Jan. 2, 1962 J. MARLEY 3,015,152

PROCESS OF MANUFACTURING MAGNETIC DEFLECTION YOKES

Filed Aug. 23, 1955 3 Sheets-Sheet 1

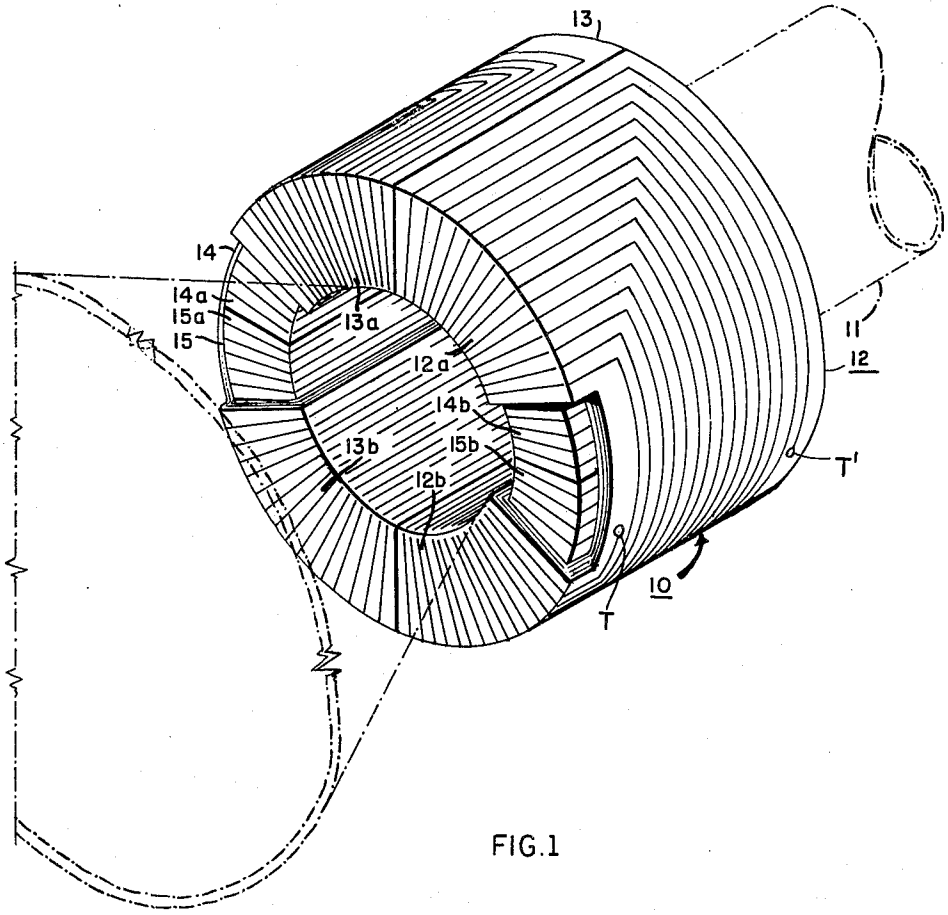


FIG. 1

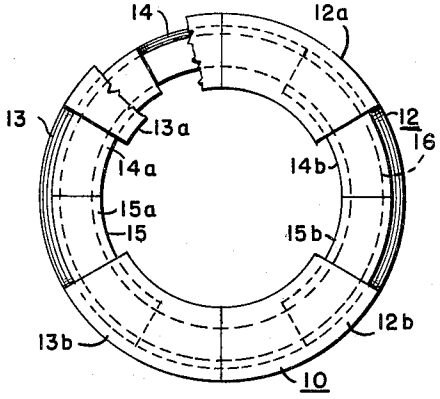


FIG. 2

PROCESS OF MANUFACTURING MAGNETIC DEFLECTION YOKES

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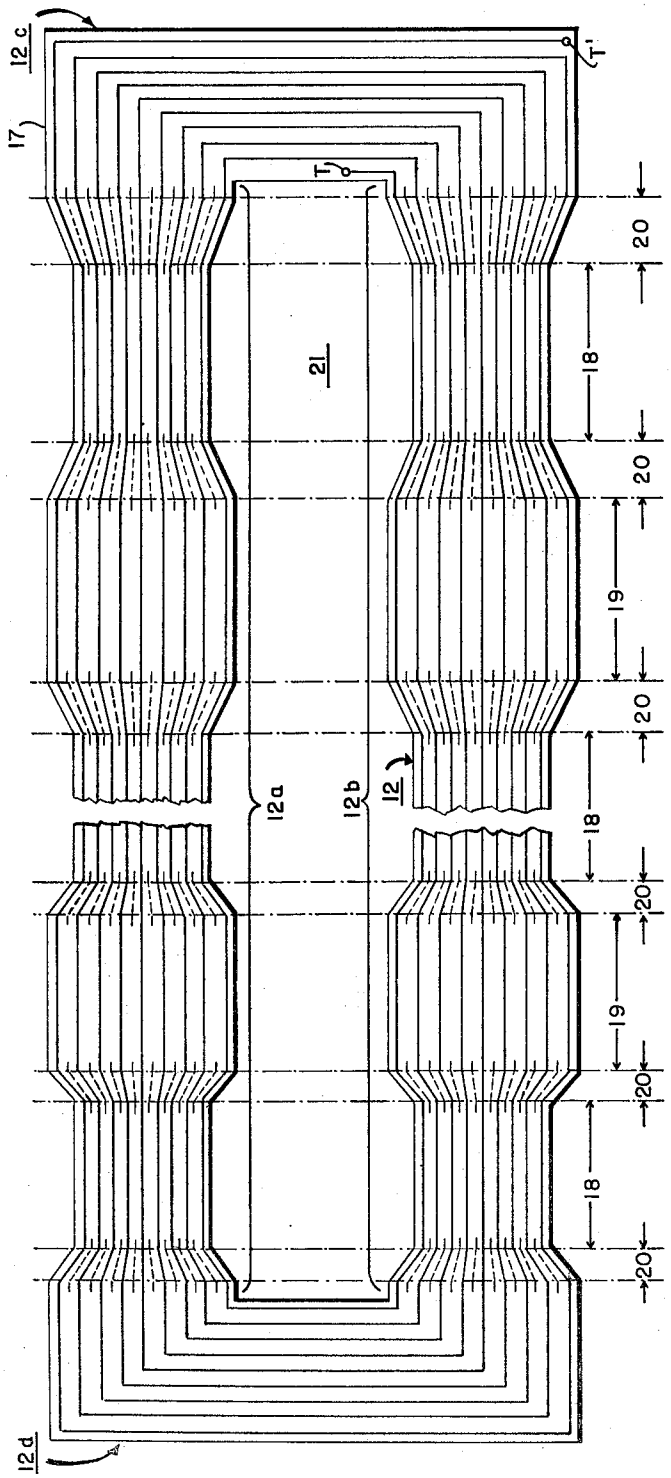


