

J. BIJUR.
 ARMATURE FOR DYNAMO-ELECTRIC MACHINES.
 APPLICATION FILED DEC. 6, 1913.

Patented Aug. 21, 1917.
 2 SHEETS—SHEET 1.

1,237,459.

Fig 1.

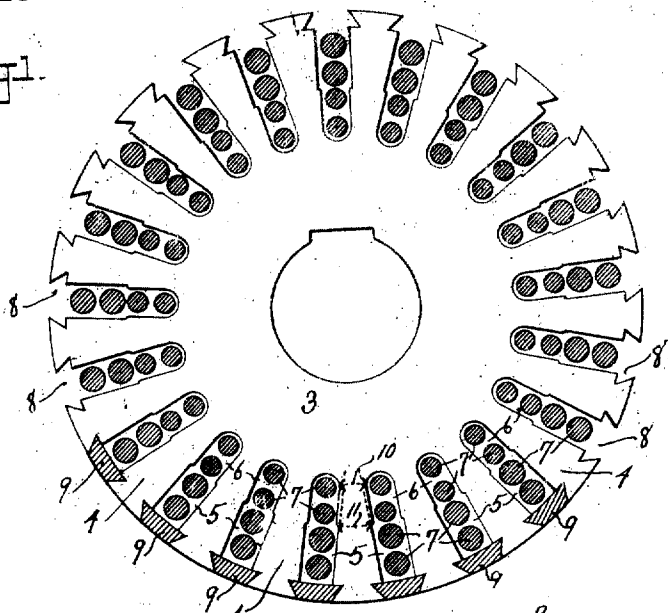


Fig 2.

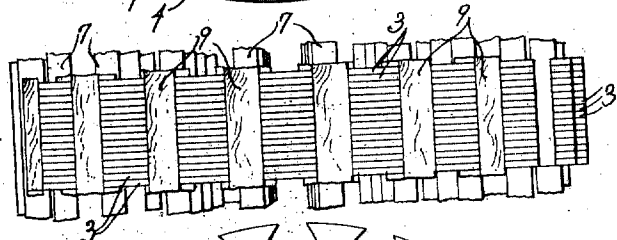
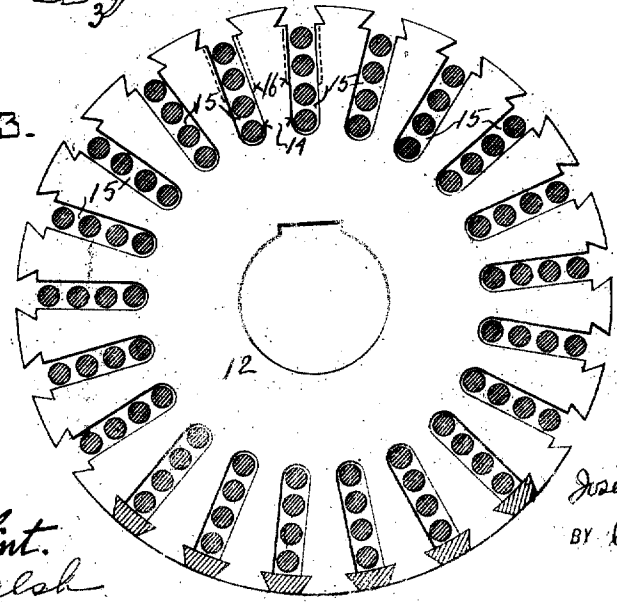


Fig 3.



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A. V. Walsh.

