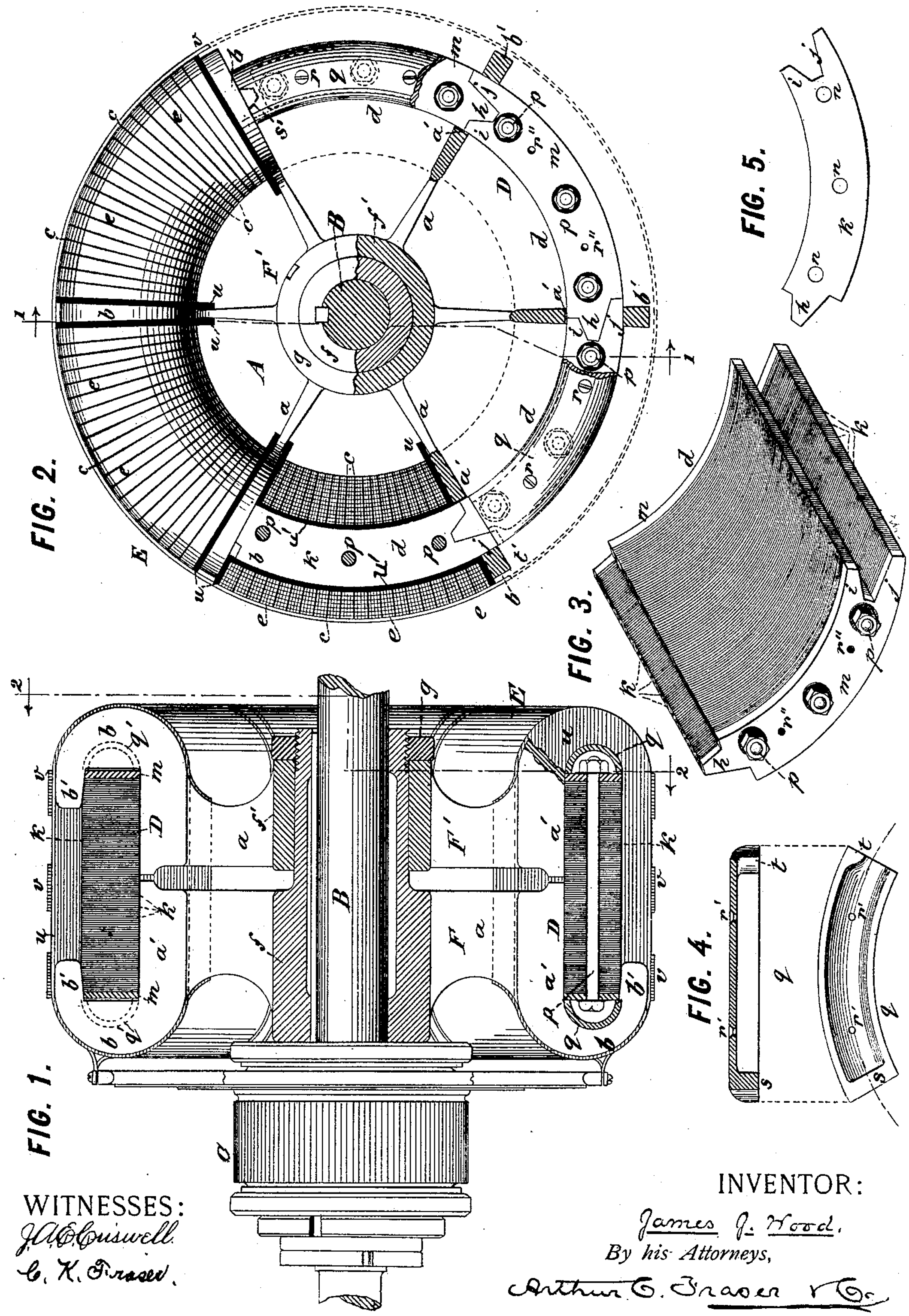
(No Model.)

2 Sheets—Sheet 1.

# J. J. WOOD.

## ARMATURE FOR DYNAMOS.

No. 418,301. Patented Dec. 31, 1889.