FIG. 3

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PROCESS OF MANUFACTURING MAGNETIC DEFLECTION YOKES

Filed Aug. 23, 1955 3 Sheets-Sheet 3

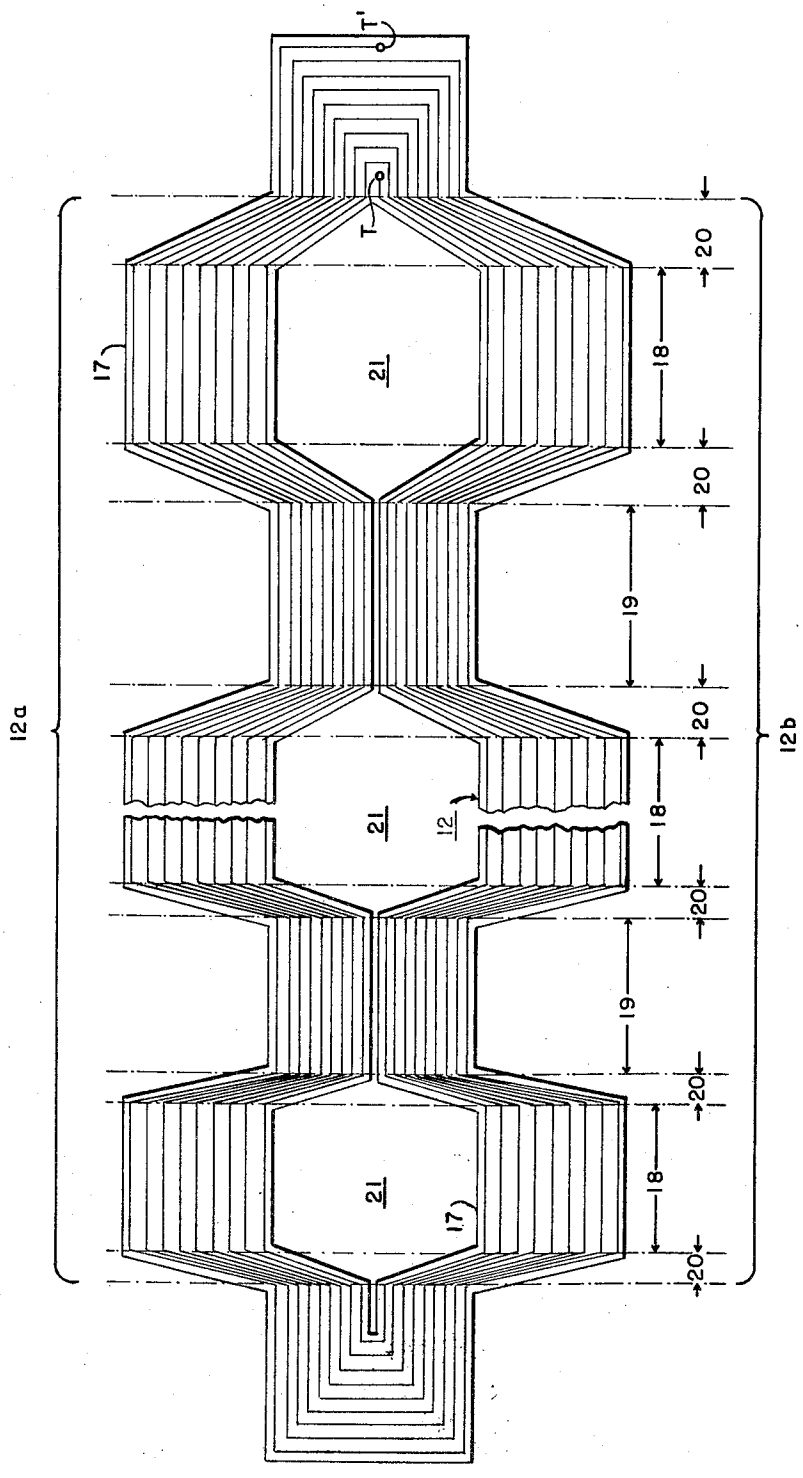


FIG. 4

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PROCESS OF MANUFACTURING MAGNETIC DEFLECTION YOKES

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19 Claims. (Cl. 29—155.57)

General

This invention is directed to a method of manufacturing electron-beam deflection yokes utilized to effect lateral motion of beams of electrons or similar electrical particles and is particularly directed to a method of manufacturing magnetic deflection yokes of this type. These yokes are particularly useful for deflecting the electron beams in cathode-ray tubes of the types conventionally employed in oscilloscopes, target indicators, and most commonly used in television receivers. To a large degree the stringency of the requirements of deflection yokes determines the methods of manufacturing these yokes. Since television deflection yokes have the most exacting requirements, the process of manufacturing such a yoke will be described herein. However, it should be understood that the method of manufacturing deflection yokes in accordance with the present invention may be employed in other than the manufacture of television yokes.

The fundamental principles underlying television transmission and reception and the details of the apparatus employed are so well known it is deemed unnecessary for the purpose of the present invention to describe a complete transmitter or receiver. It is well known in the art to employ cathode-ray tubes of various forms in conventional television receivers to reproduce televised images. To effect such reproduction, the cathode-ray tubes include means for emitting an electron beam which is intensity modulated by video-frequency information. This beam is focused into an extremely narrow beam to provide the high definition required in reproducing the televised image and is deflected in two orthogonal directions to scan a rectangular raster on the image screen of the picture tube to provide a two-dimensional reproduced image. Focusing of the electron beam is ordinarily accomplished by providing nonuniform magnetic or electric fields of regular configuration in the space traversed by the electron beam between the cathode and the image screen. Deflection of the focused electron beam is effected by developing varying electric or magnetic fields in the space traversed by the beam between the point of focusing and the image screen. The present invention is directed to deflection yokes for developing such varying magnetic deflection fields.

As is well known, a beam of electrons passing through a magnetic field is deflected in a direction perpendicular to the instantaneous direction of motion of the electrons in the beam and to the lines of magnetic force cut by the beam. In order to effect continuous and uniform deflection of the beam in the horizontal and vertical directions, the intensities of the components of the magnetic field in these two directions are varied, usually by employing separate coils of complex configurations with their axes mutually perpendicular in which the magnitudes of the currents in the separate coils are varied independently to provide mutually perpendicular fields.

