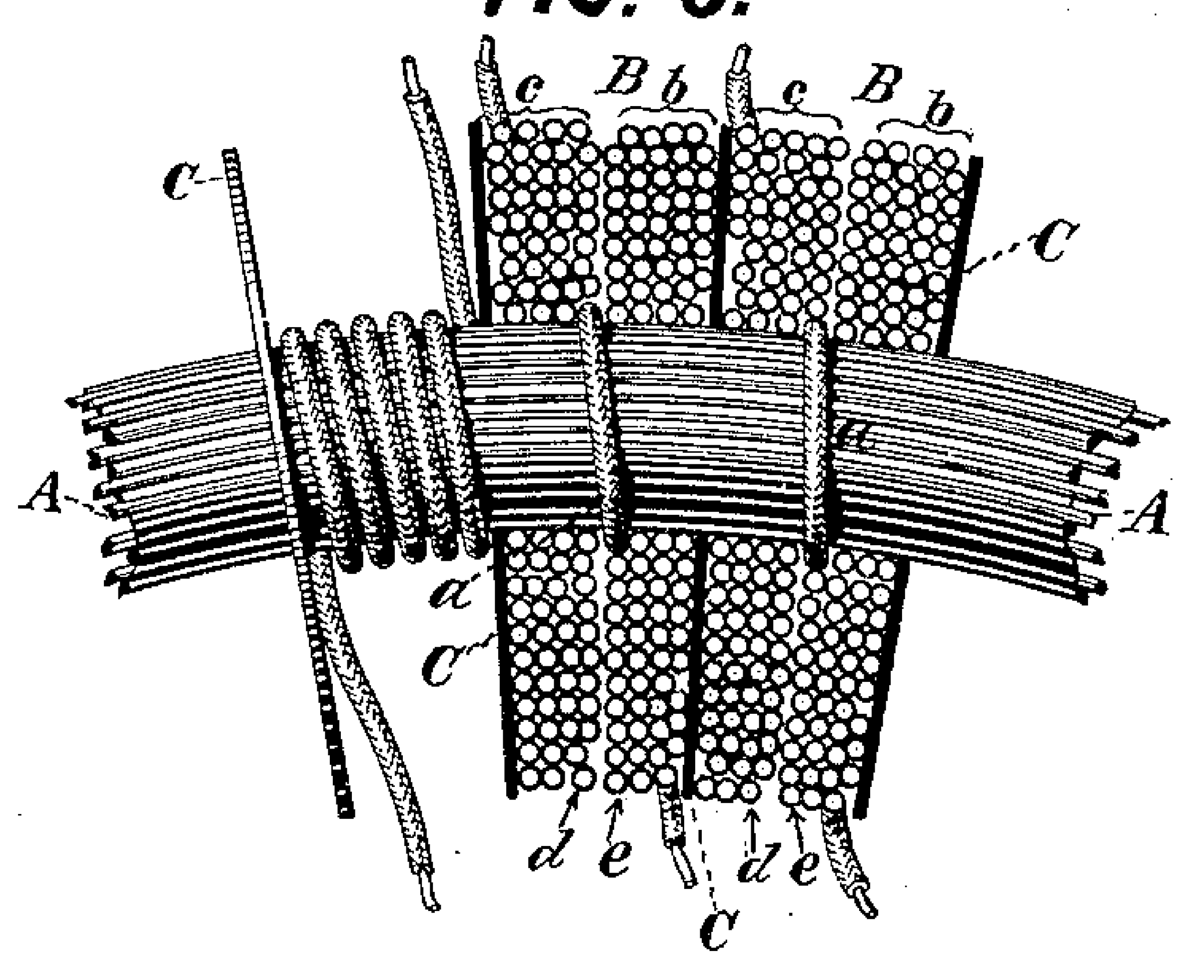
