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2,448,672

ART OF WINDING ODD-SHAPE COILS

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Fig. 1.

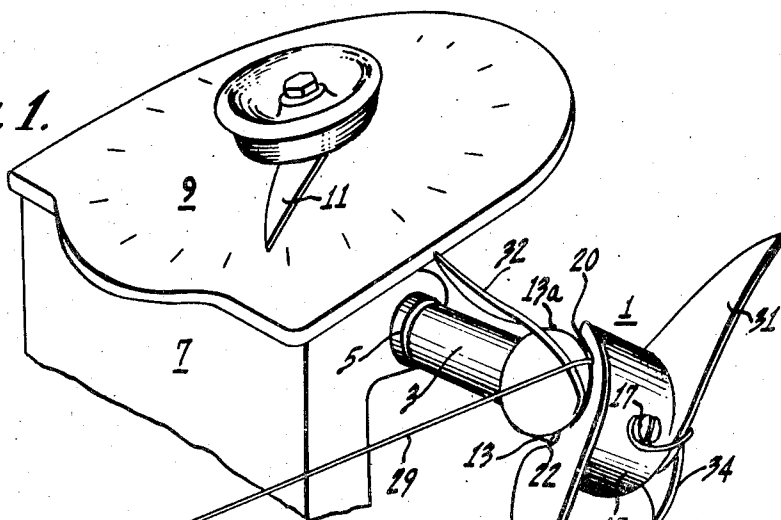
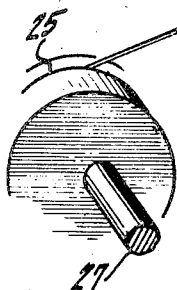


Fig. 2.

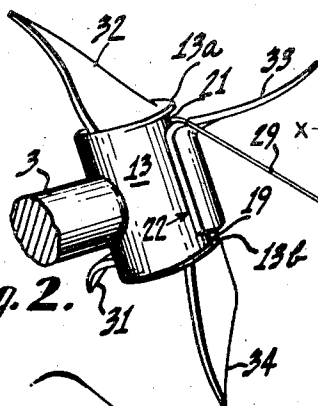


Fig. 3.

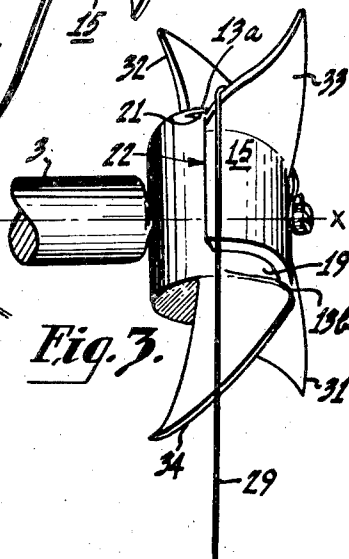


Fig. 4.

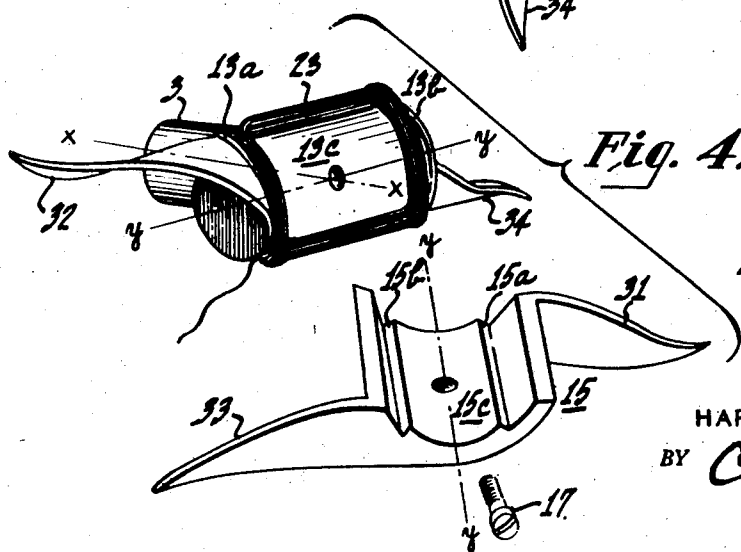


Fig. 5.

