Jan. 13, 1931. V. G. APPLE 1,789,129

BAR WINDING

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Fig. 1.

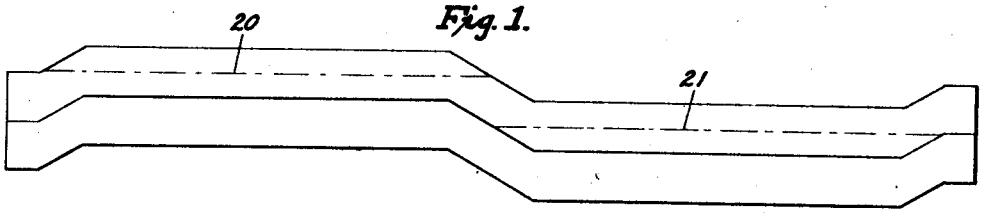


Fig. 2.

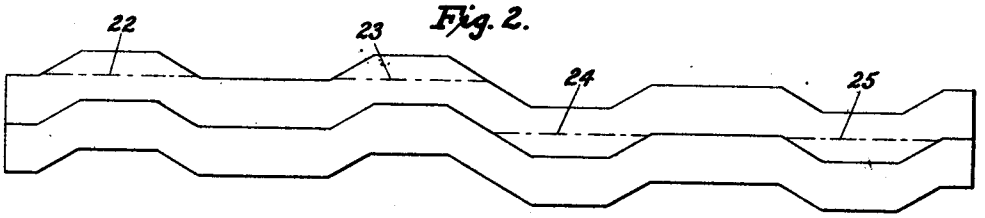


Fig. 3.

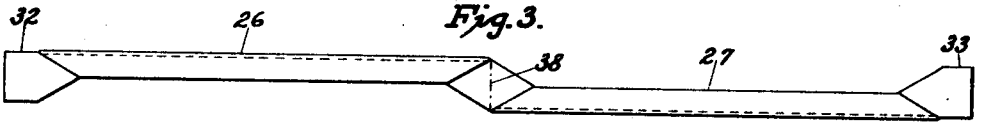


Fig. 4.

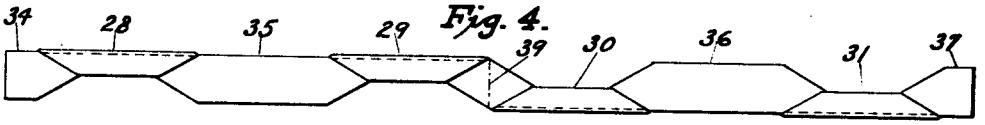


Fig. 7.



Fig. 5.

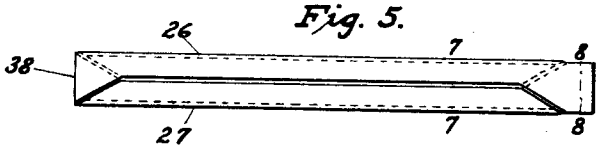
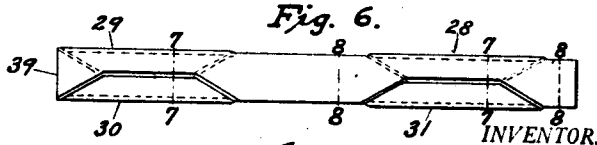


Fig. 8.



Fig. 6.



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Fig. 9.

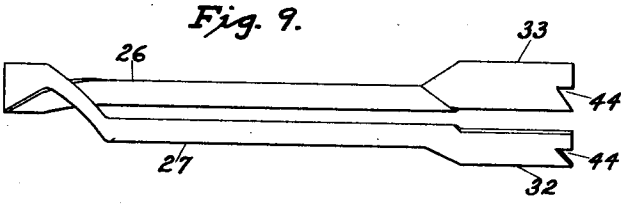


Fig. 10.

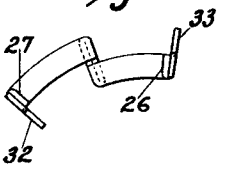


Fig. 11.

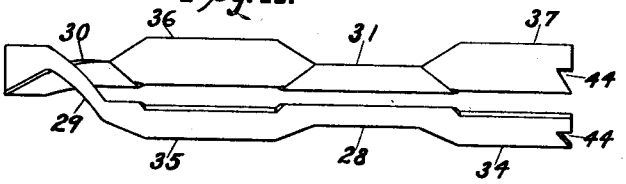


Fig. 12.

