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2,395,736

DEFLECTING COILS AND YOKE AND METHOD OF MANUFACTURING SAME

Filed May 30, 1944

2 Sheets-Sheet 1

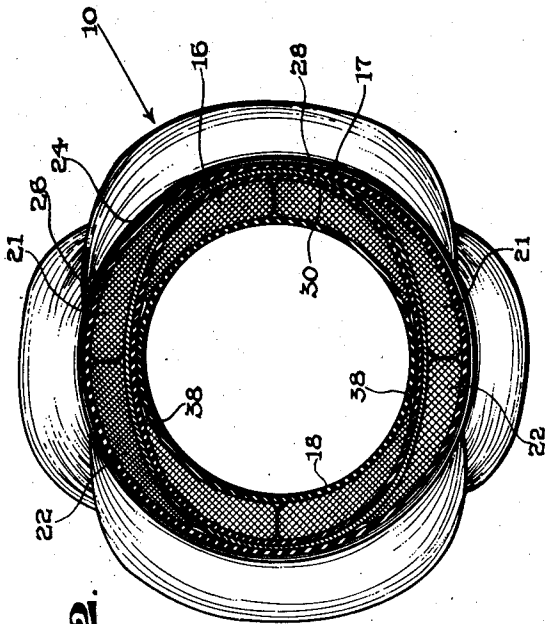


Fig. 2.

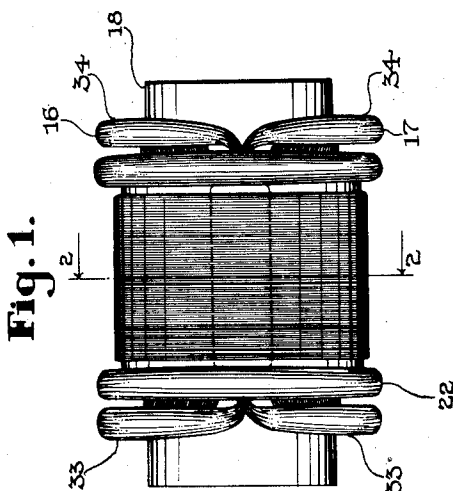


Fig. 1.

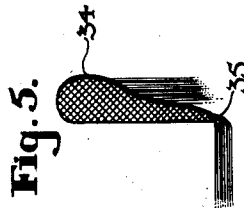


Fig. 5.

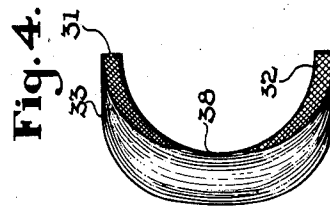


Fig. 4.

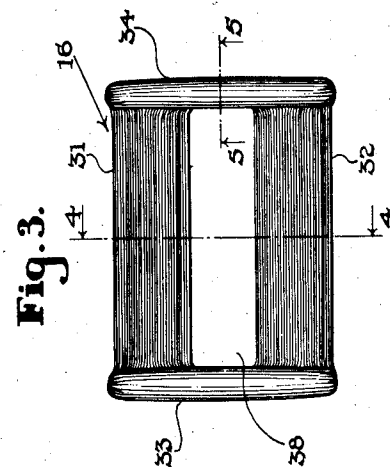


Fig. 3.

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2 Sheets-Sheet 2

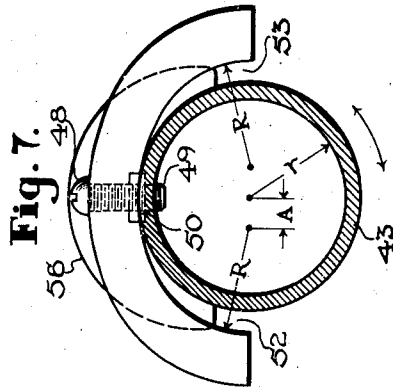


Fig. 6.

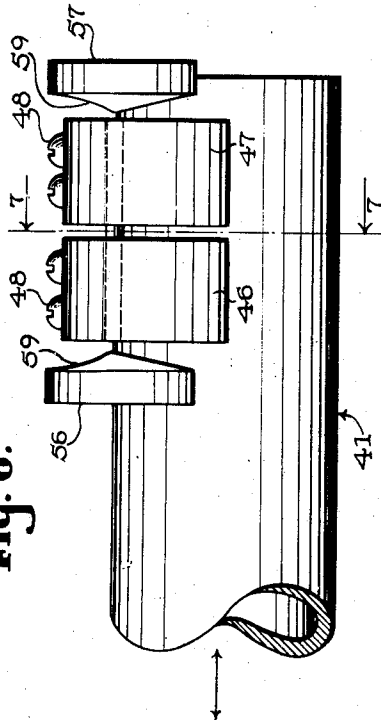


Fig. 8.