Progressive advancements in the art of television have imposed rather stringent requirements upon deflection yokes. A deflection yoke should be an efficient power converter, provide linear scanning, develop uniform deflection fields which do not cause defocusing, and be free from resonant ringing and from undesired interaction of the vertical and horizontal fields. In addition, the yoke should be inexpensive and there should be a high degree

of consistency between the deflection fields developed by yokes of the same construction. With the advent of the wide-angle picture tubes having deflection angles approaching 90° and having an extremely short neck portion it has become difficult to satisfy these requirements.

It has been conventional to utilize "saddle" yokes, so-called because of the "saddle"-like configuration of each of the four coils which combine to form the yoke. Because of the complex configuration of these coils, "saddle" yokes require complex winding apparatus which individually winds each of the four coils and which in spite of its complexity fails to maintain a uniform or any other desired spatial relationship of the turns in each coil or to wind coils which are consistently the same. After the winding process, the coils usually require additional shaping by manual or mechanical means to assume the "saddle" form. The latter operation introduces additional inconsistencies between coils and additional irregularities within each coil. Four coils so formed are then nested with a winding of one coil in the cavity or window of another to provide the complete deflection yoke. The latter assembly operation introduces additional characteristics between yokes of the same type. As a result of the above-mentioned factors, "saddle" yokes have field irregularities and a lack of consistency in fields developed by yokes of the same type. To compensate for the field irregularities and the variations between fields developed by different coils of the same type, only a small segment at the center of the field pattern developed by a yoke is used for deflection. The inner surfaces of the coils forming the yoke are spaced from the neck of the tube in order to minimize the effects of field irregularities which are strongest in the vicinity of the coil surfaces. Since only a relatively small portion of the total field developed by a yoke is employed, conventional "saddle" yokes tend to be expensive, large, and heavy, and they develop deflection fields which are less uniform than is desired and which fail to provide the degree of control of deflection of the beam required for best reproduction of the image. The present methods of physically winding wire into complex coil forms and then assembling the complex coils into a "saddle" yoke make the elimination of the above-described undesired factors extremely difficult. Therefore, it is desirable to practice new methods of manufacturing deflection yokes.

