Jan. 13, 1931. V. G. APPLE **1,789,128**

BAR WINDING

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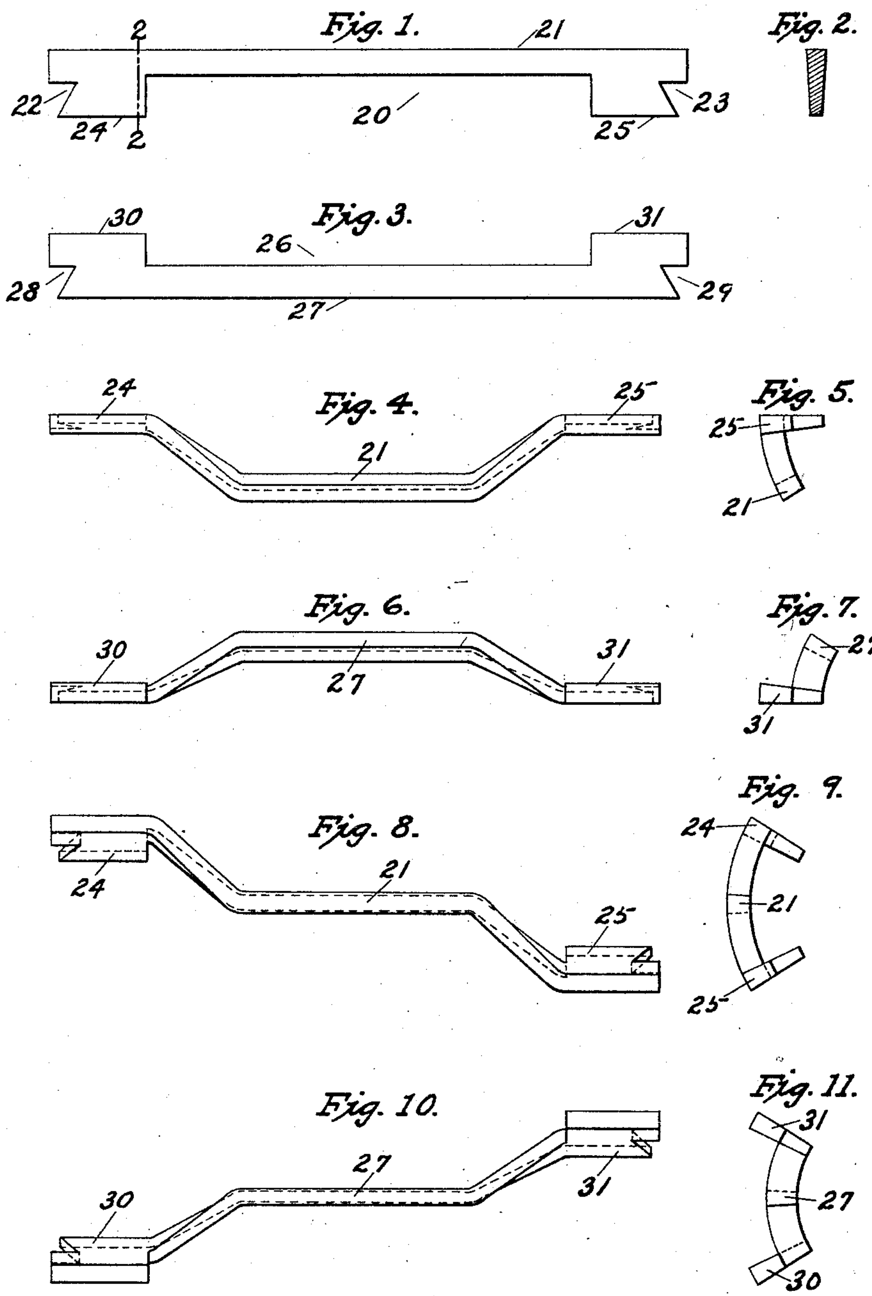


INVENTOR
Vincent G. Apple

Fig. 12.