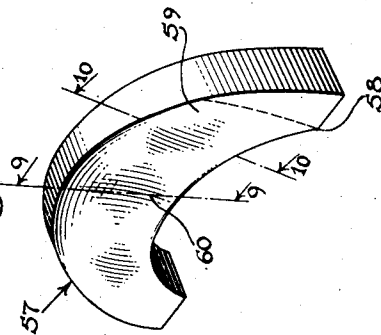
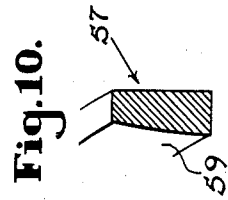
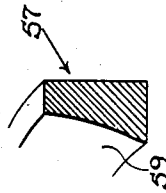


Fig. 9.



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DEFLECTING COILS AND YOKE AND
METHOD OF MANUFACTURING SAMEGustave L. Grundmann, Westmont, N. J., as-
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Application May 30, 1944, Serial No. 538,006

2 Claims. (Cl. 250—157)

The present invention relates to cathode ray tube deflecting devices and, more particularly, to novel electromagnetic deflecting coils for novel deflecting coil assemblies, and also to novel methods of manufacturing deflecting coils and coil assemblies.

The principal object of the invention is to provide horizontal and vertical deflecting coils, so called, which may be manufactured easily and cheaply, and which, when assembled in pairs to form a complete yoke, will give an improved vertical and horizontal deflecting effect over known yokes.

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

A further object of the invention is to provide a coil having an improved winding factor.

Still another object of the invention is to provide a coil in which the outwardly bent coil ends are formed in an improved manner during winding of the coil. These upturned ends, which have been known heretofore but have been somewhat difficult to produce in practice, add to the effectiveness of the coil since they provide a fringing field which causes less defocusing in the corners of the scanned area.

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 of the drawings is an elevational view of a deflecting yoke constructed in accordance with the invention;

Fig. 2 is a view taken along the line 2—2 of Fig. 1, only the parts lying in the cross-sectional plane being shown for convenience;

Fig. 3 is a view in plan of a single horizontal deflecting coil of Fig. 1 constructed in accordance with the invention;

Fig. 4 is a view in sectional elevation of the coil of Fig. 3 cut on line 4—4;

Fig. 5 is an enlarged fragmentary section of the coil end taken on line 5—5 of Fig. 3;

Fig. 6 is a view in side elevation of a mandrel used in winding and shaping coils similar to those of Figs. 3, and 5;

Fig. 7 is a section taken on line 7—7 of Fig. 5 viewed in the direction of the arrows;

Fig. 8 is a perspective on an enlarged scale of a portion of the mandrel of Figs. 6 and 7; and

Figs. 9 and 10 are sections taken on lines 9—9 and 10—10, respectively, of Fig. 8.

Referring to Figs. 1 and 2, the deflecting yoke, designated generally by reference character 10, includes two diametrically opposed horizontal deflecting coils 16 and 17, each of which is constructed as shown in Figs. 3, 4, and 5 of the drawings. The coils 16 and 17 are mounted upon a supporting tube 18 of insulating material such as fiber or the like. This tube forms the sole support of the deflecting yoke 10 and may be readily slipped over the neck of a cathode ray tube, the generated beam of which is to be deflected by the yoke structure 10. A pair of diametrically opposed vertical deflecting coils 21 and 22 are fitted against the coils 16 and 17, and the coil assembly is surrounded by a covering of iron 24, which is preferably in the form of one or more layers of iron wire wrapped on the portion outside of the yoke structure. The yoke structure is of substantially uniform thickness or diameter axially and radially. A protective layer 26 of any suitable insulating material may be placed between the iron sheath 24 and the exposed parts of the coils. This insulating layer may be composed of paper, reconstituted cellulose, or the like.

An electrostatic conductive shield 28, such as thin sheet metal or metallic foil, may be placed between the horizontal and vertical windings. In this way, undesired electrostatic coupling between the horizontal and vertical windings may be avoided. The shield 28 may, if desired, be applied over a layer 30 of binding and insulating material such as an insulating wrapping of thin fibrous material. This protective material on the coils 16 and 17 may be like the insulation 26.

The overall generally symmetrical cross sectional configuration of the yoke 10, illustrated by Fig. 2 of the drawings, is one of the important features of the present invention and is attained because of the novel coil structure disclosed. This coil structure is produced conveniently by the novel equipment of Figs. 6 to 8.