It is, therefore, an object of the present invention to provide a method of manufacturing deflection yokes which do not have the deficiencies and limitations of prior yokes.

It is an additional object of the present invention to provide a method of manufacturing deflection yokes utilizing printed wiring techniques.

It is still another object of the present invention to provide a method of manufacturing deflection yokes which is easily and simply practiced to provide yokes with constant magnetic characteristics.

It is a further object of the present invention to provide a method of manufacturing deflection yokes in which a plurality of windings are preformed in fixed spatial relationship.

It is a further object of the present invention to provide a new and improved deflection yoke which does not have the deficiences and limitations of prior yokes.

It is a further object of the present invention to provide a simple and inexpensive deflection yoke with uniform magnetic characteristics utilizing printed wiring techniques.

In accordance with the present invention, a method of manufacturing a deflection yoke for a cathode-ray tube comprises forming on an insulating base an elongated flat coil, the turns of which progress continuously between the center and outer regions of the coil, and wrap-

ping the elongated sides of the coil around a yoke core wall in such manner that the elongated sides of the coil encircle the core wall to form two deflection windings in different radial quadrants of the core.

Further in accordance with the present invention, a cathode-ray tube deflection yoke comprises a yoke core and a dielectric sheet bearing a continuous loop-type conductor pattern surrounding a wall of the yoke core so that the two coils formed by the two sides of the loop-type conductor pattern fall in radial quadrants of the core.

Referring to the drawings:

FIG. 1 is a perspective view of a deflection yoke in accordance with the present invention mounted on the neck of a cathode-ray tube shown in fragmentary form;

FIG. 2 is a front elevation view of the yoke of FIG. 1, with a portion cut away to show interior detail;

FIG. 3 is a plan view of a strip of dielectric material including one of the coils utilized in the yoke of FIGS. 1 and 2; and

FIG. 4 is a plan view of a strip of dielectric material including a modified form of coil winding.

Description of deflection yoke

In FIG. 1 a perspective view of a deflection yoke **10** manufactured in accordance with the present invention is shown mounted on the neck of a cathode-ray tube **11** which may be, for example, the picture tube of a television receiver. The yoke **10** is a circular in cross section and preferably fits closely around the neck of the tube **11** with one end of the yoke, more specifically the beam-exit end, extending over at least a small length of the flared portion of the tube **11**. The yoke **10** includes four complete coils **12–15**, inclusive, which are identical in shape and form but which differ in size and may differ in the size or number of conductors. Each of these coils surrounds 180° of the surface of a ring core **16**. For example, as represented in FIG. 2, the coil **12** occupies the first and fourth quadrants, the coil **13** the second and third, the coil **14** the first and second, and the coil **15** the third and fourth quadrants of the circle formed by the core **16**. As is apparent from the drawing, the dimensions of the coils **14** and **15** are such that they may be placed within the outer coils **12** and **13**.

Each of the coils **12–15**, inclusive, is supported on a dielectric sheet and, when in their assembled form as shown in FIG. 1, each includes a pair of distinct, though interconnected, windings. Referring to FIGS. 1 and 2, the coil **12**, for example, has a pair of distinct windings **12***a* and **12***b*. These windings are shown in FIG. 3 in more detail and in unfolded form. The two distinct windings result when the dielectric sheet **17** of FIG. 3 is rolled up around, for example, the end turns **12***d*, the winding **12***a* being formed by the rolled-up side **12***a*, while the winding **12***b* is formed by the rolled-up side **12***b*. It is apparent that these two windings are interconnected by the end turns **12***c* and **12***d*.

The coils **12–15**, inclusive, are so disposed with respect to each other around the neck of the tube as to develop mutually perpendicular magnetic axes to effect horizontal and vertical deflection of the beam in the tube. For example, assuming the coils **12** and **13** having windings **12***a*, **12***b* and **13***a*, **13***b* develop the vertical deflection field, then windings **14***a*, **14***b* and **15***a*, **15***b* of coils **14** and **15**, respectively, are utilized to develop the horizontal deflection field. Each of the coil windings such as, for example, the winding **12***a* of coil **12** occupies approximately 60° of the circumference of the ring core **16**, the windings **12***a*, **12***b* and **13***a*, **13***b* individually overlapping portions of the windings **14***a*, **14***b* and **15***a*, **15***b*.

Referring now to FIG. 3, each of the coils **12–15**, inclusive, as represented by coil **12** in FIG. 3, is supported on a sheet of dielectric material **17** and has rectangularly disposed flat ends corresponding to the ends **12***c* and **12***d* as well as flat sides corresponding to the sides **12***a* and **12***b*. By "flat" is meant that the ends and sides of the coil lay flat against the surface of the dielectric sheet **17**.

The sides of these coils, as represented by the sides **12***a* and **12***b* in FIG. 3, have alternate beam-deflection sections **18** and current-return sections **19** connected by alternate flaring and converging sections **20**. For the form of coil construction shown in FIG. 3, the beam-deflection sections **18** are relatively narrow in the vertical dimension of the drawing, while the current-return sections **19** are relatively wide sections. This configuration is desirable so that the conductors of the flaring and converging sections **20**, which form the end turns of the assembled structure, will fan out radially from the cathode-ray tube axis. It will be noted that the coil **12**, when viewed in its unfolded form as shown in FIG. 3, is a continuous coil winding having a plurality of elongated rectangular-like turns which progress in a spiral-like manner towards the center region of the unfolded coil winding.

