Feb. 7, 1950 G. L. GRUNDMANN 2,496,913

MECHANISM FOR FORMING COILS

Original Filed May 30, 1944

Fig. 6.

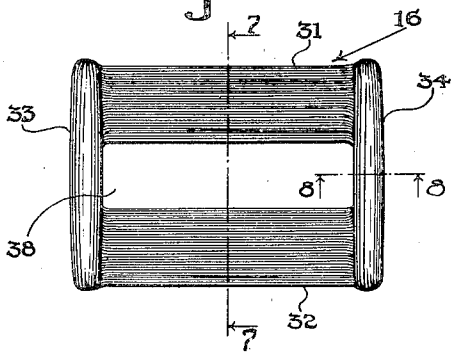


Fig. 7.

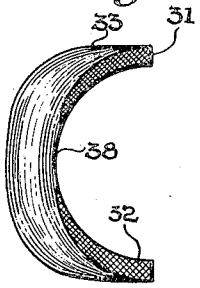


Fig. 8.

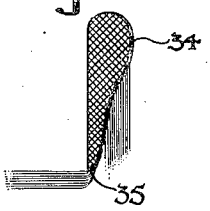


Fig. 1.

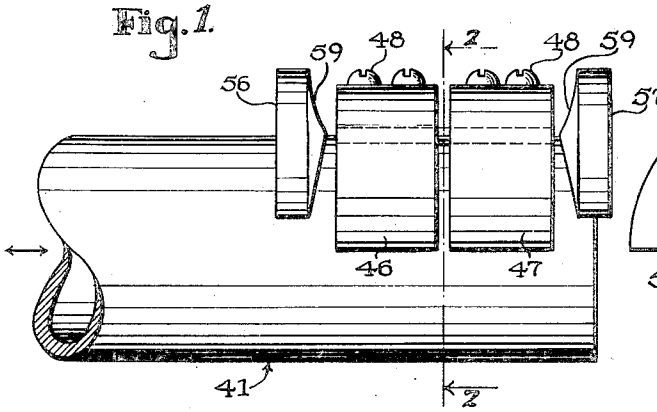


Fig. 2.

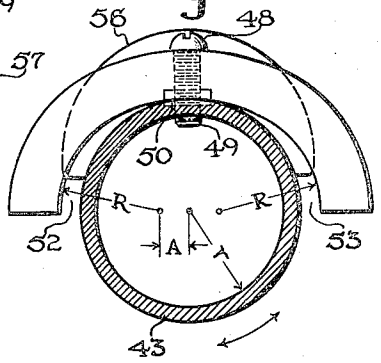


Fig. 3.

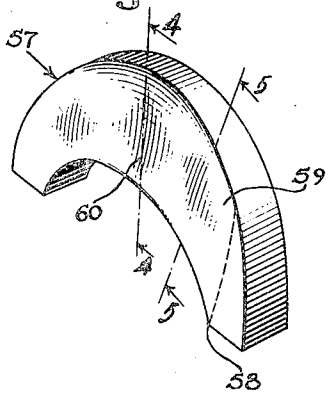


Fig. 4.

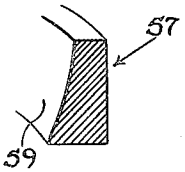
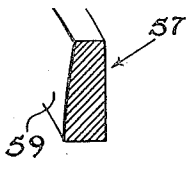


Fig. 5



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MECHANISM FOR FORMING COILS

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Original application May 30, 1944, Serial No. 538,006, now Patent No. 2,395,736, dated February 26, 1946. Divided and this application November 29, 1945, Serial No. 631,734

3 Claims. (Cl. 140—92.1)

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The present invention relates generally to the production of windings and, more particularly although not necessarily exclusively, to novel methods of manufacturing coils such as are used for dynamo-electric machinery and deflecting coils for deflecting the cathode ray beam in cathode ray tubes or the like. This invention is a division of my copending application, Serial No. 538,006, which was filed May 30, 1944, now Patent No. 2,395,736 granted February 26, 1946.

The principal object of the invention is to provide a novel means for winding and at the same time imparting a desired shape to coils intended for use in electrical apparatus.

Another object of the invention is to provide a novel means for producing a deflecting coil having a more efficient utilization of effective length of the winding than previously known coils.

Still another object of the invention is to provide a novel means for producing a coil in which the outwardly bent coil ends are formed in an improved manner during winding of the coil.

Other and more specific objects of the invention will become apparent from a consideration of the following specification and claims in connection with the accompanying drawings illustrating one preferred form of the invention in which:

Fig. 1 is a view in side elevation of a mandrel used in accordance with the invention to wind and shape coils;

Fig. 2 is a section taken on line 2—2 of Fig. 1 viewed in the direction of the arrows;

Fig. 3 is a perspective view on an enlarged scale of a portion of the mandrel of Figs. 1 and 2;

Figs. 4 and 5 are sections taken on lines 4—4 and 5—5, respectively, of Fig. 3;

Fig. 6 is a view in plan of a cathode ray tube deflecting coil;

Fig. 7 is a view in sectional elevation of the coil of Fig. 6 cut on line 7—7; and

Fig. 8 is an enlarged fragmentary section of the coil end taken on line 8—8 of Fig. 6.