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(No Model.) 2 Sheets—Sheet 2.

# J. J. WOOD.

## ARMATURE FOR DYNAMOS.

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FIG. 13.

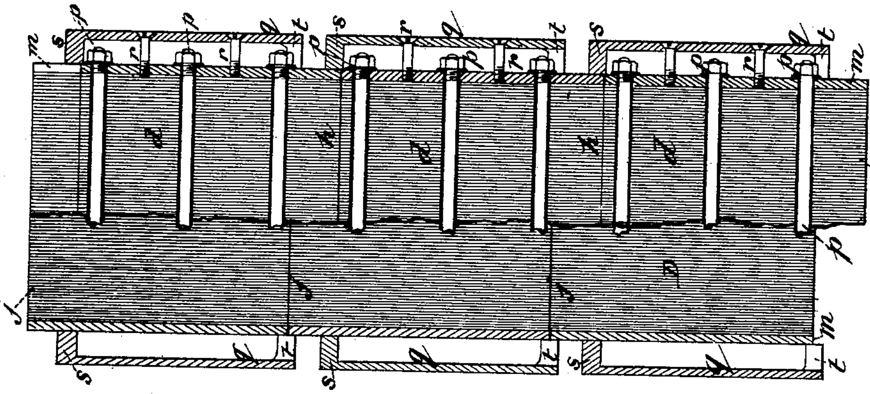


FIG. 11.

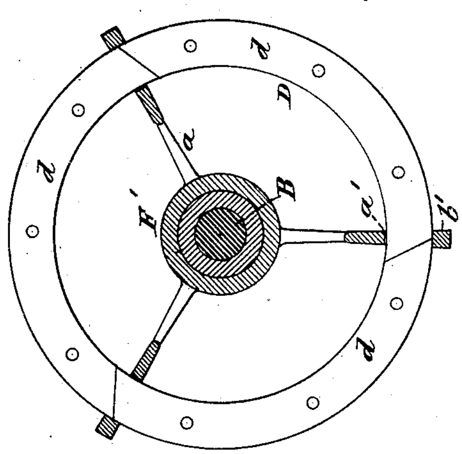


FIG. 12.

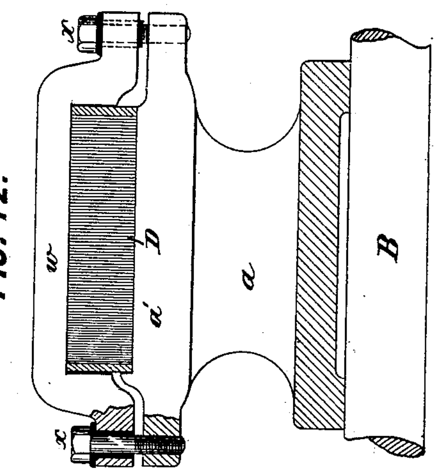


FIG. 7.

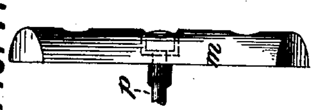


FIG. 8.

FIG. 6.

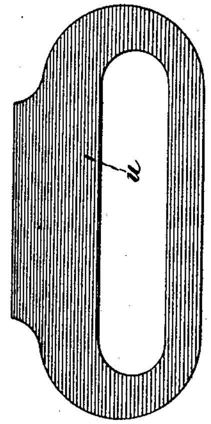


FIG. 10.

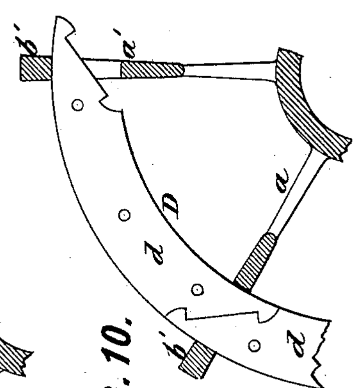
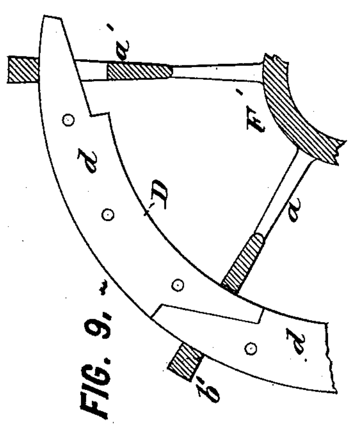


FIG. 9.