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ART OF WINDING ODD-SHAPE COILS

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7 Claims. (Cl. 140—92.2)

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This invention relates to the art of winding coils, particularly odd-shape (e. g., "bent") coils and, while not limited thereto, will be described as applied to the manufacture of so-called "saddle-shape" coils.

Saddle-shape coils find useful application not only in electric motors and generators (where they may comprise the stator windings) but also in television and analogous arts wherein they are commonly employed as deflecting-coils for imparting horizontal and vertical scanning movements to the electron-beam in cathode-ray tubes of various types. Such coils are usually made by hand from plane rectangular coils simply by bending-down the sides and bending-up the ends of the rectangle. This practice, however, is objectionable because in distorting the original coil the wire may break or its insulation may be damaged. Alternatively, the saddle-shape may be acquired during the winding operation, for example in the manner taught by Grundmann in copending application Serial No. 538,006, filed May 30, 1944, Pat. No. 2,395,736, granted February 26, 1946. While Grundmann's method and machine obviate the above mentioned objections to bent coils it may be said, generally, that the reciprocating or oscillatory winding-movement advocated by Grundmann limits the winding speed.

Accordingly, the principal object of the present invention is to obviate the foregoing and other less apparent objections to present day methods of manufacturing coils of the general character described.

Another and important object of the invention is to provide an improved method of, and apparatus for, making odd-shaped coils; the desired odd-shape being achieved during the winding operation without the use of any reciprocating or oscillating parts or movements.

Another and specific object of the present invention is to provide a simple, inexpensive and a trouble-free machine for winding odd-shape coils, and one wherein both the winding head and the supply spool are mounted for simple rotary motion; whereby the time required to set up the wire and to remove the coils from the machine is reduced and the winding speed is greatly increased.

The invention will be described in connection with the accompanying drawing, wherein:

Fig. 1 is a view in perspective of a coil winding machine including a supply spool and a winding head constructed and arranged in accordance with the principle of the invention.

Figs. 2 and 3 are views in perspective, taken from different viewpoints of the winding head of Fig. 1.

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Fig. 4 is an exploded view of the winding head just prior to the removal of a coil therefrom and Fig. 5 is a view in perspective of the saddle-shape coil of Fig. 4.

In the drawing, wherein like reference characters represent the same parts in all figures, 1 designates, generally, a winding head which is fixed on the end of a shaft 3; the shaft being mounted for simple rotary movement as on bearings 5 in the side of a gear box or other housing 7 for the motor or other driving-mechanism, not shown. The housing 7 is shown provided with a dial plate 9 and a pointer 11 for counting the revolutions of the shaft 3 so that the operator may at all times be aware of the number of turns of wire on the winding head 1. The other parts of the counting mechanism are not illustrated since they form no part of the present invention and may be of any convenient type.

The winding head which has been selected for illustration comprises a cylindrical body 13 and a removable cap 15. The cylinder 13 is fixed on its side, midway of its length, to the end of the shaft 3 and the cap 15 is removably attached to the opposite side of the cylinder as by means of a screw or equivalent part 17. The length of the cap 15 (as measured along a median line $y-y$ normal to the common axis $x-x$ of the shaft 3 and cylinder 13) is less than the length of the cylinder and it will be observed (see Fig. 2) that the ends 13a and 13b of the cylinder extend outwardly beyond that convex surface portion 13c (Fig. 4) of the cylinder to which the cap 15 is affixed. Thus, as indicated at 19 and 21 there is an arcuate space or slot between each end of the cylinder and the adjacent end of the cap. These slots 19 and 21 extend 180°, more or less, about the convex surface of the cylinder, parallel to its axis of rotation $x-x$ and are inter-connected by slots 20 and 22 respectively, which extend lengthwise of the cylinder, i. e. normal to the common axis $x-x$ (Fig. 3) of rotation of the shaft and cylinder. The side walls of these "lateral" slots 20 and 22 comprise, on the one hand, the concave underside of the cap 15 and, on the other hand, the convex outer surface of the cylinder 13, while the "bottom" of each of the said slots is defined by one of the parallel edges 15a, 15b of a central land or riser 15c (Fig. 4) on the underside of the cap. As indicated in Fig. 4 the riser 15c is formed by cutting two arcuate grooves (of a greater radius of curvature than the cylinder 13) on the inner surface of the cap parallel to the long axis ($y-y$) of the cylinder on opposite sides of its axis ($x-x$) of rotation.