The conductors in each of the coils **12–15**, inclusive, are formed by employing printed circuit techniques and are, for example, approximately 15 mils wide, 1.5 mils thick, and are separated from each other by approximately 15 mils. For simplicity of representation, in FIGS. 1 and 3 only a few conductors have been shown representing each of the windings and the relative conductor sizes and spacings are not to scale. In practice, the density of the conductors as well as the total number and size of the conductors is controlled by the field strength desired. The pattern of the spacings of the conductors is determined by the field pattern desired. For example, if a cosine field pattern is needed to correct for such problems as pin-cushion or barrel distortion, then the windings are spaced or have distributed density according to a cosine pattern.

The side windings **12***a* and **12***b*, specifically the narrow sections **18** of these windings, provide the deflection energy for deflecting the cathode-ray-tube beam, the wide, flaring, and converging sections **19** and **20** serving only to complete the current path for the narrow sections. The center portion of the dielectric sheet may be omitted when the sheet is manufactured or may be cut out before or after the conductors have been formed on the sheet, thus, leaving an open region **21** as shown in FIG. 3. In addition, slits, represented by the dashed lines in FIG. 3, are made between conductors in the converging and flaring sections **20** to facilitate the winding of the sheet of conductors into a tubular form and the bending of the tube to fit over an arc of the core **16**. The lengths of the different sections in the coil sides are made progressively longer. That is, for example, the length of the second narrow section counting from the end **12***d* in a coil side such as side **12***b* is longer than that of the first, and the third is longer than that of the second. The difference in length is determined by the thickness of the dielectric sheet resulting in the successive circumferences of the layers of the sheet when wound in tubular form becoming progressively larger.

A group of coils of the type represented by FIG. 3, after each has been rolled into a flattened or rectangular tube about an axis parallel to the coil ends, for example, the ends **12***c* and **12***d*, are combined on the ring core **16** in the order represented in FIG. 1 to provide a complete deflection yoke. The core **16** may be, for example, of ferromagnetic material such as ferrite in order to provide a low reluctance return path for the magnetic flux developed by the coils and preferably is separable into quadrant pieces to facilitate the threading of the tubular coil structure onto the core in the desired order. The coils enclose the walls of the core and the coil sides **12***a* and **12***b* are parallel to the axis of the core. The beam-deflection or narrow sections **18** of the coil sides are superposed on the inner and the wide or current-return sections **19** superposed on the outer walls of the core **16**. The coils are secured about the circumference of the core, after being adjusted in proper spatial relationship, by means of an adhesive on the core or by adhesive tape.

Method of manufacturing deflection yoke

The process of manufacturing a deflection yoke in accordance with the present invention commences with the preparation of an elongated rectangular-like coil winding such as represented by FIG. 3 on each of a plurality of dielectric sheets. These sheets may be, for example, of some thin flexible plastic material such as vinylite or a phenolic Fiberglas and are either of a rectangular shape including a center portion or of similar shape without the center portion. By means of conventional printed wiring processes a coil, for example coil **12** having sides **12***a* and **12***b* and ends **12***c* and **12***d*, and in which the sides have alternate wide and narrow sections connected by alternate flaring and converging sections, is formed on each dielectric sheet. The printing process may, for example, comprise etching the conductors for each coil out of a thin copper plating coating the dielectric sheet, conventionally known as copper-clad. Alternatively, each coil may be impressed or sprayed onto the dielectric sheet to form copper, silver, or other conductive material. Conventional printing or spraying processes can be employed. In forming the coils on the dielectric sheet, each set of four sections of a coil, for example the sections including a wide, a narrow, a flaring, and a converging portion, is made progressively longer to compensate for the additional circumference in each coil layer of four sections. The lengths of the first four sections are determined by the length of the first narrow section and the thickness of the core. The length of the first narrow section is determined by the deflection force desired and is limited by the available length on the neck of the picture tube. Each coil is one continuous loop of conductors having terminals as indicated by the reference letters T and T′ in FIG. 3. If desired, slits, as represented by the dashed lines, are cut or otherwise formed between the conductors in the flaring and converging sections to facilitate the forming of the dielectric sheet and the coil thereon into a flattened tube. If slits are provided they should be slightly longer than the flaring and converging sections, but not so long as to disturb the fixed spacing of at least the conductors in each narrow section.

Each sheet so prepared is rolled on a mandrel or by other means about an axis parallel to the ends of the coil so that the coil sides are normal to this axis and form rings at the ends of the tube formed by the sheet. The folding process is such that corresponding sections in each side, as well as the two end sections, are superposed. In other words, each layer in the flattened tube includes a set of the four coil sections with, for example, all of the beam-deflection or narrow sections **18** in the different layers superposed. For coils **14** and **15**, the interior dimensions of the tubes formed by the coils are approximately equal to the outside dimensions of the core **16**. Coils **12** and **13** form tubes in which the internal dimensions are approximately equal to the outside dimensions of the coils **14** and **15**. In view of the difference in size of the tubes formed by the different coils, coils **12** and **13** have longer sides and each of the sections in each side is correspondingly longer than the sides and the sections of coils **14** and **15**.