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# UNITED STATES PATENT OFFICE.

JAMES J. WOOD, OF BROOKLYN, NEW YORK.

## ARMATURE FOR DYNAMOS.

SPECIFICATION forming part of Letters Patent No. 418,301, dated December 31, 1889.

Application filed March 12, 1889. Serial No. 303,024. (No model.)

*To all whom it may concern:*

Be it known that I, JAMES J. WOOD, a citizen of the United States, residing in Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Armatures for Dynamo-Electric Machines, of which the following is a specification.

This invention relates to armatures of the Gramme-ring type for dynamo or magneto electric machines or electromotors.

The object of the invention is to provide a practicable construction which will enable a ring-armature to be made in sections, whereby are secured the important advantages of greater ease and cheapness in winding the coils upon the core and greater facility in repairing or renewing a defective coil. To this end I construct my improved armature with a core divided at intervals into sections overlapping one another at their joints, each section being wound with a suitable number of coils, whereby any section with the coils wound upon it may be removed from the other sections in order to repair, replace, or rewind any of the coils. The sections are connected together and mounted upon the armature-shaft by means of carrier-arms or spiders fixed on the shaft and engaging the sections at or adjacent to their joints. These carrier-arms are so constructed that on being forced to place they draw the core-sections inwardly, or toward the axial center, whereby the successive sections are forced into intimate magnetic contact at their junctions. The adjoining ends of the sections overlap in such manner that the end of one extends outside of the end of the other, whereby the effect of centrifugal force is to insure greater rather than less intimacy of magnetic contact, and thereby retain the magnetic conductivity of the core unimpaired. The lamination of the core to avoid Foucault currents is provided for without thereby weakening the sections or increasing the difficulty of uniting them as compared with sections which are not laminated.

In the accompanying drawings, Figure 1 is a diametrical section of my improved armature, showing its commutator in elevation. Fig. 2 is an end elevation of the armature, showing it dissected and partly in transverse section, cut in the plane of the line 2 2 in Fig. 1. Fig. 3 is a perspective view of one of the sections of the core removed. Fig. 4 includes a longitudinal section and an elevation of one of the core-section caps removed. Fig. 5 is an elevation of one of the layers or laminæ of sheet-iron of which the armature-core is built up. Fig. 6 is a plan of an insulating-plate.

The remaining views illustrate modifications, and will be fully described hereinafter.

Referring to the drawings, let A designate the armature as a whole, B the armature-shaft, and C the commutator. The commutator and its connections, with the terminal wires of the armature-coils, may be of any known construction, and will not be herein described.

D designates the soft-iron core of the armature, which is subdivided into sections or segments *d d* of any convenient or suitable number, six being shown in Fig. 2.

E designates the armature-winding, consisting of coils *e e*, wound around the core D between radial separating-plates *c c* of insulating material. There is nothing novel in this method of winding a Gramme armature. For further information as to the precise winding that is preferred, reference may be made to my application for patent for armature-windings for dynamos filed October 12, 1888, Serial No. 287,917.