While the length dimension of each of the slots 19 and 21 extends parallel to the axis ($x-x$) of rotation of the head 1, and the length dimension of each of the slots 20 and 22 extends in a direction normal to the said axis it will be observed that the depth dimension of the transverse slots 20 and 22, like the depth dimension of each of the longitudinal slots 19 and 21 extends into the head along lines (note the arrows 21 and 22 of Fig. 2) which are substantially parallel to the said axis. However, it should also be observed that the approach to the entrance or mouth of the transverse slots 20 and 22 is from the shaft end of the head while the approach to the longitudinal slots 19 and 21 is from the opposite direction, that is from the outer end of the head. Thus the wire (29) must be thrown first in one direction along the axis $x-x$ and then in the opposite direction along the said axis if it is to enter the slots 19, 20, 21 and 22 and form the saddle-shape coil of Figs. 4 and 5.

As previously set forth saddle-shape coils have heretofore been wound by imparting reciprocating and oscillating movements to a winding mandrel as by means of cam and lever actions which, however, simple, introduce friction, retard the winding speed, and hence contribute materially to the cost of making such coils. These difficulties are obviated in accordance with the present invention by mounting the supply spool 25 for simple rotary motion as on a spindle 27 and by the provision of oppositely directed vanes 31, 32, 33 and 34 on the winding head 1 for directing the wire 29 alternately forwardly and rearwardly of the head whereby it is entered, successively, into the winding slots 19, 20, 21 and 22. There are two vanes (31 and 33) on the cap 15 and two (32 and 34) on the cylinder 13. The cap-vanes 31 and 33 extend outwardly in opposite directions (i. e. "up" and "down" as viewed in Fig. 1) from diametrically opposite corners of the cap. The vanes 32 and 34 on the other hand extend outwardly (to the "left" and to the "right" as viewed in Fig. 1) and curve rearwardly from diametrically opposite portions of the extended, i. e. "forward" end-plates 13a and 13b of the cylinder 13. Thus, the head 1 may be said to be provided with a series of oppositely extending "alternate" and "intermediate" coil forming slots (19, 21—20—22) which surround the axis ($x-x$) of rotation of the head, and with "alternate" and "intermediate" vanes for directing the strand 29 sequentially into said oppositely extending coil-forming slots.

In setting up the winding head the free end of the wire is tied under the head of the screw 17 which holds the cap 15 on the cylinder 13. The wire 29 is then looped over the vane 31 (Fig. 1) and moved into both the longitudinal slot 19 and the lateral slot 20. (In Fig. 1, the slot 19 is concealed by vane 31.) It will be observed upon inspection of Fig. 1 that the curved (forward) edge of the vane 32 is now in contact with the wire adjacent to the point at which the wire emerges from the lateral slot 20. When the power is turned on, the head, and hence the vanes thereon, rotate in the clockwise direction and the vane 32 urges the wire forwardly (i. e. toward the outer end of the head) and into the adjacent longitudinal slot 21. As the clockwise movement of the head continues the wire encounters the curved (rear) surface of the next vane 33 whereupon the wire is urged downwardly and rearwardly over the transverse edge of the cap 15 and into the other lateral groove 22 to com-

plete the first full turn of the coil 23. In Fig. 2 the head is shown in a position whereat the wire 29 having been entered into the longitudinal slot 21 by the vane 32 has now encountered the cap vane 33 which urges it rearwardly into the second transverse slot 22. Fig. 3 shows the wire just before it rides over the transverse edge of the cap 15 into the lateral slot 22 and just before it encounters the cylinder-vane 34 which moves it downwardly and forwardly into the next or first mentioned (longitudinal) slot 19 to start the second turn of the coil.