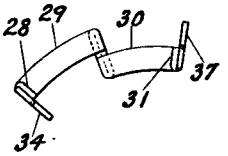


Fig. 13.

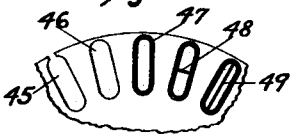


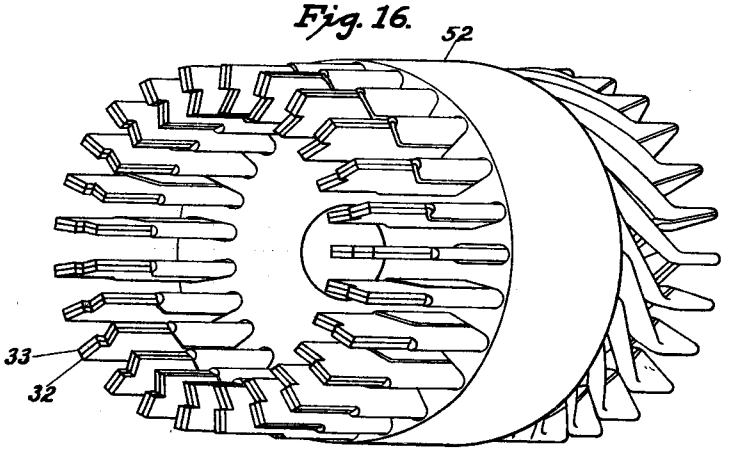
Fig. 14.



Fig. 15.



Fig. 16.



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Fig. 20.



Fig. 19.

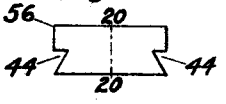


Fig. 17.

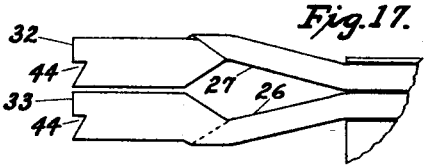


Fig. 18.

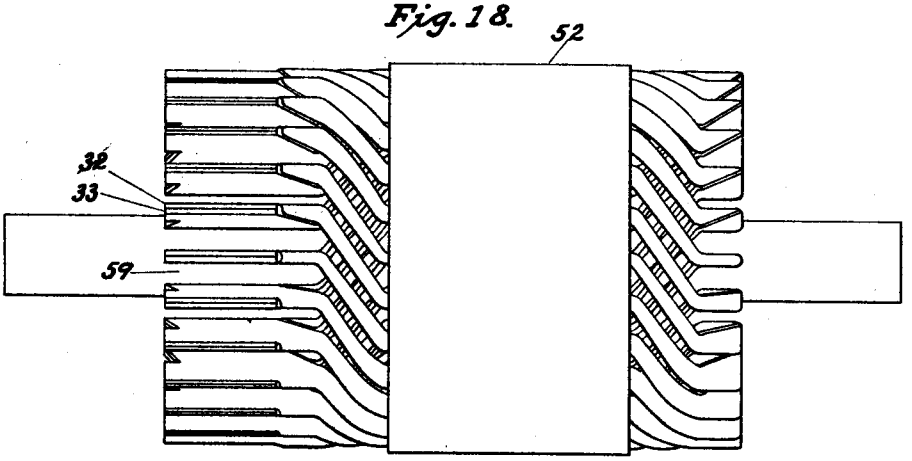
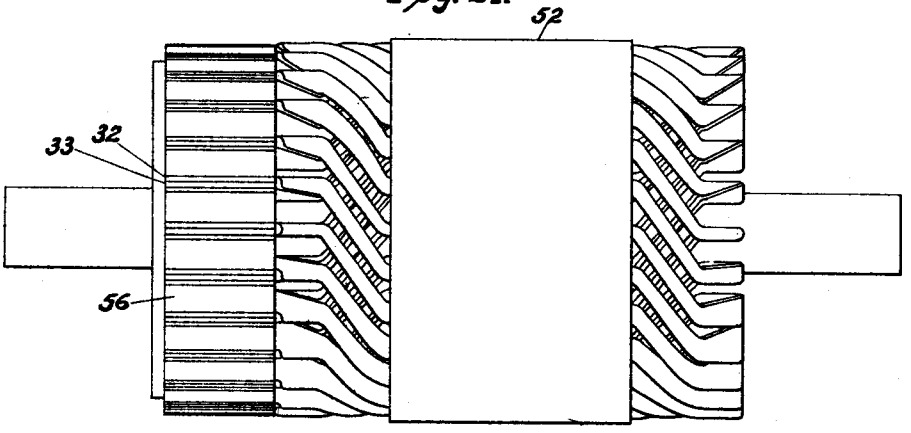


Fig. 21.