F and F′ designate the spiders by which the armature is mounted on the armature-shaft. These spiders have as many radial arms as there are sections *d d* on the armature-core, and their arms engage the core at or adjacent to the joints between the sections. Each arm consists of a radial web *a*, a head *a′*, against which the core-sections rest, and a jaw *b*, extending around one side of the core and terminating in a beveled end portion or finger *b′*, which overlaps the outer side of the core, as shown in Fig. 1. The spider F has a long hub *f*, which is keyed on the shaft B and one end of which is reduced. The spider F′ has a short hub *f′*, which fits over the reduced end of the hub *f* and is fastened thereon by a nut *g*, which engages screw-threads formed on the protruding end portion of the hub *f*. The core-sections *d d* are made to overlap at their joints; or, in other words, are united by means of scarf-joints. The purpose of this is twofold, first, to afford an extended bearing-surface at the joint in order that the metallic contact of the two sections may be as complete as possible, whereby the magnetic conductivity of the core is preserved unimpaired, and, second, to provide against the tendency of centrifugal force to spread the sections apart and thereby impair their magnetic contact. To accomplish the latter purpose it is essential that the sections shall be supported at or near their junction by means of supports engaging the outer side of one section, the end of which laps over and is exterior to the end of the other section. The hooked fingers $b'$ constitute these exterior supports in the construction shown. The effect of centrifugal force is to throw the inner overlapping end into firmer contact with the outer overlapping end, since the outer tendency of the latter is resisted by its supports.

The preferred form of scarf-joint is that shown in Fig. 2, where the end of one section is formed with a projection $h$, entering a groove in the end of the adjoining section between a short projection $i$ and a long projection $j$. The projections $h$ and $j$ overlap for a considerable distance, the outer projection $j$ being supported by the hooked finger $b'$. All the sections are alike, each one having a projection $h$ on one end and a projection $i$ and $j$ on the other, as shown in Fig. 3. This construction is preferred, for the reason that it brings the joints between the sections on the inner side of the core in such position relatively to the outer overlapping projection $j$ and its support $b'$ that the adjoining ends of both sections may rest upon and be supported by the flat seats afforded by the heads $a'$ $a'$ of the two spider-arms. By referring to Fig. 1 it will be seen that these heads $a'$ $a'$, which stand directly in line with each other, approach each other closely in the middle and extend thence to the outer sides of the core, so that they afford a guide for the core-sections, supporting the latter for almost the entire width thereof, and, being thick enough to bridge over the joint between the sections, they thus support both ends of each section. This support is chiefly useful in the assembling of the sections, since in order to allow of crowding them together at their joints the outer faces of the heads $a'$ $a'$ are turned very slightly smaller than the inner diameter of the core.

The core-sections might be of solid iron; but preferably they are built up of insulated laminæ in order to suppress Foucault currents. To this end sheets or leaves $k$, of the shape shown in Fig. 5, are stamped from thin sheet-iron, and a sufficient number of these leaves are superposed one upon another, being separated by some suitable insulating medium—such as varnish or thin paper or oxide—whereby a sufficient thickness of laminæ is acquired to form an armature-section of the desired width. Against the opposite sides of the superposed laminæ are placed two iron plates $m$ $m$, of sufficient thickness to afford the desired strength, as shown best in Fig. 3. The laminæ $k$ $k$ and the plates $m$ $m$ are all formed with coinciding bolt-holes $n$ $n$, two or more in number, three being shown. These holes may either be punched before the parts are put together, or they may be drilled afterward. Insulated bolts $p$ $p$ are then put through these holes, their heads coming against the plate $m$ on one side and nuts being screwed on their opposite ends against the plate $m$ on the other side, whereby the plates $m$ $m$ are drawn together and the intervening laminæ are compressed into a compact and rigid mass, thereby forming the laminated sections shown in Fig. 3. The bolts $p$ $p$ are insulated by means of a tube or sheath of insulating material slipped over them and by means of washers of insulating material placed against the plates $m$ beneath the bolts and nuts, respectively. The sections thus made are complete, except that their opposite ends or sides $m$ $m$ are angular, and consequently unfitted for winding the coils upon.