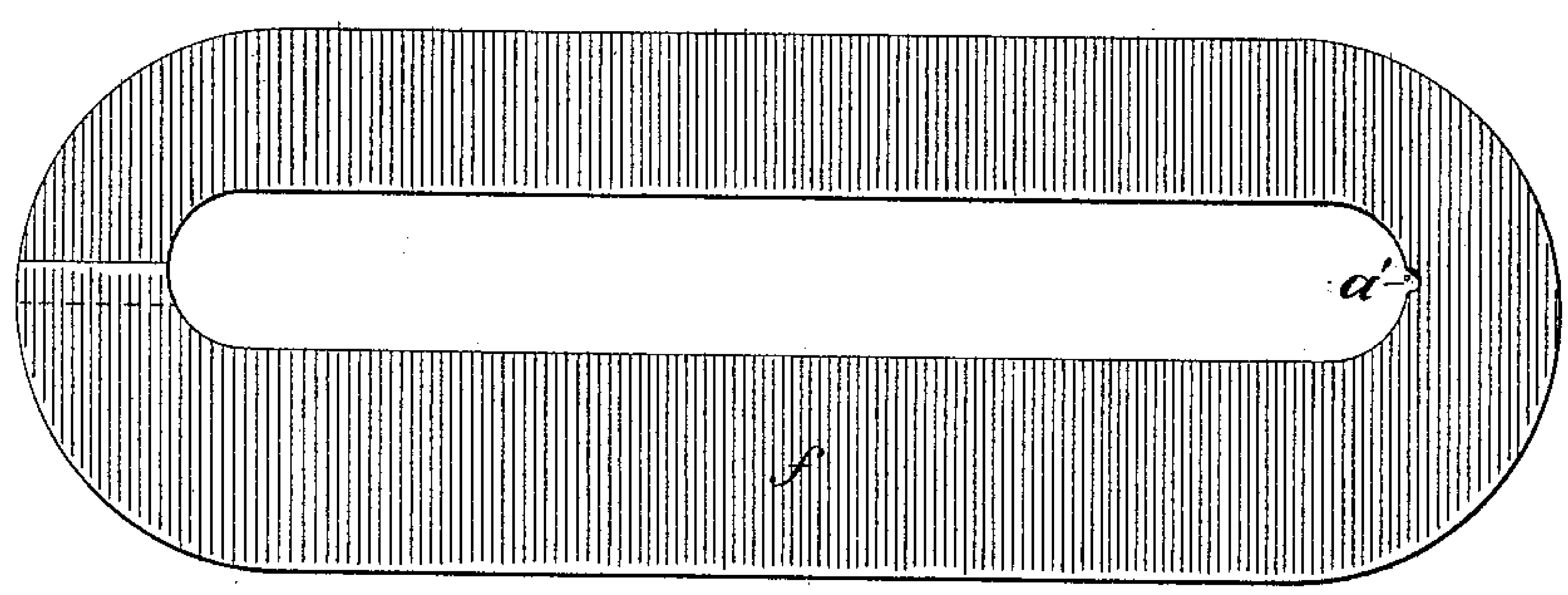