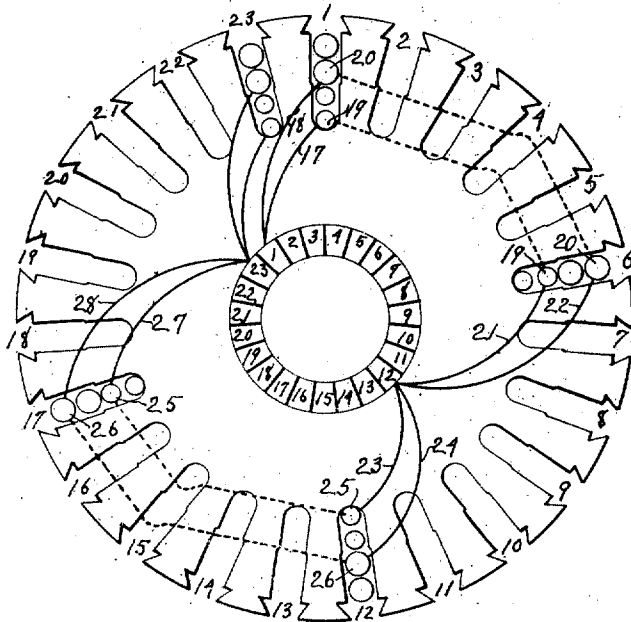
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Fig. 4.



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UNITED STATES PATENT OFFICE.

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ARMATURE FOR DYNAMO-ELECTRIC MACHINES.

1,287,459.

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To all whom it may concern:

Be it known that I, JOSEPH BIJUR, a citizen of the United States, and a resident of New York, borough of Manhattan, in the county of New York and State of New York, have made and invented certain new and useful Improvements in Armatures for Dynamo-Electric Machines, of which the following is a specification.

10 My invention relates to armatures for dynamos, motors and similar machines of the type having a series of longitudinally extending teeth, with intervening grooves within which the coils or winding of the armature lie; and the object thereof is to provide an armature in which the grooves and teeth are so formed as to permit the use of a greater amount of winding, or more coils, with an armature of a given diameter, than has been possible in armatures as heretofore constructed. A further object of my invention is to provide an improved winding or arrangement of the coils or wires of an armature of the type herein referred to.

25 With the above and other objects in view, my invention consists in the improved armature for dynamo-electric machines illustrated in the accompanying drawings and hereinafter described and claimed, and in such variations and modifications thereof as will be obvious to those skilled in the art to which my invention relates.

In the drawing wherein the preferred embodiment of my invention is illustrated:

35 Figure 1 is a view showing a section of my improved armature upon a plane perpendicular to the axis of rotation thereof;

Fig. 2 is a view showing a portion thereof in plan;

40 Fig. 3 is a view similar to Fig. 1 but showing an old form of armature and illustrating the advantages secured by my invention; and

45 Fig. 4 is a diagrammatic view illustrating the scheme of winding employed.

The core of my improved armature is made up of a large number of thin circular disks of soft iron arranged side by side and secured together to form a unitary structure, as is common in armature construction, which disks are designated by the reference numeral 3, Figs. 1 and 2. The core thus formed is provided with a series of longitudinally extending teeth 4, whereby inter-

vening grooves are formed within which 55 grooves the wire is wound which forms the coils or winding of the armature.

Fig. 1 of the drawing illustrates the form of longitudinally extending teeth and grooves employed in my improved armature, 60 the grooves having a wider outer portion designated by the numeral 5 and a narrower inner portion 6 extending inward from the bottom of the outer groove, both said portions being shown as having parallel side 65 walls. The wires which form the armature winding are indicated by the shaded circles 7 appearing within the grooves, although it will be understood that the drawing is intended to be conventional as to the winding, 70 and that each groove will contain as many wires of such a diameter as may be necessitated by the particular service for which the armature is intended, these features being matters of design. 75

