J. W. PEARSON.

ARMATURE.

APPLICATION FILED SEPT. 12, 1918.

1,338,093.

Patented Apr. 27, 1920.

2 SHEETS—SHEET 1.

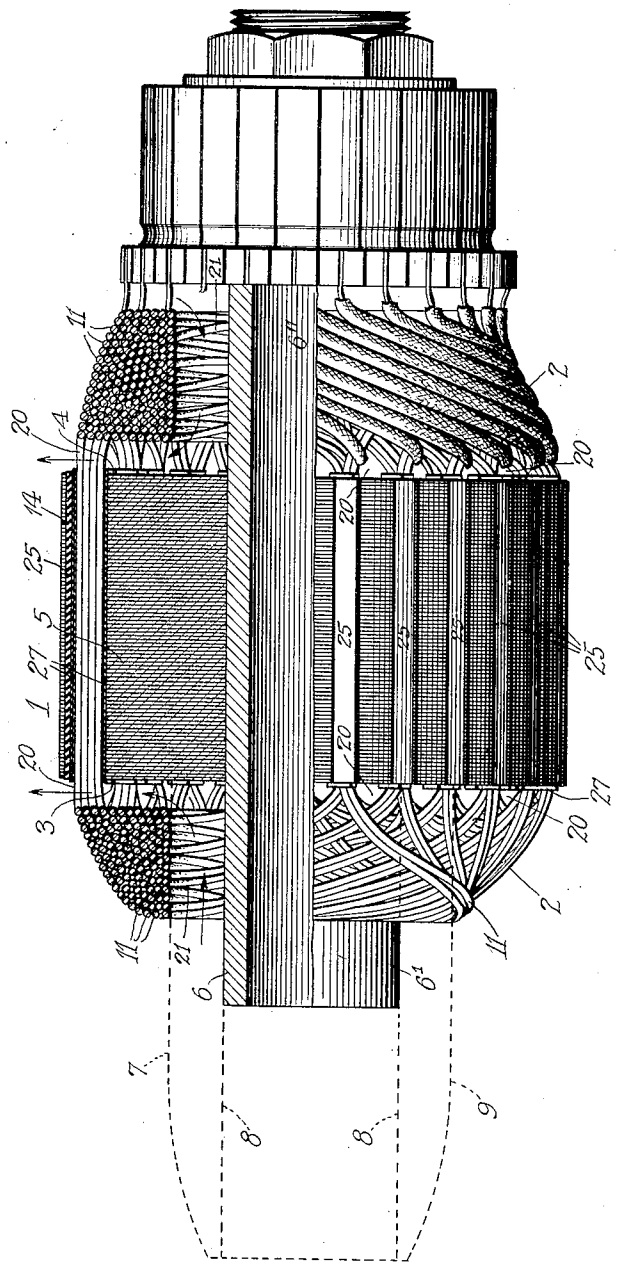


Fig. 1.

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2 SHEETS—SHEET 2.

Fig. 2.

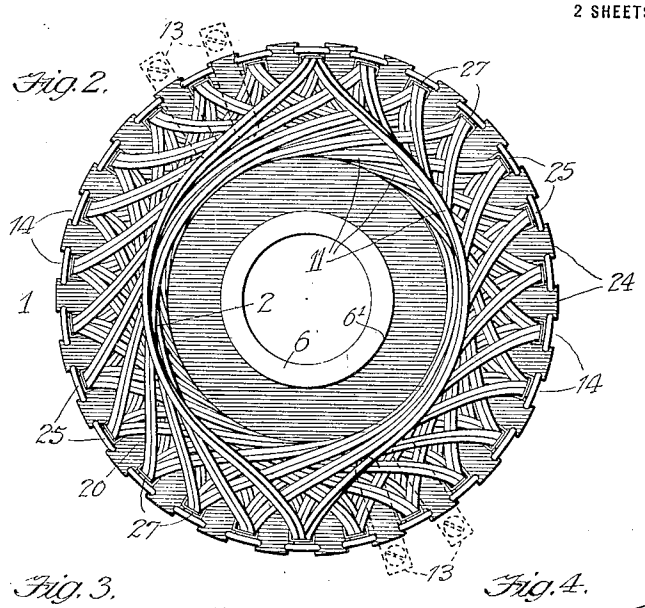


Fig. 3.