It is customary to construct Gramme-ring cores with their opposite sides or ends rounded in approximately semicircular form. This I accomplish in my improved sectional core by fitting onto the opposite sides of the sections half-round caps $q$ $q$, one of which is shown detached in Fig. 4. These caps are of arc shape, corresponding in curvature to the core-sections, and are of such length as to extend from one spider-arm to the next, so that when in place their ends abut against the radial side surfaces of the hooked portions $b$ $b$ of the spider-arms in the positions shown by the dotted arcs at $q'$ on the upper side of Fig. 1. The cap $q$ is hollowed out on the flat side, which comes against the plate $m$, in order to reduce the metal and prevent Foucault currents, but chiefly to afford room for the heads and nuts of the bolts $p$ $p$, which project into these hollow spaces, as shown in the lower side of Fig. 1. The caps $q$ $q$ are fastened in place by screws $r$ $r$, Fig. 2, passed through holes $r'$ $r'$, Fig. 4, in the caps and screwed into holes $r''$, Figs. 2 and 3, in the plates $m$ $m$. One end $s$ of each cap $q$ is made solid or flat on its inner side, so that when drawn to place by the screws $r$ $r$ it overlaps the projecting end of the projection $h$ of the next section, as shown at $s'$ in Fig. 2. The opposite end of the cap is formed with a thickening or filling piece $t$ on one side, which, when the core is put together, overlaps the end of the projection $j$ on the next section, as shown at $t'$ in Fig. 2. By means of these overlapping portions $s$ and $t$ engaging lateral faces or shoulders $s'$ and $t'$ the side faces of the sections are maintained flush with one another and the relative lateral displacement of the sections is prevented. The sections having been constructed and provided with their caps $q$, as described, the winding of armature-coils is applied to them, either by winding the coils directly on the sections or by winding them separately and slipping them onto the sections. In the drawings I have shown twenty coils *e e* applied on each of the sections; but this number may be varied, as desired. Any number of coils from one up to the greatest practicable number may be applied to each section. The prescribed number of coils having been properly wound on the sections, they are fitted together end to end to form a complete ring. It will be understood that each section of the core is covered with insulation *u'*, as usual, and has insulating-plates *u u* applied to its opposite ends, as shown in Fig. 2. The shape of these plates is shown in Fig. 6. The spider F being in place on the shaft B and the spider F' removed therefrom, the armature is then slipped over the spider F, so that the arms of the latter enter between the insulating-plates *u u*. When the armature has thus been properly placed on the spider F and pushed along thereon as far as it will go, the spider F' is slipped on, its arms also entering between the plates *u u*, and the nut *g* is screwed on in order that the spider F' may be forcibly moved toward the spider F. During this movement the beveled inner faces of the overhanging fingers *b' b'* on the ends of the respective spider-arms engage the outer sides of the sections and draw them all powerfully and uniformly toward the center, thereby drawing the scarfed joints into intimate magnetic contact and drawing the core to a perfect circle. Subsequently the usual exterior winding of wire *v v* is applied in order to prevent any displacement of the armature-winding by centrifugal force.

In case it at any time becomes necessary to repair or rewind any coil or coils of the armature, the latter can be readily and quickly dismounted and subdivided in order to gain easy access to the coil requiring repair or renewal by unscrewing the nut *g*, pulling off the spider F', and, after cutting the exterior winding *v v*, disconnecting and lifting out the section carrying the defective coil or coils.

My invention may be variously modified by the omission of certain of its parts or features, and by the varying of its mechanical construction. I will proceed to illustrate a few instances of such modifications.

Instead of using a separate cap-piece *q* the plates *m m* may be made of half-round form in cross-section or be suitably rounded on their outer sides, as shown for example in Figs. 7 and 8. In such case the plates should be provided with recesses to receive the heads of the fastening-bolts *b b* and their nuts.

Instead of the scarf-joint shown in Fig. 2 either of the forms shown in Figs. 9 and 10 or that shown in Fig. 11 may be used. These joints are all so simple as to require no description.

Any number of sections, from two up to whatever limit of subdivision may be deemed practicable, may be used. I consider three sections the smallest number that is practically advantageous, and this number is more suitable for small armatures than large ones. Fig. 11 shows a three-section armature for small machines. In general, the larger the armature the greater the number of sections into which its core should be divided.