FIG. 4.



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UNITED STATES PATENT OFFICE.

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ARMATURE-WINDING FOR DYNAMOS.

SPECIFICATION forming part of Letters Patent No. 406,492, dated July 9, 1889.

Application filed October 12, 1888. Serial No. 287,917. (No model.)

To all whom it may concern:

Be it known that I, JAMES J. WOOD, of Brooklyn, Kings county, New York, have invented certain new and useful Improvements in Dynamo Armature-Windings, of which the following is a specification.

This invention relates to the winding of Gramme armatures for dynamo-electric machines or for electromotors. Its object is to prevent the short-circuiting within themselves of the several coils with which an armature is wound, by which short-circuiting the insulation of the winding wire is destroyed and an arc is formed between separate convolutions of the wire.

In the accompanying drawings, Figure 1 is a longitudinal section of one-half of an armature of a kind to which my invention is applicable. Fig. 2 is a sectional end elevation of a fragment of the armature wound according to my invention, the winding being partly opened out or dissected. Fig. 3 is a similar view illustrating the old method of winding, on which my invention is an improvement. Fig. 4 is a face view of one of the insulating sheaths or washers employed with my invention. Fig. 5 is a view similar to Fig. 2, but showing a slight modification.

The armature shown in Fig. 1 is of the same construction as that shown in my patents, No. 261,288, dated July 18, 1882, and No. 262,529, dated August 8, 1882, to which reference may be made for a detailed understanding of its mechanical construction. Suffice it here to say that the armature consists of an annular core A, of soft iron, with a winding consisting of coils B B wound thereon and separated by the plates or washers C C, of insulating material. The core is best made by winding soft-iron wire upon a cylindrical mandrel, as usual. The coils B B are of insulated wire, the two ends of the coil being connected electrically through suitable connecting devices to the corresponding segments of the commutator.

I will first explain with reference to Fig. 3 the method of winding heretofore adopted for armatures of this character. The coils, being of uniform resistance, are wound with wire of uniform size and cut in uniform lengths. The length of wire for one coil is wound with its middle portion directly around the core and its end portions terminating at the exterior of the coil. The winding is commenced at the middle of the wire by winding the middle portion thereof once around the core in the middle of the space to be occupied by the coil, as shown at a, and then continuing by winding the opposite halves or portions of the wire around and around the core until the space is filled, and then in a second layer upon the first layer thus formed, a third, fourth, and any desired number of layers being thus wound on until the coil is completed. In thus winding the wire each of the end portions or halves of the length of wire is confined to one-half of the space to be occupied by the coil, so that when the coil is finished the right-hand half of the length of wire is wound about itself in the right-hand half of the space, as shown at b in Fig. 3, while the left-hand half of the length of wire is wound in the left-hand half of the space, as shown at c in Fig. 3. This method of confining the opposite halves of the length of wire to the opposite halves of the space has been found best, for obvious reasons. When the winding was completed, the two ends of the wire were carried to one side of the coil and fastened at D in Fig. 1 to the commutator-connectors.

It is well known to electricians that the difference of potential generated in a wire or coil in its passage through a magnetic field is directly proportional, other things being equal, to the length of the wire employed; hence it follows that the difference of potential between any two convolutions of a coil is equal to that difference due to the length of the wire forming one convolution, which in practice is very low, so that the tendency to short-circuit or arc between two successive convolutions is insignificant. The same may be said with reference to the superposed layers of successive convolutions, wherein the difference of potential is, at its greatest, equal only to the sum of the differences of potential of the several convolutions constituting the two superposed layers, or, with the precise proportions shown in Fig. 3, equal to from seven to nine convolutions—a difference which, in practice, occasions no difficulty; but between the convolutions of the respective half-coils b and c there exists a much greater difference of potential, which increases with each layer to an extent corresponding to the entire length of wire used in winding that layer, and which at the outermost convolutions becomes very considerable and occasions a strong tendency to short-circuit or arc between the adjoining outer convolutions of the respective half-coils. It hence often occurs that an armature is ruined by the formation of an arc between these convolutions, (indicated by the letters *d* and *e* in Fig. 3,) which burns off the insulation of the wires.

Theoretically the length of wire of which each coil is wound should have a very thin insulation at its middle portion, and the thickness of the insulation should be increased progressively toward each end and be thickest at the adjoining outer convolutions *d* and *e*. Such a construction, however, even if feasible, would have the disadvantage of separating the outer convolutions of each half-coil unduly far from one another, thereby wasting room and reducing the length of wire that can be wound in a given space. My present invention accomplishes all the advantage of this theoretical winding without involving its disadvantage.