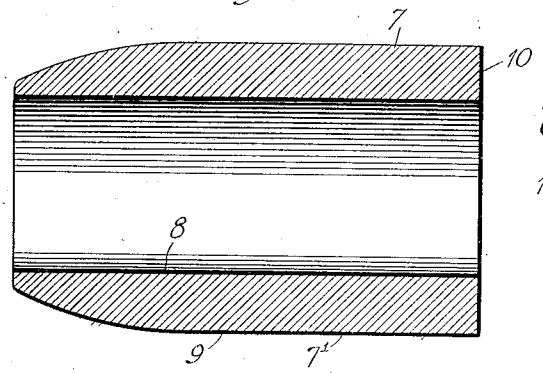


Fig. 4.

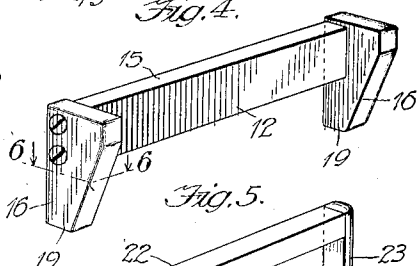


Fig. 5.

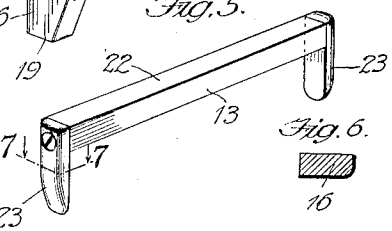


Fig. 6.

Fig. 8.

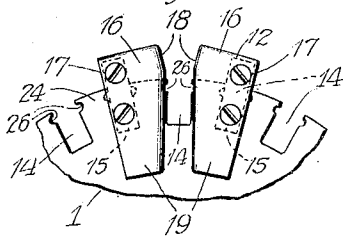


Fig. 9.

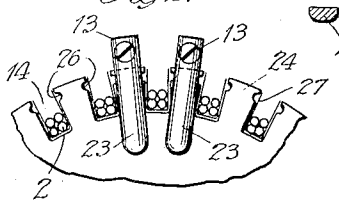
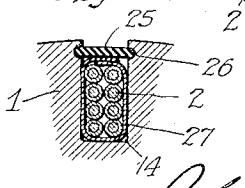


Fig. 7.



Fig. 10.



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UNITED STATES PATENT OFFICE.

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ARMATURE.

1,338,093. Specification of Letters Patent. Patented Apr. 27, 1920.

Application filed September 12, 1918. Serial No. 253,746.

To all whom it may concern:

Be it known that I, JOHN W. PEARSON, a citizen of the United States of America, and a resident of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Armatures, of which the following is a specification.

This invention relates to rotor windings and to methods and means for applying same, and more particularly to the mechanical disposition of the conductors on the core and across the ends of slot-wound drum armatures intended for high speed operation.

The main objects of the invention are to place and arrange the end loops or cross-over parts of the windings in such manner that they may inherently hold themselves stably in definite fixed relation for all speeds, especially on high voltage armatures, and will effectively resist all tendency of centrifugal force to displace them or to throw the armature out of balance mechanically when run at a high speed; to so arrange and group the conductors at and adjacent to the ends of the armature as to provide for more efficient ventilation and cooling of the windings; to provide an improved method or process for definitely and positively positioning such parts of the conductors as project beyond the ends of the core in self-sustaining position; and to provide suitable means adapted for guiding and supporting the conductors in place during the winding process in course of manufacture.

Heretofore, in winding armatures of the general character referred to, it has been customary to let the end loops lie close against the armature shaft and to make relatively sharp turns in the conductors at the ends of the slots. In order to secure the coils in place it has been largely the practice to use band wires, but such wires are subject to certain well-known evils and are always to be avoided whenever possible. Such wires interfere with interior air circulation and moreover, the usual arrangement of conductors at the ends of the armature is not inherently conducive to efficient ventilation. As usually wound, there is a tendency on the part of the end loops to fly outward centrifugally from the shaft and so, because of the more or less unsymmetrical resultant position of the conductors, to throw the armature out of balance mechanically, resulting in such vibration as to limit the practical and safe operating speed of the machine. By the present invention, the coils are inherently self-sustaining in mechanical balance, and efficient ventilation is well provided for by virtue of maintaining the conductors of the several slots in mutually spaced groups for a short distance beyond the ends of the slots whereby radial air passages are provided communicating at their inner ends with a common cylindrical passage through which air is drawn toward the core and outward through the radial branches, as hereinafter explained.