As the head continues to revolve above the axis $x-x$ the wire is piled up in the slots 19, 20, 21 and 22 to form a coil of the desired number of turns. When the movement is halted the screw 17 is unscrewed whereupon the cap 15 and the coil 23 may be removed from the cylinder 13. Subsequently, the coil may be impregnated and "set" as in a suitable mold or the like, not shown.

Since the coil winding machine of the present invention requires no cams, levers or other eccentric parts it may be operated at almost any speed. In practice a convenient speed for winding deflecting-coils (for cathode-ray tubes of various types) is 1500 revolutions per minute. Somewhat lower speeds are recommended for winding stator and other coils of a size requiring the use of a larger or heavier winding head than the one illustrated.

It will be observed upon inspection of Figs. 4 and 5 that the coil 23 here illustrated is symmetrical about both its axes $x-x$ and $y-y$. It will be apparent however that this symmetry and indeed the general contour of the coil may be altered by altering the shape or the relative dimensions of one or both parts of the winding head. By way of example, the relative length-to-thickness or length-to-width ratio, or the angle of tilt, or the arc of curvature of any or all of the boundaries of the coil may be changed by altering the dimensions or shapes of the slots in which the coil is wound.

Accordingly, it is to be understood that the foregoing description of a specific embodiment of the invention is to be interpreted as illustrative and not in a limiting sense except as required by the prior art and by the spirit of the appended claims.

What is claimed is:

1. A winding head having an axis of rotation and a plurality of coil-forming slots arranged around said axis and extending into said head in alternately longitudinal and transverse directions with respect to said axis, and means responsive to rotation of said head for directing a strand sequentially into said longitudinal and transverse coil-forming slots.

2. A winding head having an axis of rotation and having alternate and intermediate coil-forming slots arranged around said axis and extending into said head in opposite directions, and alternate and intermediate vanes individual to said slots on said head for directing a strand sequentially into said oppositely extending coil-forming slots.

3. A winding head having an axis of rotation and a plurality of coil-forming slots arranged about said axis and extending into said head in opposite directions substantially parallel to said axis, and means integral with said winding head for guiding a strand sequentially into each of said slots from a point on a line drawn substantially normal to said axis of rotation.

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4. An apparatus for winding coils comprising a winding head having an axis of rotation and a plurality of coil-forming slots arranged about said axis substantially in the outline of a rectangle, the slots defining the parallel ends of the rectangle extending into said head in one axial direction and the slots defining the sides of the rectangle extending into said head in the other axial direction, means to supply a strand to said head along a line substantially normal to the axis of rotation of said head, and a plurality of vanes individual to said slots mounted on said head in a position to successively engage said strand upon rotation of said head, each of said vanes having a strand-engaging edge curved in a direction calculated to urge said strand into the slot to which said vane is allotted.

5. A winding head comprising a body member having a saddle-shape portion and a complementarily-shaped cap member adapted to be removably affixed to said body member to form a saddle-shape coil-forming slot, and a plurality of vanes mounted on said body and cap members adjacent to the respective sides of said saddle for directing a strand into said coil-forming slot.

6. A winding head comprising a part having a convex surface, a second part adapted to be secured to said first mentioned part and having

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an inner concave surface presented across an intervening space to said convex surface, said parts having an axis of rotation lying along a radius common to said convex and concave surfaces and said intervening space comprising a coil-forming slot, and means responsive to rotation of said head about said axis for directing a strand into said slot from a point along a line drawn substantially normal to said axis of rotation.

7. The invention as set forth in claim 5 and wherein said last mentioned means comprises a pair of strand-engaging vanes extending outwardly from diametrically opposite areas on said second mentioned part.

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The following references are of record in the file of this patent:

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