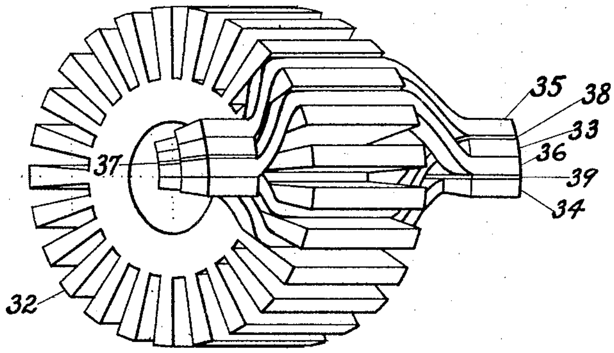


Fig. 15.

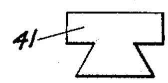


Fig. 13.

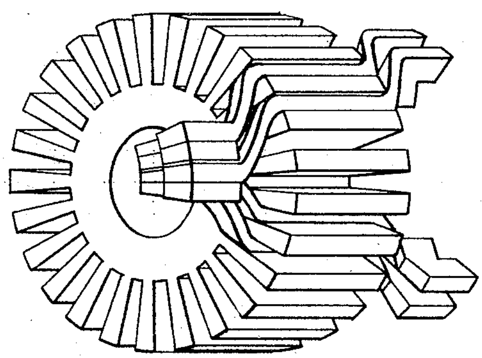


Fig. 16.

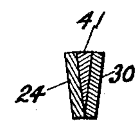
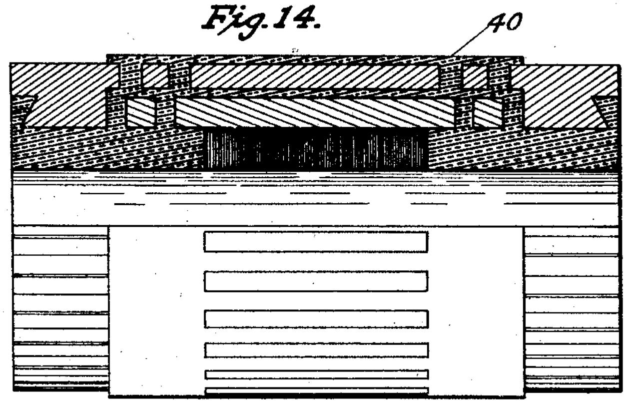


Fig. 14.



INVENTOR

Vincent G. Apple

Patented Jan. 13, 1931 1,789,128

UNITED STATES PATENT OFFICE

VINCENT G. APPLE, OF DAYTON, OHIO

BAR WINDING

Application filed December 9, 1927. Serial No. 238,956.

My invention relates to bar windings for dynamo-electric machine elements, and is particularly applicable to those having cores with open winding slots.

One of the objects of my invention is to provide a winding of this type which is simple of construction, easily assembled and which eliminates all soldered or welded joints, and provides a large commutator wearing surface for the brushes.

Another object is to combine a winding of this type with such methods of assembling into a complete armature as will result in a finished product of greater durability and dependability and of better appearance than when built by present methods.

Other objects will become readily apparent to those skilled in the art from a consideration of the following description and drawings wherein a form of the invention is described and illustrated. Referring to the drawings—

Fig. 1 is an outer layer bar before bending.

Fig. 2 is a cross section taken on line 2—2 Fig. 1.

Fig. 3 is an inner layer bar before bending.

Fig. 4 is an outer layer bar bent for a lap winding.

Fig. 5 is an end view of Fig. 4.

Fig. 6 is an inner layer bar bent for a lap winding.

Fig. 7 is an end view of Fig. 6.

Fig. 8 is an outer layer bar bent for a wave winding.

Fig. 9 is an end view of Fig. 8.

Fig. 10 is an inner layer bar bent for a wave winding.

Fig. 11 is an end view of Fig. 10.

Fig. 12 shows two inner layer bars and two outer layer bars laid in a core for a lap winding.

Fig. 12 shows two inner layer bars and two outer layer bars laid in a core for a lap winding.

Fig. 13 shows two inner layer bars and two outer layer bars laid in a core for a wave winding.

Fig. 14 shows a completed armature, partly in section.

Fig. 15 shows the outline of a pad which may be combined with the commutator lugs to compose a commutator segment.

Fig. 16 shows two lugs of rectangular cross section combined with a pad of wedge shaped cross section to compose a commutator segment.