Instead of employing two spiders F F', only a single spider may be employed, as heretofore, for supporting the inner side of the core, and some other means than the beveled faces of the fingers *b'* may be provided for drawing the core-sections toward the center. Fig. 12 is a fragmentary section answering to the upper half of Fig. 1, and showing such a modification. The single spider has on each of its arms *a* a head *a'*, extending the entire width of the core and beyond the sides thereof, and terminating in threaded eyes, into which are screwed screws or bolts *x x* at opposite ends, which screws engage the opposite ends of a yoke *w*, which extends outside of the core, and by which screws this yoke is drawn forcibly toward the center. The screws *x x* are insulated from the yoke *w*, as shown, in order to prevent the circulation of alternating currents through the yoke *w* and head *a'* and the two screws, as would otherwise occur, and which would be productive of heat and waste of energy. The construction first described is preferred, however, because of its greater simplicity and cheapness, and because by a single tightening movement all the core-sections are drawn simultaneously toward the center, whereas with the construction shown in Fig. 12 a separate tightening motion is required for each joint, and it is less easy to draw the core to a perfect circle. The spaces or interruptions between the ends of the successive caps *q q* constitute approximately notches in the opposite sides of the core coinciding with the spider-arms, and into which these arms enter at the opposite sides, whereby the arms are enabled to be made of greater width at this point than would be possible were they to extend outside of the caps *q q*, whereby their strength is greatly enhanced, as will be apparent from the upper part of Fig. 1. This notched effect is also apparent in Fig. 13, which is a longitudinal development of the armature-core in a straight line, or what is commonly termed a "stretch-out" view, the right-hand portion of the core being in section midway between its outer and inner surfaces, and its left-hand portion being in section through the projections *j j*. The manner in which the caps *q q* embrace the opposite sides of the section and overhang the projecting portions of the adjoining sections will be apparent from this view.

I am well aware that sectional armatures, broadly speaking, are not new, numerous attempts having been made to subdivide the armature-core into a greater or less number of sections by radial subdivision—as, for example, in the case of the armature illustrated in my patent, No. 231,745, dated August 31, 1880. Sectional armatures, however, as heretofore proposed have not proved practically successful, owing the difficulty of mounting and connecting the sections and the difficulty of securing lamination and perfect insulation to avoid Foucault currents.

In most of the constructions heretofore proposed the core has been radially divided. Such radial division is objectionable because of the liability of the sections to slightly separate under the action of centrifugal force when running at high speeds, thereby impairing the magnetic conductivity of the core and reducing the efficiency of the armature.

In the attempts at lamination that have been made the laminæ have usually been united only at their ends, and difficulty has been found in making a strong connection capable of resisting the centrifugal strain. The interleaving or alternate overlapping of the laminæ of adjoining sections and the passing of a bolt through the interleaved portion has been proposed; but this construction is disadvantageous because of the difficulty of removing and replacing a section.

My improved construction overcomes the tendency to break contact by centrifugal action quite as effectively as the one last referred to, while providing for a greater amount of iron in a given space and enabling the sections to be readily separated and reunited.

It is characteristic of that feature of my invention which involves the joining of the sections by a scarf-joint that the plane or planes of the overlapping or contacting faces of the joint are developed in directions parallel with the rotative axis, or approximately so, in contradistinction to being in planes perpendicular to the axis of rotation, as is the case with interleaved laminæ.

I claim as my invention the following defined novel features or combinations, substantially as hereinbefore specified, namely:

1. An annular armature-core consisting of sections constructed to overlap at their junction, the end portion of one section extending outside of the other, combined with supports for the sections adjacent to their joints and engaging the exterior overlapping end portion, whereby centrifugal action is resisted by said support and the inner overlapping ends are pressed into closer contact with the outer overlapping ends.

2. An annular armature-core consisting of sections united by scarf-joints, each section being formed with two projections at one end, a short projection at its inner side, and a long projection at its outer side, and on its opposite end with a projection adapted to enter between two similar short and long projections on the next adjoining section.

3. An annular armature-core consisting of sections united by scarf-joints and each section built up of leaves or laminæ in planes perpendicular to the axis of rotation, fastened together with their edges coincident at the joints.