According to my invention, I wind the coils as shown in Fig. 2. Taking a length of wire, as heretofore, and commencing by winding one middle convolution *a* around the core, as heretofore, I then apply an insulating sheet, plate, or washer *f*, which is shown best in Fig. 4, placing this sheet in the middle of the space to be occupied by the coil, as shown in Fig. 2, and then continuing the winding of the opposite end portions or halves of the wire in the spaces on opposite sides of this sheet *f* until both these spaces are wound full of wire. In this way I form a single armature-coil B of two half-coils *b* and *c*, separated by the intervening sheet *f*. This insulating-sheet is of sufficient thickness and of suitable material to resist the arcing tendency due to the difference of potentials between the adjoining outermost convolutions *d* and *e* of the respective half-coils on the opposite sides of the sheet. The ends of the wire are connected in the same manner as heretofore.

It results from my improved method of winding that the greatest tendency to short-circuit that is required to be resisted by the insulation of the wire itself is that difference which exists between the successive layers of convolutions, since no greater difference exists within the wire of one coil, except between the adjoining convolutions of the respective halves *b* and *c* of the coil, and this difference is provided against by the interposition of the insulating-sheet *f*; hence my invention enables wire to be used which has a much thinner insulating coating than has heretofore been practicable, thereby enabling a greater length of wire to be wound in the same space, and consequently increasing the efficiency of the armature. My invention also enables a cheaper and poorer grade of insulation to be employed with less danger of injury by burning out than has heretofore existed with the most expensive and perfect insulating coverings. In case of any defect in the insulating covering the formation of a short-circuit is much less likely to occur in an armature wound according to my invention than in one wound in the old way.

The insulating-sheet *f* may be of any suitable material; but, in order to economize room and interfere as little as possible with the winding of the convolutions, I prefer to employ a sheet of thin yielding material—such as tough paper—so that the sheet may, by the winding in of the wire, become crimped between the adjoining convolutions of the respective half-coils. In order to admit the middle convolution *a*, I form the sheet with a notch *a'* at one end, as shown in Fig. 4.

In the modification shown in Fig. 5 several layers of the respective half-coils are wound on before the sheet *f* is applied, this sheet having consequently a much larger central opening and serving only to separate the outer convolutions of the respective half-coils, which, however, is sufficient to accomplish the purpose aimed at in my invention, since the difference of potential between the adjoining convolutions of the respective coils is not sufficiently great at the inner layers to require their separation. It is at the extreme outer adjoining convolutions that the burning out of the armature-coils occurs or commences, and in this construction the sheet *f* serves to separate these outer portions.

The adoption of this invention has enabled me to make a dynamo developing an electromotive force of four thousand one hundred volts, whereas previously with the old winding the highest that could be made was two thousand seven hundred volts, and with the new winding the armature is less liable to burn out at the high potential than it was with the old winding at the low potential named.

I claim as my invention the following defined novel features, substantially as hereinbefore specified, viz:

1. An armature-coil consisting of a single length of wire wound with its middle portion at the inner part and its terminal portions at the outer part, and with the outer convolutions of its opposite end portions wound on opposite sides of an insulating-sheet, whereby the tendency to short-circuit between the opposite end portions of the wire is overcome by the additional insulation afforded by said interposed sheet.

2. An armature wound with coils consisting each of a single length of wire with its middle portion wound against the core and its opposite end portions wound on opposite sides of a sheet of insulating material, whereby the tendency to short-circuit between the opposite end portions of the wire is overcome by the additional insulation afforded by said interposed sheet.

3. A Gramme armature wound with juxtaposed pairs of coils consisting of a single length of wire with its middle portion crossing between the two coils and an insulating-sheath separating the two coils.

4. The combination, with an armature-coil consisting of a single length of wire wound with its middle portion at the inner part and its terminal portions at the outer part, and with the outer convolutions of its opposite end portions wound as separate half-coils in opposite halves of the space for the coil, of an insulating-sheet *f*, interposed between said half-coils, formed with a central opening to admit the core, and a notch *a'* to admit the middle convolution of wire.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

JAMES J. WOOD.

Witnesses:
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