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Patented Jan. 13, 1931 1,789,129

UNITED STATES PATENT OFFICE

VINCENT G. APPLE, OF DAYTON, OHIO

BAR WINDING

Application filed December 8, 1927. Serial No. 238,595.

My invention relates to bar windings for dynamo electric machine elements and is particularly valuable where a commutator is required.

A single turn bar winding is usually arranged in two concentric layers so that the portion of the bars which project beyond the ends of the core may extend, the one end helically right-handed and the other layer helically left-handed, and by such an arrangement a bar of one layer may join a widely separated bar of another layer thru their helically projecting ends without interference or contact with the helical ends of other bars of the winding. It is therefore obvious that the conductors of such a winding need be arranged in two concentric layers only at such portions of their length as are helically disposed, and that at all other portions of the winding the conductors may be brought circumferentially adjacent in a single cylindrical layer, and one of the objects of my invention is to provide a winding which will take advantage of such an arrangement to gain points of superiority hereinafter specifically described.

Another object of my invention is to effect economy by cutting the winding from sheet stock with substantially no waste of material.

Further objects will be apparent to those skilled in the art as the invention is described in detail and reference is made to the drawings wherein—

Fig. 1 shows two blanks of such form that they may be cut from sheet stock without waste.

Fig. 2 shows two blanks of another form that may be cut from sheet stock without waste.

Fig. 3 shows a blank after folding on the broken lines Fig. 1.

Fig. 4 shows a blank after folding on the broken lines Fig. 2.

Fig. 5 shows a blank Fig. 3 after it is folded on the broken line running crosswise of its length.

Fig. 6 shows a blank Fig. 4 after it is folded on the broken line running crosswise of its length.

Fig. 7 is a cross section taken on lines 7—7 of Figs. 5 and 6.

Fig. 8 is a cross section taken on lines 8—8 of Figs. 5 and 6.

Fig. 9 is a loop which has been formed from a blank as shown in Fig. 5 except that the ends have been prolonged and notched to form commutator lugs.

Fig. 10 is an end view of Fig. 9.

Fig. 11 is a loop which has been formed from a blank as shown in Fig. 6 except that the ends have been prolonged and notched to form commutator lugs.

Fig. 12 is an end view of Fig. 11.

Fig. 13 shows types of core slots to which loops Figs. 9 and 11 are particularly adaptable.

Figs. 14 and 15 show a method of insulating the legs of a loop.

Fig. 16 shows a core and a complete set of loops Fig. 9 which have been endwise entered thru the core slots.

Fig. 17 shows one pair of conductor legs the ends of which are relatively displaced so that helical bending may be effected.

Fig. 18 shows the set of loops Fig. 14 after all of the ends have been helically bent.

Fig. 19 shows the outline of a pad which may be added to the pairs of terminal ends to compose commutator segments.

Fig. 20 is a cross section taken on line 20—20 of Fig. 19.

Fig. 21 shows a completed armature.

Fig. 1 shows two blanks of such form that when placed adjacent as shown they fit closely one into the other. When the length of these blanks is taken from the width of a sheet of stock they may be consecutively cut from the sheet thruout its length without waste.

Fig. 2 shows two blanks of a modified form which may be similarly cut from a sheet without waste.

From Figs. 1 and 2 it may be seen that the blanks are of nearly uniform width and consequently of nearly uniform current carrying capacity thruout their length.

After cutting blanks Fig. 1 and Fig. 2 they are folded at parts of their length on the broken lines 20 to 25 inclusive and after so folding the blank Fig. 1 will appear as in Fig.

3 and the blank Fig. 2 will appear as in Fig. 4, the folded portions 26 to 31 inclusive being adapted to occupy positions in the winding where it is composed of two concentric layers, the single portions 32 to 37 inclusive being adapted to occupy positions where the winding is arranged in a single cylindrical layer.

The blanks are next folded on the broken lines 38 and 39 after which blank Fig. 3 appears as in Fig. 5 and blank Fig. 4 appears as in Fig. 6.