An illustrative embodiment of this invention is shown in the accompanying drawings, in which—

Figure 1 is mainly a side elevation of a finished armature embodying the invention, part of the device being in axial section.

Fig. 2 is an elevation of the non-commutating end of the armature.

Fig. 3 is an axial section of the guide shown by dotted lines in Fig. 1.

Fig. 4 is a perspective view of the initial turn guide member.

Fig. 5 is a perspective view of the finishing turn guide member.

Fig. 6 is a section on the line 6—6 of Fig. 4.

Fig. 7 is a section on the line 7—7 of Fig. 5.

Fig. 8 is a fragmentary view showing a pair of slot guides (of Fig. 4) in place ready for the initial windings.

Fig. 9 is a fragmentary view showing a pair of tooth guides in place ready for the outer windings.

Fig. 10 is an enlarged detail showing one of the slots and a set of conductors secured in place therein.

In the illustrative embodiment shown in the drawings, the drum-wound slotted core armature 1 is of the usual character, so far as its electrical features are concerned, but the windings 2, instead of being bent inward sharply against the ends 3 and 4 of the core

5 and disposed close against the shaft 6 adjacent to said core ends, are spaced therefrom as shown in Fig. 1. Such spacing is in part provided for in the process of winding the armature by means of a pair of hollow guide tools 7 placed at the ends respectively, said guide members being formed cylindrically on their inner sides 8 and somewhat conically on their exteriors 9. The guides 7 are adapted to fit on the projecting ends 6′ and 6″ of the shaft and to abut at their base ends 10 against the ends of the core just inside the slotted part, so that when the winding 2 is applied, the end loops 11 at and adjacent to their middle points are spaced from the shaft substantially in accordance with the thickness of the guide base as shown in Fig. 1.

The said base of the guide 7 is nearly cylindrical, but is preferably largest a short distance from its thicker end, as at 7′, and is accordingly beveled slightly for a corresponding distance from the base or inner end, so as to permit ready removal of the guide after the coils are in place. When the guides 7 are removed, the end loops remain separated from the shaft by a substantially cylindrical air space, which facilitates ventilation. Moreover, the curvature and arrangement of the loops is such that the conductors furnish mutual support for one another.

The spacing of the loops from the core ends 3 and 4 is effected in the course of winding by means of certain guide tools 12 and 13 having certain adjustable relation to the ends of the core slots 14, as will be hereinafter explained.

In order that the windings may be perfectly balanced both mechanically and electrically, each coil is divided at the heads, half of the turns being deflected to one side of the shaft and the other half to the opposite side, as well shown in Fig. 1.

By virtue of the expanded or relatively outward cylindrical position of the loops in spaced relation to the shaft, the stress arising from centrifugal force in any conductor loop 11 may for convenience in considering the device analytically be resolved into two components, one longitudinal with the conductor, and the other transverse thereto. The former is readily opposed by the tensile strength of the conductor and the other by the solidly banked relation of the loops. By the present construction, the first-mentioned factor is relatively much larger than in the usual form of winding.

In winding the coils on the armature, two pairs of each kind of slot guides 12 and 13 are provided, the first set for applying the initial turns, and the second set for applying the subsequent and finishing turns. Each set of said guides comprises four similar members, two for each of the pairs of slots in which a given coil is to be wound. This arrangement is illustrated by the four dotted guides 13 shown in Fig. 2.

Each guide member 12 of the first set comprises a flat bar 15 adapted to fit in a slot 14 and to project somewhat from the cylindrical face of the armature when the bar rests in the bottom of the slot, as shown in Fig. 8. Said bar is provided with a transversely disposed plate or head 16, one side or edge 17 of which may be flush with the side of the bar, and the other edge 18 of which projects laterally sufficiently to register with the adjacent edge of the next slot. Said head also projects inwardly as at 19 toward the center of the core, somewhat beyond the bottom of the slot. In use, these guides are arranged in pairs on opposite sides of diametrically opposite slots, or slots which are 180 electrical degrees apart, with their laterally projecting heads turned inward toward each other so as to guide the conductors as they are wound into place. After placing a certain part of the windings for a given pair of slots in position, the guides are set for the next pair of slots, and so on around the core. The second set of guides is then applied, as will be explained.