The conventional method of making bar wound armatures consists of forming a plurality of loops of drawn or roller bar copper, each loop representing one turn of the winding, placing the legs of the loops in the core slots and joining the beginning and end of each loop by soldering to bars of a conventional commutator. As the volume of current passing thru an armature circuit of this type is very large it frequently happens that the solder is melted at the joints and the usefulness of the armature impaired. In eliminating the separate costly commutator and the labor necessary to joining the windings to it, by combining the winding and commutator, and in providing a brush track at each end of the armature, I provide a structure which is not only novel but which is adapted to current of large volume and at the same time insures a degree of durability not to be found in common practice.

In Fig. 1 a length of bar stock is cut away as at 20 leaving a conductor leg 21 which may be termed an outer conductor leg because it becomes a part of the outer layer of the winding. The ends of the bar are notched, as at 22 and 23, thus forming commutator lugs 24 and 25.

In Fig. 3 a length of bar stock is cut away as at 26, leaving a conductor leg 27 which may be called an inner conductor leg as it becomes a part of the inner layer of the winding. The ends of the bar are notched, as at 28 and 29, to form commutator lugs 30 and 31.

Stock from which these bars are cut is preferably of a cross section shown in Fig. 2.

As a commutator division in the complete armature is made up of two such lugs, as 24 and 30, or 25 and 31, in electrical contact we may call two such lugs thus joined a commutator segment.

When the armature is to be lap wound the bar shown in Fig. 1 is bent as in Fig. 4 and end view Fig. 5, and the bar shown in Fig. 3

is bent as in Fig. 6 and end view Fig. 7, but when the armature is to be wave wound the bar shown in Fig. 1 is bent as in Fig. 8 and end view Fig. 9 and the bar shown in Fig. 3 is bent as in Fig. 10 and end view Fig. 11, and while in the drawings the bends are such that the two halves of a pair are angularly displaced equal amounts they may be bent the one more than the other as long as the sum of the bends is sufficient to compose a turn of the winding which usually spans approximately a pole pitch.

While I have here shown and described a method of making an integral winding unit comprising a half turn of the winding having half of a commutator segment at each end, by using wedge shaped bar stock, it is to be understood that I do not wish to limit myself strictly to this form of stock nor to the method of making the winding unit, as there are occasions when conductors of rectangular cross section must be supplied for core slots of that shape, in which case I provide winding units having the conductor legs of a rectangular cross section and commutator lugs of a wedge shaped cross section, a convenient method of producing such bars is to make parts as in Fig. 1 and Fig. 3 from bars of rectangular cross section or from flat sheets, thus leaving conductor legs 21 and 27 of a rectangular cross section and bringing the lugs 24, 25, 30 and 31 to a wedge shape by forging or striking in a die or similar means and while for clearness I have described methods of making these bars as a process requiring several operations it is apparent that cutting and bending, or forging and bending may be combined into one operation, or the complete bar may be forged or cast to its finished form.

Another method of producing these bars consists of using bar stock of such size and cross section as will provide one conductor leg of whatever section the core slot requires and upsetting and forging the ends into commutator lugs of the size and shape required.

Still another method of producing bars to meet a situation where the core slots have parallel sides thus requiring rectangular conductors, is to cut the outlines shown in Figs. 1 and 3 from a bar of rectangular cross section or from flat sheets and where two commutator lugs thus formed are brought together to make a commutator segment the wedge shaped cross section necessary to a commutator segment may be formed by inserting between the two said lugs a pad of wedge shape cross section cut preferably to an outline shown at 41, Fig. 15, thus forming, as shown in Fig. 16, a wedge shaped commutator segment comprising rectangular lug 24, wedge shaped pad 41 and another rectangular lug 30.

It is obvious that the method of completing the commutator segment by adding a pad may be extended to include bars having conductor legs and commutator lugs of any cross section whatsoever so long as the pad supplies the difference between the combined cross section of the two lugs and that required in the commutator segment, and occasions may arise where the padding supplied may be in several parts of smaller section, and the padding may be placed either between the lugs or the lugs may be adjacent and the padding added thereto, and while a bar as shown in Fig. 1 or 3 is shown as consisting of a single layer, it may be laminated material if desired.

In Fig. 12 a core 32 is shown in which two bars 33 and 34 composing part of the inner layer of a lap winding and two bars 35 and 36 composing part of the outer layer of a lap winding have been assembled, the purpose of the illustration being to show that in order to provide a continuous circuit it is only necessary to observe care in placing the spacers 37, 38, 39, etc., in such a manner that any two bars having commutator lugs adjacent and in electrical contact at one end will have their commutator lugs at the other end spaced apart by insulation material, the number of spacers used being half the number of commutator lugs so that between each spacer will be two lugs in electrical contact to make one commutator segment.