In Fig. 4 of the drawings is shown a suitable form of armature winding. In this figure each separate coil is in the form of a U-shaped loop, as is usual in armature construction, but the several loops are made of 80 different size wire, and are so connected with one another and with the commutator segments as to form two superposed layers or sections, one of coarser wire located in the wider outer portions of the grooves and 85 the other of finer wire located in the narrower inner portions of the grooves, the two layers or sections of the winding considered as a whole being connected in parallel with one another. Each layer or section is in turn 90 shown as made up of two superposed loops or wires of the same cross section. Thus, referring to Fig. 4, the ends 17, 18 of fine and coarse wire loops 19, 20 located respectively 95 in the narrower inner and wider outer portions of the grooves are shown as connected with a commutator segment 1, while the other ends 21, 22 of these loops are connected with an oppositely located commutator segment 12, the loops being thus connected in 100 parallel with one another. The ends 23, 24 of other similar loops 25, 26 are likewise connected with the commutator segment 12, while the other ends 27, 28 of these last-mentioned loops are in turn connected with 105 an oppositely located commutator or segment 23. This scheme of winding and connection with the commutator segments will

be continued around the armature several times and until all the loop ends are connected with the commutator segments, as will be understood, thus providing a winding which, considered in its entirety, is made up of two superposed layers or sections connected in parallel with one another, the individual wires of the outer section being larger, or of greater area, than the individual wires of the inner section in the embodiment of my invention illustrated.

The winding may be held in place within the grooves in any way. I have, however, shown the core as provided with longitudinally extending dove-tailed recesses 8 at the outer ends of the grooves, along which strips 9 of non-magnetic material are driven after the winding has been completed, whereby the wires will be securely held in place, as will be understood.

Referring now to Fig. 1 of the drawing, and remembering that when an armature is in use a flow of lines of magnetic force occurs between poles of opposite polarity through the armature core and either diametrically across the same or through a portion of one side thereof, according to the arrangement of the poles, it will be seen that the maximum permissible cross-sectional area of the grooves is determined and limited by the minimum area of the path along which the flow of magnetic flux takes place; that is, by the sum of the areas of the bases or roots of those of the teeth through which the flow of magnetic flux occurs, (it being obvious that when the armature is in use the flow of the lines of magnetic force will occur simultaneously through several teeth) as the cross-section of the path along which the lines of magnetic force flow is the least at the roots of the teeth. Thus, referring to Fig. 1, the reference numeral 10 indicates the width of a tooth root, and the area of the tooth root computed by multiplying its width by its length must obviously be sufficiently great to avoid saturation of the iron by the portion of the flow of magnetic flux which takes place through the tooth.

It will be appreciated that in designing an armature of a given diameter and assuming a certain minimum width of tooth root necessary to avoid saturation, the permissible cross-sectional area of the grooves might be found insufficient to accommodate the amount of armature winding necessary. In such a case the wider outer portion of the grooves cannot be made deeper to accommodate the necessary amount of winding, as to do so would reduce the area of the tooth root, as will be understood from the dotted lines, Fig. 1, to such an extent that saturation of the iron at the tooth root would occur. It has therefore been necessary, in armatures as heretofore constructed, to increase the diameter of the core in cases

where the cross-sectional area of the grooves necessary to accommodate the winding would result in too great a reduction of the area of the tooth root, in order to avoid saturation at the tooth roots.

In an armature constructed in accordance with my invention, however, in which a narrower inner groove is provided extending inward from the bottom of the wider outer groove, it is possible to materially increase the cross-sectional area of the grooves without reducing the area of the tooth root to such an extent that saturation will occur, and thereby provide for an increased amount of armature winding. Thus, referring to Fig. 1, the area of the tooth at 11 is substantially the same as at 10, which latter area is assumed as a starting point in designing the armature, and is sufficiently great that saturation will not occur at the tooth root; and no saturation of the metal will occur although the cross-sectional area of the grooves has been materially increased by narrowing the grooves and extending them farther into the body of the core, whereby more winding may be placed upon the armature, this result having been attained without increasing the diameter of the armature.