A cross section taken on lines 7—7 of Figs. 5 and 6 is shown in Fig. 7 where 40 and 41 are folded portions of the blank, 40 to occupy a position in the outer layer of the winding and 41 a position in the inner layer.

Fig. 8, a cross section taken on lines 8—8 of Figs. 5 and 6 shows the unfolded portions of the blank as at 42 and 43 which in the winding will occupy positions circumferentially adjacent to like portions in a single cylindrical layer.

It may be seen from Figs. 5 to 8 inclusive that the blanks when folded as shown are composed thruout their length of two thicknesses of the sheet from which they are cut.

The blanks Figs. 5 and 6 are next spread to form loops Figs. 9 and 11 respectively. The ends 32, 33, 34 and 37 Figs. 3 and 4 however, are shown as being somewhat longer and notched as at 44 to permit these ends to be utilized as commutator lugs. An end view of loops Figs. 9 and 11 are shown in Figs. 10 and 12 respectively.

In Fig. 9 the folded two layer portion 26 of the loop extends not only thruout the helically disposed ends but also thruout that part of the loop which must occupy the core slots.

In Fig. 11 the helically disposed parts 29 and 30 and the parts 28 and 31 which will later be helically disposed are of a two layer configuration as in Fig. 7 while the parts 35 and 36 which will occupy the core slots and the parts 34 and 37 which will become part of the commutator are adapted to compose their part of the single cylindrical layer.

In many applications it will be highly advantageous to have relatively thin and wide conductors circumferentially adjacent in the core slots rather than thicker narrower conductors radially one upon the other because of the reduction in eddy current losses thus effected. The loop Fig. 11 may be profitably applied to such cases.

Core slots may be of the open, closed or semi-closed type but the advantages of the closed and semi-closed types are too well known to require discussion, and Fig. 13 shows core slots 45 or 46 to which loops Figs. 9 or 11 are particularly applicable. The slots may have linings of insulating material as at 47 and a further partitioning rib of insulation may extend thru the slot as at 48 when loops Fig. 9 are used and as at 49 when loops Fig. 11 are used, or the insulation may be applied directly to the legs of the loop prior to their entry into the core slots in any manner desired. A preferred method of so applying sheet insulation to a blank Fig. 3 is shown in an enlarged section Fig. 14 wherein a leg 26 has been but partly folded, as at 50 then surrounded by a sheet of insulation as at 51 and then tightly folded as in Fig. 15 thus completely surrounding the leg with insulation and at the same time holding it tightly in place.

After some form of insulation has been applied either to the core slots or to the conductor legs, a number of loops corresponding to the number of core slots may be stacked in cylindrical arrangement with the tips of the terminal ends 32 and 33, or 34 and 37 slightly entered into the slots of the core 52, and as the composite contour of any two legs which must enter a slot is at some parts as in Fig. 7 and at other parts as in Fig. 8 it is apparent that the entire winding may be simultaneously endwise entered thru the core slots. An armature which has reached this stage of construction is shown in Fig. 16.

When an entire winding has been thus assembled with the core 52, provision must be made to rearrange the pairs of terminal ends 32 and 33 into other pairs so that more widely separated conductors may be joined by helically disposing the projecting legs thereof. To do this however, it is first necessary to radially displace all of the terminal ends 32 or 33 or both so that pairs may be circumferentially moved without interference to new positions separated from each other an amount corresponding to the front pitch of the winding.

Fig. 17 shows a pair of conductors projecting from the same slot, said conductors having been radially displaced relative to each other an amount necessary to allow circumferential displacement of the terminal ends without interference.

When all of the terminals have been thus radially displaced to compose two cylindrical layers and the pairs have been circumferentially separated the required amount they are again brought to the same cylindrical position with the terminals rearranged in new pairs, which, thru the helically bent portions, connect conductors which are sufficiently separated to compose the winding turns. An armature with the terminals so rearranged is shown in Fig. 18.

From Fig. 18 it may be seen that a pair of terminal ends 32 and 33 are of insufficient thickness to alone compose a commutator segment, there being considerable space 59 between adjoining pairs of terminals so that it is advisable to combine with each pair a pad preferably of the outline 56 Fig. 19 and having a cross section as at 57 Fig. 20.

When such a pad has been combined with each pair of terminal ends 32 and 33 a means

of binding the pads and ends into a commutator must be supplied and this means may consist of insulating material moulded about the ends and pads in a manner to bind them together or of washers having conical interior diameters engaging the notched ends 44 of the terminals and pads in a manner well known to the prior art.