In Fig. 13 the core 32 is shown having two outer and two inner layer bars which have been bent for a wave winding and the method of pairing the lugs is similar to that shown in Fig. 12 except that because of the manner in which the bars are bent the successive turns of the circuit will be spaced apart substantially a pole pitch instead of being adjacent. As the difference between a lap and a wave winding is well known in the art no further description need be given.

Other requirements of common practice must be observed, such as lining the core slots with insulation material, keeping the outer and inner layers of the winding separated, etc.

When all the slots in a core have been filled in a manner as in Figs. 12 or 13 the whole structure must be securely bound together and an improved means of binding is shown in the half section at 40, Fig. 14. This method consists of placing the assembled core and bars in a mold and molding insulation material through and about them in such a manner as to make a solid mass, leaving a commutator at each end. It is essential that the two halves of each segment be held in intimate electrical contact while molding is being effected.

While in the drawing a commutator is shown of a diameter but slightly smaller than the armature core it is obvious that the relative diameter of the commutator and core may be varied by properly proportioning the relative thickness of commutator lugs and conductor legs. The commutator lugs may be thickened by forging, or by padding similar to the manner shown in Fig. 12, or the loops may be cast or otherwise produced with any relative thickness of commutator lug to conductor legs, and while in the drawings the bent part of conductors commonly known as the leads extend helically from the core in two concentric cylindrical layers it is apparent that when the winding and commutators are of different diameters these leads may extend from the core in conical layers or in extreme cases they may be in longitudinally adjacent layers, the leads extending spirally away from the axis in the well known involute end connected arrangement.

Having described my invention, I claim—

1. An integral unit of a two layer bar winding for an armature having one layer wound about the other layer comprising, a bar of the outer layer of said winding having an axially parallel portion at each end offset inwardly from said bar and notches at the outer ends of said axially parallel portions for a commutator binding means to engage, each said axially parallel portion being adapted to compose one half of a commutator segment.

2. An integral unit of a two layer bar winding for an armature having one layer wound about the other layer comprising, a bar of the inner layer of said winding having an axially parallel portion at each end offset outwardly from said bar and notches at the outer ends of said axially parallel portions for a commutator binding means to engage, each said axially parallel portion being adapted to compose one half of a commutator segment.

3. As an article of manufacture, a turn of an armature winding consisting of two bars, the one comprising integrally in the following order, a commutator lug, one half turn of the inner layer of the winding, then another commutator lug, the other comprising integrally in the following order, a commutator lug, one half turn of the outer layer of the winding, then another commutator lug and notches at the outer ends of said lugs for a commutator binding means to engage, one lug of one bar being adjacent to and in contact with one lug of the other bar to electrically complete the turn, and the other two lugs so disposed as to make similar contact with the lugs of succeeding turns.

4. In a bar wound dynamo electric machine armature, the combination of a slotted core, a plurality of bars in said slots in two concentric layers, axially parallel lugs at the ends of the bars of substantially double the depth of the bars and of a length suitable for a brush track, the lugs of bars of the outer layer being offset radially inward and the lugs of bars of the inner layer being offset radially outward whereby the lugs are arranged in a single cylindrical layer at each end of the core, notches in the ends of the lugs, and molded insulating material extending into said notches to bind the ends together to form a commutator at each end of the armature.

5. The method of making an armature of large current capacity, which consists of providing a slotted core, providing a number of bars corresponding to the number of core slots, each bar being of a cross section to substantially fill a slot but considerably longer than said core, cutting away the inner half of half of the bars and the outer half of the other half of the bars at the middle part of their length leaving full width ends of sufficient length to compose commutator segments, notching the full width ends, circumferentially displacing the full width ends relative to the middle part of the bars, assembling the bars in the core slots, the middle part in two concentric layers and the ends extending parallel to the core axis in a single cylindrical layer and molding insulating material thru and about the ends and into the said notches to hold pairs of said ends in electrical contact to compose commutator segments and the segments spaced apart to compose a commutator at each end of the core.

In testimony whereof I hereunto subscribe my name.

VINCENT G. APPLE.