4. An annular armature-core consisting of sections united by scarf-joints and each section consisting of leaves or laminæ arranged with their edges coincident at the joints, and outer plates between which the laminæ are confined, and bolts passing through from one plate to the other, whereby they are drawn together and the laminæ constituting one section are united independently of the other sections.

5. An annular armature-core consisting of sections united by joints, each section consisting of superposed laminæ fastened together, and exteriorly-rounded caps constituting the opposite sides of the sections and fastened to the laminæ.

6. An annular armature-core consisting of sections united by joints and each section consisting of leaves or laminæ and outer plates between which the laminæ are confined, with bolts passing through from one plate to the other, whereby they are drawn together, and exteriorly-rounded caps fastened against the opposite sides of the plates and formed with hollows to admit the bolt-heads and nuts.

7. An annular armature-core consisting of laminated sections built up of laminæ in planes perpendicular to the axis of rotation, united by scarf-joints in planes intersecting the laminæ, and with the laminæ in the successive sections meeting edge to edge in the planes of the joints.

8. An annular armature-core consisting of sections having exterior caps fastened against the sides of the sections, the caps being constructed to partially overlap at their ends the joints between the sections, whereby are formed reciprocal shoulders for preventing the relative lateral displacement of the sections in direction parallel with the axis of rotation.

9. An annular armature-core consisting of sections combined with a supporting-spider the arms of which engage the sections at their joints, the sections having caps or plates fastened against the opposite sides of the sections extending between the spider-arms and abutting at their ends against the spider-arms.

10. The combination, with an annular armature-core subdivided into sections, of a supporting-spider having as many radial arms as there are sections, and said arms constructed with heads extending across within the core from side to side thereof and parallel with and coinciding with the joints between the sections, and with hooked fingers or jaws embracing the opposite sides of the sections and overhanging the exterior thereof.

11. The combination, with a supporting-spider, of an annular armature-core consisting of sections united by scarf-joints, the one member of each of which joints extends ex-

terior to the other member, whereby, when engaged by said spider, the relative displacement in radial direction of said sections is prevented, and said sections being provided with oppositely-facing interengaging reciprocal lateral shoulders, as $s\ s'$ or $t\ t'$, for preventing relative displacement of the abutting ends of said sections in direction parallel with the axis of rotation.

12. The combination, with an annular armature-core subdivided into sections, of means for supporting the core and drawing the sections together, consisting of jaws $b\ b$, connected together and arranged against one side of the core and formed with beveled fingers $b'\ b'$, overhanging the exterior of the core, and similar jaws movable in direction parallel with the rotative axis toward and from the first-named jaws, arranged against the opposite side of the core and formed with beveled overhanging fingers $b'\ b'$, whereby, when the last-named jaws are moved toward the first-named jaws, the reciprocal action of the beveled surfaces of said fingers exerts a centripetal pressure against the sections.

13. The combination, with an annular armature-core subdivided into sections, of means for supporting the core and drawing the sections together, consisting of a spider having radial arms formed with jaws extending past one side of the core and said jaws having beveled fingers overhanging the exterior of the core, and a second set of similar jaws arranged at the opposite side of the core and formed with beveled fingers overhanging the exterior of the core and said last-named jaws movable toward and from the first-named jaws in direction parallel with the rotative axis, whereby, when they are moved toward the first-named jaws, the reciprocal action of the beveled surfaces of said fingers exerts a centripetal pressure against the sections.

14. The combination, with an annular armature-core subdivided into sections, of means for supporting the core and drawing the sections together, consisting of two spiders movable relatively to one another in direction parallel with the axis of rotation and formed with jaws extending over opposite sides of the core, said jaws having beveled fingers overhanging the exterior of the core, whereby, when the two spiders are drawn together, the reciprocal action of the beveled surfaces of said fingers exerts a centripetal pressure against the sections.

15. The combination, with the sectional core D, of the fixed spider F, having jaws $b\ b$, formed with beveled fingers $b'$, the movable spider F′, having similar jaws, and the nut $g$, for forcing the spider F′ toward the spider F.

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

JAMES J. WOOD.

Witnesses:
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