Fig. 3 illustrates in another way the advantages secured in my improved armature, in which figure the armature is shown as made up of disks 12 having grooves of uniform width. If the area of the tooth root at 14, which is determined by physical characteristics of the iron of the core and the amount of magnetic flux or number of lines of force passing through the tooth, is taken as a minimum, and if the resulting area of the grooves is insufficient to accommodate the necessary amount of winding, the grooves 15 may be widened at their upper ends, as indicated in dotted lines, without decreasing the area of the path along which the flow of magnetic flux occurs. Thus the area at 16 is as great as the area at 14, and no saturation will occur, although the area of the grooves will be considerably increased.

By properly proportioning the outer and inner grooves an armature having a given predetermined diameter and amount of winding may be so designed as to increase the area of the tooth root over the area in case the grooves were of uniform width throughout, thus decreasing the resistance of the path of the lines of force and increasing the efficiency of the armature, as the core is worked farther below the point of saturation; and the fact that the area of the grooves is increased for a given diameter of armature and area of tooth root permits more winding to be used, and provision made for more ampere turns upon the armature than would be the case if the grooves were of uniform width, thus materially increasing the torque when the armature is

used in a motor, without changing the diameter or other fixed dimensions thereof. This increase in torque is accompanied by an increase in speed, other conditions being unchanged, because of the fact that provision is made for a greater area of armature winding which obviously reduces the resistance of the armature winding as hereinbefore explained.

10 Toothed armatures of the type heretofore in common use have been deficient in torque because of the fact that the area of the tooth root has been small because of the fact that as large an area as possible has had to be provided in the grooves to accommodate the necessary amount of armature winding, and saturation at the tooth root has commonly occurred. In my improved armature, however, the area at the tooth root is increased for an armature of a given diameter, and a greater total area for the reception of the winding of the armature is provided, thus reducing the density of the magnetic flux at the tooth root to a point at which saturation will not occur. This obviously permits the flow of a greater amount of magnetic flux along the teeth and across the tooth root and secures a greater torque as hereinbefore explained.

30 Having thus described and explained my invention, I claim and desire to secure by Letters Patent:

1. An armature provided with an inner winding of conductors and with an outer winding of larger conductors, each winding being complete in itself and the two windings being connected in parallel.

2. An armature provided with a slot wider at the outer portion than at the inner portion, a complete winding in the inner portion and a complete and larger winding in the outer portion, the two windings being connected in parallel.

3. An armature having slots narrower at their inner portions than their outer portions, each inner portion carrying a winding of one coil in each slot and each outer portion carrying a winding of one coil in each slot, the two windings being similarly dis-

posed mechanically and electrically connected in parallel. 50

4. In armature construction for dynamo electric machines, in combination, an armature having a plurality of radially disposed slots extending longitudinally thereof, said slots being narrower at their inner end portions in a direction circumferentially of the armature than at their outer end portions, a conductor in the narrower portion of each of said slots, a conductor of larger diameter in the wider portion of each of said slots, and means connecting said conductors in parallel in the winding of the armature. 60

5. In armature construction for dynamo electric machines, in combination, an armature having a radially disposed slot extending longitudinally thereof, said slot being narrower at its inner end portion in a direction circumferential of the armature than at its outer end portion, a conductor round in cross section in the narrower portion of said slot, a conductor round in cross section of larger diameter in the wider portion of said slot, and means connecting said conductors in the winding of the armature. 75

6. In armature construction for dynamo electric machines, in combination, an armature having a radially disposed slot extending longitudinally thereof, said slot being narrower at its inner end portion in a direction circumferential of the armature than at its outer end portion, a plurality of radially superposed conductors round in cross section and resting within the narrower portion of said slot, a plurality of radially superposed conductors round in cross section and of larger diameter resting within the wider portion of said slot, and means connecting said conductors in the winding of the armature. 90

Signed at New York borough of Manhattan in the county of New York and State of New York this 2nd day of December, A. D. 1913.

JOSEPH BIJUR.

Witnesses:

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GEORGE E. COOK.