When the conductors are looped across the ends of the armature, the heads of the guides prevent sharp turns and provide radial openings 20 between the coils of adjacent slots. These radial openings communicate with the cylindrical openings 21 hereinbefore mentioned and so provide an efficient ventilation path for air, the movement of which, in accordance with the arrows shown on Fig. 1, is induced by centrifugal force, as will be understood. Although this ventilation feature is not so clearly shown on the commutator end as on the opposite end, it is to be understood that while the leads extending to the commutator bars in some measure block and hide the air circulation path, still this feature exists very effectually at both ends of the armature.

Each guide member of the second set of tools, namely 13, above referred to, comprises a bar 22 provided with a head 23 on each end. Said bar is formed of substantially the same width as a core tooth 24, so that its sides are flush with the sides of the tooth whereon it rests, and hence also with the corresponding slot sides. The heads 23 are of the same width as the bar and are spaced apart according to the length of the core. Said heads are somewhat wedge-shaped and when the tool is in use, extend inward radially toward the axis, opposite the ends of the tooth and between the first layers of the winding already in place, as shown in Figs. 2 and 9. When said tools 13 are thus arranged in pairs on opposite sides

of slots disposed 180 electrical degrees apart, the outer turns of the coil may be readily wound into place, said heads 23 serving to insure proper curvature of the conductor adjacent to the end of the slot and a suitable spacing sufficient to provide an outward extension of the initial part of the radial air passages 20 which are disposed opposite each tooth.

In order that the curvature of the conductors where they bend around the heads of the above-mentioned tools may be even and free from sharp bends, and also in order to prevent possible injury to the insulation, the edges of the heads 16 and 23 against which the windings are placed are suitably rounded, as may be seen by reference to the drawings.

The inductively active part of the coils, namely the part lying in the slots, is secured tightly in place by the slot closure wedges 25 driven into grooves 26 adjacent to the outer edges of the slots. The slots 14 are each lined with fiber board 27 or the like, to protect the conductors, as shown in Fig. 10.

The conductors are wound on the armature under tension directly from the supply spools, the armature being held in a vise-like, two-jawed chuck, adapted to fit on a suitable power driven winding-head, as will be understood (though not shown), so that the windings are thus all caused to fit tightly in place throughout their entire length.

The shaft 6 may be made hollow so as to facilitate, in certain forms of construction, interchangeability of armatures.

It will be noted that the form of winding of this invention is especially adapted for two-pole machines, the general plane of the end loops of the greater part of the coils being inclined at an angle of about 45° to the shaft of the armature, and the loops being tightly wound mutually support one another in place.

Although but one specific embodiment of this invention is herein shown and described, it will be understood that numerous details of the construction shown may be altered or omitted without departing from the spirit of the invention as defined by the following claims.

I claim:

1. A guide adapted for use in applying the coils of slot-wound armatures, comprising a flat bar adapted to fit edgewise in the slot and having heads at its ends projecting laterally substantially flush with the near wall of the next adjacent slot.

2. A guide for use in winding slotted drum armatures, comprising a bar adapted to lie upon the outer face of a tooth and having heads at its ends of substantially the same width of the tooth whereby its edges are substantially flush with the adjacent sides of the two next adjacent slots.

3. Means for providing radial air spaces between successive coils adjacent to the core ends, said means comprising a bar having a pair of transverse head pieces on its ends respectively, said bar being of sufficient length to hold said pieces against the ends of the core, and said pieces each being formed to project inward toward the armature axis and to be flush at its edge with the side of the next adjacent slot.

4. The method of applying the windings to a slot-wound drum armature which consists in placing a set of four guide members in pairs in the slots next adjacent to the two respective slots for the opposite sides of a given coil, winding part of the coils into place and then substituting another set of guides comprising two pairs disposed upon the teeth next adjacent to the said slots respectively for the said winding, and then completing the coil.

5. A drum armature having a shaft, a core, and windings secured thereon including paired conductors, the end loops of which are disposed in stable and symmetrical balance in the resultant position that they would tend to assume if they were laid out against the shaft and then were thrown outward by centrifugal force in opposition to the stiffness of the conductors to a natural position of stability for the normal speed between the shaft and the core end.

Signed at Chicago this 12th day of September 1917.

JOHN W. PEARSON.