As previously mentioned, the core **16** is preferably broken into four quadrant pieces having irregular rather than machined mating edges. The irregular mating edges of adjacent pieces provide greater contact surfaces thereby decreasing interface effects. On quadrant of the core **16** is threaded through the internal openings in the tubes formed by the coils **14** and **12** in the order mentioned to provide the upper right-hand or first quadrant of the yoke of FIGS. 1 and 2. In a similar manner the second quadrant of the core **16** is threaded through the tubes formed by coils **14** and **13**, the third quadrant through the tubes formed by coils **15** and **13**, and the fourth quadrant through the tubes formed by coils **15** and **12** in that order. The quadrant sections of the core are then fitted together to form the cylindrical or ring core **16** and are secured in that position by use of adhesive or by tape which secures the different coils in proper position. A dust cover (not shown) and a magnetic shield (not shown) may be added to enclose and protect the coils. In addition, considering FIG. 3, not all of the end turns at ends **12***c* and **12***d* need cross over at the very ends. Some may cross over at intermediate points to delete the total number of turns per layer of coil as the layers build up. This saves cost and space with little loss in magnetic flux.

Modified coil structure of FIG. 4

Referring now to FIG. 4 of the drawings, there is shown an alternative form of conductor pattern that may be printed on the dielectric sheet **17** and which should be mentioned in detail because of the reduced energy losses associated with a deflection yoke which utilizes such a conductor pattern. The conductor pattern as shown on the unfolded dielectric sheet **17** of FIG. 4 is similar to the pattern on the unfolded dielectric sheet shown in FIG. 3 except that the current-return sections **19** on opposite sides **12***a* and **12***b* of the conductor pattern have been positioned more closely to one another.

The conductor pattern on the dielectric sheet **17** of FIG. 4 is rolled up the same manner as previously described so as to form a flattened tubular structure which may be placed on the ring core **16** of the deflection yoke. It will be apparent that when this is done, the more closely spaced current-return sections **19** will lay on top of one another on the outside of the core **16**. Now, as the current flow in the current-return sections **19** making up the side **12***a* is flowing in a direction oppositie to the current flowing in the sections **19** making up the side **12***b*, the magnetic fields produced by adjacent sections on the two sides **12***a* and **12***b* of the conductor pattern will partially cancel one another. This means that less energy will be stored in the magnetic fields produced by the current-return sections and, hence, the energy losses due to eddy currents, etc., will be reduced, thus resulting in a more efficient operation of a deflection yoke utilizing such conductor patterns.

While the conductor configuration shown in FIG. 4 indicates one manner in which the current-return sections **19** of the coil **12** may be spaced more closely to one another, it will be apparent to those skilled in the art that other configurations are possible for producing the desired magnetic field cancellation. Any conductor pattern wherein the current-return sections on opposite sides of the conductor pattern are brought into a closely adjacent relationship with one another will produce the desired results.

In deflection yokes of any of the foregoing types, the conductors in each of the coils is constrained as a result of being printed in fixed position to have fixed and consistent spatial relationships with respect to each other. As a result, uniform coils or coils with conductors nonuniformly distributed in any desired pattern are consistently manufactured. The magnetic fields developed by coils manufactured in the manner described herein are as exact and controlled in pattern as desired and are consistently duplicated. This results in a relatively inexpensive and light-weight deflection yoke which provides greatly improved deflection and has a minimum disturbing effect on the focusing of an electron beam.

Though relatively simple deflection yokes and their manufacture have been described and no extensive discussion of techniques for correcting for well-known deficiencies in yokes has been presented, it should be apparent to those skilled in the art that many of the practices which are conventionally employed to develop magnetic field patterns of suitable distribution to correct for field deficiencies may equally well be employed in the preparation of a yoke such as described herein. In fact, the use of printed-wiring techniques facilitates the obtain-

ing of many of these corrective effects by simplifying the grading of conductor size and spacing of conductors in any desired manner to obtain field patterns which provide the corrective effects desired.

While there have been described what are at present considered to be the preferred embodiments of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is, therefore, aimed to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. The method of manufacturing a deflection yoke for a cathode-ray tube comprising: forming on an insulating base an elongated flat coil the turns of which progress continuously between the center and outer regions of the coil; and wrapping the elongated sides of the coil around a yoke core wall in such manner that the elongated sides of the coil encircle the core wall to form two deflection windings in different radial quadrants of the core.

2. The method of manufacturing a deflection yoke for a cathode-ray tube comprising: forming on an insulating base an elongated flat coil the turns of which progress continuously between the center and outer regions of the coil; and wrapping the elongated sides of the coil around a yoke core wall in such a manner that the elongated sides of the coil encircle the core wall to form two deflection windings in different radial quadrants of the core and the short ends of the coil are positioned on the outer periphery of the core.