A complete armature made by my improved method is shown in Fig. 21, and while in the drawing I show a commutator of a diameter as large as the winding, by radial displacement of the terminal ends and corresponding decrease in the thickness of the pads Fig. 20, or by elimination of the pads altogether, a commutator of considerable smaller diameter may be produced, or if notches 44 are eliminated from the terminal ends these ends may be joined to the risers of a conventional commutator, and while in that case I prefer that these ends be helically bent to join the widely separated conductors which compose a winding turn to a commutator bar, they may be shortened and left extending straight out from the core and joined to a commutator bar by separate connectors of involute or other form. By eliminating the notches 44 and using shorter terminal ends as in Figs. 5 and 6 they may be joined by welding or otherwise to complete a winding which will have great value in its application to dynamo electric machine elements of that character which do not include a commutator in their construction. Other conditions may arise which will make it advisable to eliminate the circumferentially adjacent terminal ends altogether and extend the folded portions to the ends of the conductors.

While in the foregoing I have shown and described my method as consisting of a number of steps in a given sequence it is obvious that the steps need not necessarily be taken in the exact sequence named, but may be reversed or rearranged, or, steps described as separately taken may be combined if so desired, and while the loops are particularly applicable to closed or semi-closed core slots since the composite contour formed by placing together a leg of one loop and the opposite leg of another loop is such that they may be endwise entered therethru, said loops may be advantageously used with cores having open slots and may be either endwise or radially entered therein, and while the method, when using closed or semi-closed slots, is applicable to endwise entry and subsequent bending of the projecting ends, when open slots are preferred and used these ends may be separately bent to their final form prior to radial entry into said open slots.

Cases may arise where it will be found advantageous to use offset and folded blanks of the character described to produce single conductors instead of loops comprising two conductors, and such single conductors may be placed in the core slots, and their projecting ends at both ends of the core simultaneously bent to helical formation. The one end of such conductors may be bent prior to endwise entry or both ends may be bent prior to radial entry into the slots. Such other variations in details of construction and in the application of the method as are not limited by prior art and do not depart from the spirit of the invention I desire to cover in the following wherein—

I claim—

1. Steps in the method of making a winding loop for a bar wound dynamo electric machine element, which consists of cutting a sheet metal blank to such an outline as will leave one portion offset edgewise in one direction from near the middle of its length to near one end and another portion offset edgewise in the other direction from near the middle of its length to near the other end leaving the outer ends in line, folding the offset portions back upon themselves midway of their width and lengthwise of the blank and folding the blank back upon itself crosswise of the bar and midway of its length.

2. Steps in the method of making a conductor for a bar wound dynamo electric machine element, which consists of cutting a sheet metal blank to such an outline as will leave one portion of its length offset edgewise from adjacent portions, partly folding the offset portion back upon itself midway of its width and lengthwise of the blank, wrapping a strip of sheet insulation around the folded portion and the edges of the strip of insulation tucked in between the folds of the blank and completely folding the blank to hold said insulation in place.

3. Steps in the method of making a conductor for a bar wound dynamo electric machine element, which consists of cutting sheet metal to an irregular outline so as to make a blank having one portion of its length offset edgewise from adjacent portions, and folding the offset portion back upon itself midway of its width and lengthwise of the blank to bring the folded edge in line with one edge of the unfolded portions.

4. As a winding unit of a bar wound dynamo electric machine element, a sheet metal blank having two major portions of its length offset oppositely edgewise and the outer ends in line, the offset portions being folded back upon themselves midway of their width and lengthwise of the blank and the blank being folded back upon itself crosswise of the blank and midway of its length.

5. As a conductor for a bar wound dynamo electric machine element, a sheet metal blank having a portion of its length offset edgewise from adjacent portions, and a strip of sheet insulation covering said offset portion, said offset portion being folded back

upon itself midway of its width and lengthwise of the blank with the edges of the strip of sheet insulation held between the folds of the bar.

6. As a conductor for a bar wound dynamo electric machine element, a sheet metal blank having one portion of its length offset edgewise with respect to portions adjacent thereto, said offset portion being folded back upon itself midway of its width and lengthwise of the blank, the folded edge being in line with one edge of the unfolded portions.

In testimony whereof I have hereunto set my hand.

VINCENT G. APPLE.