The details of the coils will now be described, and since the horizontal deflecting coils are similar in form to the vertical deflecting coils, only the horizontal coils will be described in detail. The general outlines of the vertical deflecting coils 21 and 22 are believed to be shown with sufficient clearness in Figs. 1 and 2 to afford a complete understanding of the invention.

Referring now to Figs. 3, 4, and 5 of the drawings, which illustrate either one of the horizontal deflecting coils 16 and 17 in greater detail, for example, the coil 16 is seen to comprise two

groups of active conductors 31 and 32 and end turn sections 33 and 34. Fig. 4 shows the cross section of the active group of conductors 31 and 32, and Fig. 5 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 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. 5 of the drawings, results from the coil winding process disclosed herein, and is such that a neat and well formed coil is obtained. Important electrical and magnetic advantages also arise from the conductor distribution in the coil sections 33 and 34. As shown in Fig. 5 at the region 35, only one end turn conductor is present. In this region end conductors will have the greatest undesired effect on the field set up for deflection purposes. The minimum number of conductors in the region 35 minimizes the undesired effect in a practical and workable manner.

Referring to Figs. 6 to 9 of the drawings, the mandrel 41, on which coils having the configuration shown in Figs. 3 to 5, 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. 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 which are to be fitted on a symmetrical support, such as the tube 18 of Fig. 2, which conforms generally to the neck of typical cathode ray tubes, the slots 52 and 53 are, as shown in Fig. 7 of the drawings wherein the radius r of the member 43 is substantially equal to the radius of the 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. 7, 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. 6 in conjunction with Figs. 8, 9, and 10 show the general shape of the surface 59. In Fig. 6 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 con-

vex as shown in Figs. 8 and 10 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. 3 and 4. Two such coils are put together as shown in Figs. 1 and 2 to make up one complete horizontal winding.

The vertical coils 21 and 22 are made on a mandrel 41, the slots 52 and 53 and pieces 56 and 57 of which are formed in view of the shape which is to be given to this coil.

There are two methods of winding; turn winding, or skein winding which are in common use and which may be employed with the mandrel. For the horizontal winding, the first method is desired, but for the vertical winding, the second method may be used. 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 with 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.

As indicated hereinbefore, windings of the present invention possess certain important advantages over those heretofore given. The windings have an improved winding factor since there are no gaps between turns or groups of turns. The latter property of the winding means that the neck of the cathode ray tube is more closely encircled when the winding is in position. There is an improvement in the L to R ratio, that is, there is less wire for a given inductance. The turned up ends, known heretofore, for example the sections 33 and 34 of Fig. 3, give a fringing field which causes less defocusing in the corners of the scanned image. As pointed out above, these turned up ends of optimum configuration are very readily provided in accordance with this invention.

Due to the improved winding factor, the iron covering 24 is closer to the horizontal coils than in previous structures. In the prior yokes, an improvement of the order of approximately 1 to 1.1 is attained due to the presence of iron. In the yoke 10 an improvement of 1 to 1.3 or approximately 30 per cent is attained. This is reflected back into an improvement in the L to R ratio.

The iron covering 24 is also closer to the ver-

tical coils, so that, whereas the iron produces an improvement of 27 per cent in the older yokes, a 75 per cent increase of inductance of the vertical winding is produced in the yoke 10 of the present invention.

Various alterations may be made in the present invention without departing from the spirit and scope thereof, and it is desired that any and all such alterations be considered within the purview of the present invention as defined by the hereinafter appended claims.

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

1. A magnetic deflecting yoke for producing a uniform deflecting field for the deflection of a cathode ray beam in a cathode ray tube comprising a plurality of active conductors arranged to encircle the neck of said tube, said conductors being so distributed that the number thereof is a maximum at points approximately 180° apart, the number of said conductors decreasing pro-

gressively in either direction from said points to a minimum at points angularly spaced approximately 90° from said points of maximum number, said progressive decrease in the number of conductors being proportional to the cosine of the increasing angle measured from said points of maximum number.

2. A coil for producing a uniform deflecting field for the deflection of a cathode ray beam in a cathode ray tube comprising a plurality of active conductors arranged in an arcuate formation, said conductors being so distributed that the number thereof is a maximum adjacent to the ends of said arcuate formation, the number of said conductors decreasing progressively to zero at the center of said arcuate formation, said progressive decrease in the number of conductors being proportional to the cosine of the increasing angle measured from the edge of said arcuate arrangement.

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