3. The method of manufacturing a deflection yoke for a cathode-ray tube comprising: forming on an insulating base an elongated flat coil the turns of which progress continuously between the center and outer regions of the coil; and wrapping the elongated sides of the coil around a yoke core wall in such manner that the elongated sides of the coil encircle the core wall to form two deflection windings in different radial quadrants of the core, and the short ends of the coil are positioned on the outer periphery of the core in proximity to each other so that their magnetic fields tend to cancel each other.

4. The method of manufacting a deflection yoke for a cathode-ray tube comprising: forming on an insulating base an elongated flat coil the conductor turns of which progress continuously between the center and outer regions of the coil; and wrapping the elongated sides of the coil around a yoke core wall in such manner that the elongated sides of the coil encircle the core wall to form two deflection windings in different radial quadrants of the core, adjacent conductors in the elongated sides of the flat coil being shaped during forming with alternate narrow and wide spacing therebetween along the length of the coil side so that for each of the resulting deflection windings the conductors inside the core are more closely spaced to one another than the conductors outside of the core.

5. The method of manufacturing a deflection yoke for a cathode-ray tube comprising: forming on an insulating base an elongated flat coil the turns of which progress continuously between the center and outer regions of the coil; and wrapping the elongated sides of the coil around a yoke core wall in such manner that the elongated sides of the coil encircle the core wall to form two deflection windings in different radial quadrants of the core, adjacent conductors in the elongated sides of the flat coil being shaped during forming with alternate narrow and wide spacing therebetween along the length of the coil side so that for each of the resulting deflection windings the conductors inside the core are more closely spaced to one another than the conductors outside of the core and so that those portions of the turns interconnecting the foregoing conductors are directed radially of the core so as to minimize radial components of their magnetic field.

6. The method of manufacturing a deflection yoke for a cathode-ray tube comprising: forming on an insulating base an elongated flat coil the turns of which progress continuously between the center and outer regions of the coil; and wrapping the elongated sides of the coil around a yoke core wall in such manner that the elongated sides of the coil encircle the core wall to form two deflection windings in different radial quadrants of the core, the opposite elongated sides of the flat coil being shaped during forming with portions of the two sides alternately adjacent and nonadjacent so that those portions of the turns adjacent the outer periphery of the core for one of the resulting windings are closely spaced to those of the other winding, whereby magnetic fields of those portions in one winding tend to cancel magnetic fields of those portions in the other winding.

7. A method of manufacturing a deflection yoke for a cathode-ray tube comprising: forming on each of a plurality of dielectric sheets a continuous coil winding comprising a plurality of elongated rectangular-like turns which progress in a spiral-like manner towards the center region of the coil winding; rolling each of said dielectric sheets into a flattened tubular structure to form two spaced and interconnected deflection windings securing a plurality of said tubular structures around the walls of a yoke core so that said windings enclose the walls of said core thereby to form a deflection yoke for a cathode-ray tube.

8. A method of manufacturing a deflection yoke for a cathode-ray tube comprising: forming on each of a plurality of dielectric sheets a long coil having substantially rectangularly disposed flat ends and flat sides having alternate beam-deflection and current-return sections connected by alternate flaring and converging sections; rolling each of said dielectric sheets into a flattened tubular structure having said sides normal to the axis thereof and having corresponding ones of said sections superposed; and securing a plurality of said tubular structures around the walls of a yoke core to form an array of coils disposed in such manner as to enclose the walls of said core and having said coil sides parallel to the axis of said core and having said beam-deflection sections superposed on the inner and said current-return sections superposed on the outer walls of said core.

9. A method of manufacturing a deflection yoke for a cathode-ray tube comprising: forming on each of a plurality of dielectric sheets a long coil having substantially rectangularly disposed flat ends and flat sides having alternate wide and narrow sections connected by alternate flaring and converging sections; rolling each of said dielectric sheets into a flattened tubular structure having said sides normal to the axis thereof and having corresponding ones of said sections superposed; and securing a plurality of said tubular structures around the walls of a yoke core to form an array of coils disposed in such manner as to enclose the walls of said core and having said coil sides parallel to the axis of said core and having said narrow sections superposed on the inner and said wide sections superposed on the outer walls of said core.

10. A method of manufacturing a deflection yoke for a cathode-ray tube comprising: forming on each of a plurality of dielectric sheets a long narrow coil having substantially rectangularly disposed flat ends and flat sides having alternate wide and narrow sections connected by alternate flaring and converging sections; rolling each of said dielectric sheets into a flattened tubular structure having said sides normal to the axis thereof and having corresponding ones of said sections superposed; and securing a plurality of said tubular structures around the walls of a yoke core to form an array of coils disposed in such manner as to enclose the walls of said core and having said coil sides parallel to the axis of said core, said narrow sections superposed on the inner and said wide sections superposed on the outer walls of said core, and said flaring and converging sections on the side walls of said core.

11. A method of manufacturing a deflection yoke for a cathode-ray tube comprising: forming on each of a plurality of dielectric sheets a long coil having substantially rectangularly disposed flat ends and flat sides having progressively longer alternate wide and narrow sections connected by progressively longer alternate flaring and converging sections; rolling each of said dielectric sheets into a flattened tubular structure having said sides normal to the axis thereof and having corresponding ones of said sections superposed; and securing a plurality of said tubular structures around the walls of a yoke core to form an array of coils disposed in such manner as to enclose the walls of said core and having said coil sides parallel to the axis of said core and having said narrow sections superposed on the inner and said wide sections superposed on the outer walls of said core.