Figs. 1 to 5 illustrate a mandrel designated 41 and its parts which are designed in accordance with the invention for winding saddle-shaped coils. Figs. 6, 7, and 8 of the drawings show, illustratively, a type of coil which may advantageously be wound by employing the mandrel of Figs. 1 to 5 in a manner to be described in detail hereinafter by way of example. Referring for the present to Figs. 6, 7, and 8 of the drawings, which illustrate a horizontal deflecting coil for use in a cathode ray tube deflecting yoke, this coil, designated 16, is seen to comprise two groups of active conductors 31 and 32 and end turn sections 33 and 34. Fig. 7 shows the cross section of the active group of conductors 31 and 32, and Fig. 8 shows the cross sectional outline of the conductors in the end turns. An opening 38 in the coil, commonly referred to as the "window," is of a width which is controlled by the equipment used in the manufacture of the coil as will be pointed out hereinafter, and the cross section of the active portions 31 and 32 is such that a cosine distribution of the winding is obtained, thereby providing uniformity in distribution of the deflecting field flux. The distribution of the conductors in the end turn portions 33 and 34, shown by Fig. 8 of the drawings, results from the coil winding process disclosed herein, and is such that a neat and well formed coil is obtained. As shown in Fig. 8 at the region 35, only one end turn conductor is present.

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Referring to Figs. 1 to 5 of the drawings, the mandrel 41, on which coils having the configuration shown in Figs. 6 to 8 for example, are wound, comprises a member 43 shown as being circular in cross section. From what is to follow, it will be understood that the member 43 may have other shapes and cross sections depending upon the desired shape of the active sections 31 and 32 of the coil which is to be manufactured and other considerations which may arise in practice. Members 46 and 47 are detachably secured to the member 43 by suitable fastening means such as machine screws 48, threaded into tapped holes 49. Only one of these members of suitable length may be used, and a key 50 may be formed on the member 43 to assist in fixing the position of 46 and 47. The single member or members may be referred to as a cap member or members. Winding slots 52 and 53 are provided by the difference in curvature between inner surfaces of the members 46 and 47 and the peripheral outline of the member 43. For cathode ray beam deflecting coils, for example, which are to be fitted on a symmetrical support, such as a tube of insulating material which conforms generally to the neck of typical cathode ray tubes, or to be fitted on the neck of the tube itself, the slots 52 and 53 are or may be shaped as shown in Fig. 2 of the drawing wherein the radius r of the member 43 is substantially equal to the radius of curvature R of each half of the inner surface of the members 46 and 47. The displacement of the centers of these radii r and R, designated A on Fig. 2, is approximately equal to the thickness of the winding at its thickest part. The bends at the coil corners and the configuration of the end turn portions 33 and 34 of the coil are set during

the winding process by members 56 and 57 which are secured in any suitable manner to the member 43. Since the inner surface 59 of each of these members must be shaped to cause each turn to fall in its desired location, these members 56 and 57 are preferably formed as separate pieces, later secured to the member 43.

Fig. 1 in conjunction with Figs. 3, 4, and 5 show the general shape of the surface 59. In Fig. 1 it will be noted that the curvature provides a generally concave surface particularly adjacent to the outer periphery of the member 56 or 57 at its center 60. The surface becomes convex as shown in Figs. 3 and 4 at a location 59 which is approximately 45° from the center of the member. At the point 58 the surface 59 effectively vanishes as shown by the location of the dotted line which approximately indicates wire contact.

When employing the mandrel 41 to form a coil, the wire is wound through the slot 52, for instance, across the end of the mandrel between the members 46 and 56, back through the second slot 53, and across the other end of the active part of the mandrel between the members 47 and 57 making a complete turn of the coil. This is continued until the slots 52 and 53 are filled with wire resulting in a coil as shown in Figs. 6 to 8, for example.

There are two methods of winding; turn winding, or skein winding which are in common use and which may be employed with the mandrel of this invention. In skein winding, a skein is formed by coiling wire into a loop, this loop being long enough so that the necessary number of turns of the loop may be made on the mandrel 41 with a slight excess of loop length. This excess is merely twisted so as to tighten the last turn of the loop.

A coil machine constructed for manufacturing coils in accordance with the method just set forth requires only two movements of the mandrel; the first being a rocking of the mandrel slightly more than 180° and the second being a shifting of the wire or skein from one end of the form to the other. As an alternative, the mandrel may be moved axially.

After the winding process has been completed, the winding may be impregnated with any desired material and heated in any suitable manner, as by passing current through the conductors of the coil, to cause penetration of the impregnating material. The impregnating material may be thermo-plastic or thermo-setting.

Having now described the invention, what is claimed and desired to be secured by Letters Patent is the following:

1. A coil winding mandrel comprising a body portion which is curved in cross sectional outline to provide a curved surface, a slot forming member secured to said body portion and having an inner face disposed in opposition to the curved surface of said body portion, said inner face being spaced at a varying distance from said curved surface of said body portion whereby to provide winding slots of progressively decreasing width, and guide means secured to said body portion adjacent the ends of said slot forming members for forming end turns of strands which are continuous with strands wound in said slots.

2. A winding head having an axis about which it oscillates and in the direction of which it reciprocates in operation, a guide forming a plurality of coil-forming slots arranged around the axis and longitudinally thereof, said guide being responsive to oscillation and reciprocation of the head for directing a strand sequentially into the coil-forming slots, and members each having a surface facing said guide, the surfaces being of a shape to cause the ends of a finished coil to have a desired configuration.

3. A winding mandrel comprising a body member having a curved surface which conforms to the shape of a coil to be wound, and a complementarily shaped cap member mounted on said body to provide coil forming slots in cooperation with the curved surface of the body, the slots being of a shape to conform to the active conductor distribution of a coil, said cap member being removably affixed to the body to permit release of a formed coil.

GUSTAVE L. GRUNDMANN.

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