12. A method of manufacturing a deflection yoke for a cathode-ray tube comprising: forming on each of a plurality of dielectric sheets a long coil having substantially rectangularly disposed flat ends and flat sides having alternate wide and narrow sections connected by alternate flaring and converging sections; rolling each of said dielectric sheets into a flattened tubular structure having said sides normal to the axis thereof and having corresponding ones of said sections superposed; and securing a plurality of said tubular structures around the walls of a ring-type yoke core of magnetic material to form an array of coils disposed in such manner as to enclose the walls of said core and having said coil sides parallel to the axis of said core and having said narrow sections superposed on the inner and said wide sections superposed on the outer walls of said core.

13. A method of manufacturing a deflection yoke for a cathode-ray tube comprising: forming on each of a plurality of dielectric sheets a long coil having substantially rectangularly disposed flat ends and flat sides having alternate wide and narrow sections connected by alternate flaring and converging sections; rolling each of said dielectric sheets into a flattened tubular structure having said ends parallel and said sides normal to the axis thereof and having corresponding ones of said sections superposed; and securing a plurality of said tubular structures around the walls of a yoke core to form an array of coils disposed in such manner as to enclose the walls of said core and having said coil sides parallel to the axis of said core and having said narrow sections superposed on the inner and said wide sections superposed on the outer walls of said core.

14. A method of manufacturing a deflection yoke for a cathode-ray tube comprising: forming on each of a plurality of dielectric sheets a long coil having substantially rectangularly disposed flat ends and flat sides having alternate wide and narrow sections connected by alternate flaring and converging sections; rolling each of said dielectric sheets into a flattened tubular structure having said sides normal to the axis thereof and having corresponding ones of said sections superposed; and securing a plurality of said tubular structures around the walls of a yoke core with the coil sides of one of said sheets overlapping the coil sides of adjacent ones of said sheets to form an array of coils disposed in such manner as to enclose the walls of said core and having said coil sides parallel to the axis of said core and having said narrow sections superposed on the inner and said wide sections superposed on the outer walls of said core.

15. A method of manufacturing a deflection yoke for a cathode-ray tube comprising: forming on each of a plurality of dielectric sheets a long coil having substantially rectangularly disposed flat ends and flat sides having alternate wide and narrow sections connected by alternate flaring and converging sections and having slits between conductors in said flaring and converging sections; rolling each of said dielectric sheets into a flattened tubular structure having said sides normal to the axis thereof and having corresponding ones of said sections superposed; and securing a plurality of said tubular structures around the walls of a yoke core to form an array of coils disposed in such manner as to enclose the walls of said core and having said coil sides parallel to the axis of said core and having said narrow sections superposed on the inner and said wide sections superposed on the outer walls of said core.

16. A method of manufacturing a deflection yoke for a cathode-ray tube comprising: printing on each of a plurality of dielectric sheets a long coil having substantially rectangularly disposed flat ends and long flat sides having alternate wide and narrow sections connected by alternate flaring and converging sections; rolling each of said dielectric sheets into a flattened tubular structure having said sides normal to the axis thereof and having corresponding ones of said sections superposed; and securing a plurality of said tubular structures around the walls of a yoke core to form an array of coils disposed in such manner as to enclose the walls of said core and having said coil sides parallel to the axis of said core and having said narrow sections superposed on the inner and said wide sections superposed on the outer walls of said core.

17. A method of manufacturing a deflection yoke for a cathode-ray tube comprising: forming on each of a plurality of dielectric sheets a long coil having substantially rectangularly disposed flat ends and flat sides having alternate beam-deflection and current-return sections connected by alternate flaring and converging sections, corresponding current-return sections on opposite sides of the coil being formed so as to be spaced more closely to one another than the beam-deflection sections; rolling each of said dielectric sheets into a flattened tubular structure having said sides normal to the axis thereof and having corresponding ones of said sections superposed; and securing a plurality of said tubular structures around the walls of a yoke core to form an array of coils disposed in such manner as to enclose the walls of said core and having said coil sides parallel to the axis of said core and having said beam-deflection sections superposed on the inner and said current-return sections superposed on the outer walls of said core, the close spacing of the current-return sections affording magnetic-field cancellation thereby to reduce the power loss of the deflection yoke.

18. A printed circuit element for a cathode-ray tube deflection yoke, the element comrpising: a sheet of dielectric material; and a conductor pattern affixed to the dielectric sheet and comprising a continuous loop-type conductor pattern having two elongated sides joined by two short sides, the elongated sides having alternate wide and narrow sections connected by alternate flaring and converging sections.

19. A printed circuit element for a cathode-ray tube deflection yoke, the element comprising: a sheet of dielectric material; and a conductor pattern affixed to the dielectric sheet and comprising a continuous loop-type conductor pattern having two elongated sides joined by two short sides, the elongated sides having alternate sections which are spaced nearer to and farther from one another and are connected by intervening oblique sections.

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