Oct. 14, 1947. C. E. TORSCH 2,428,947

DEFLECTION DEVICE FOR CATHODE RAY TUBES

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Fig. 1.

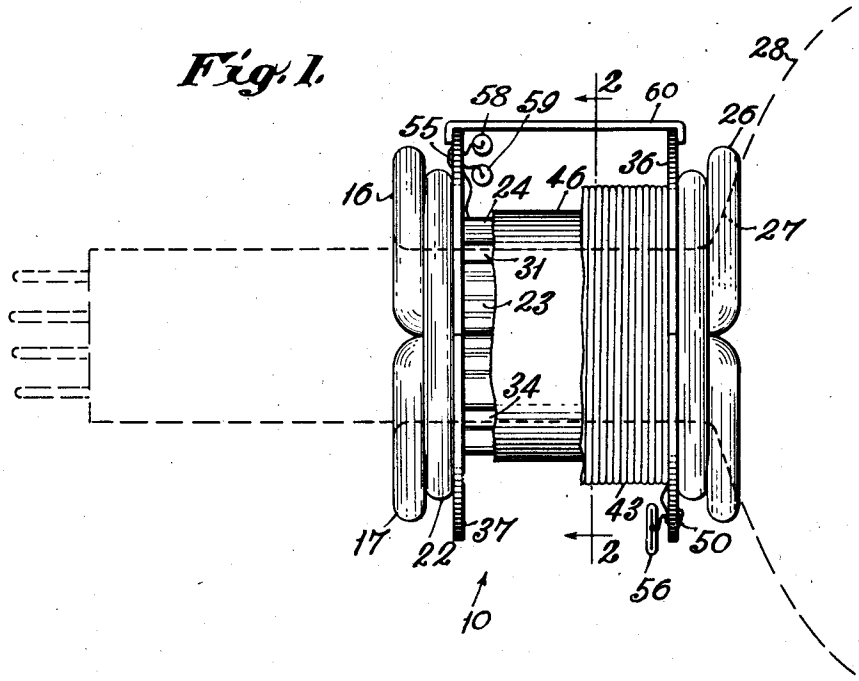


Fig. 2.

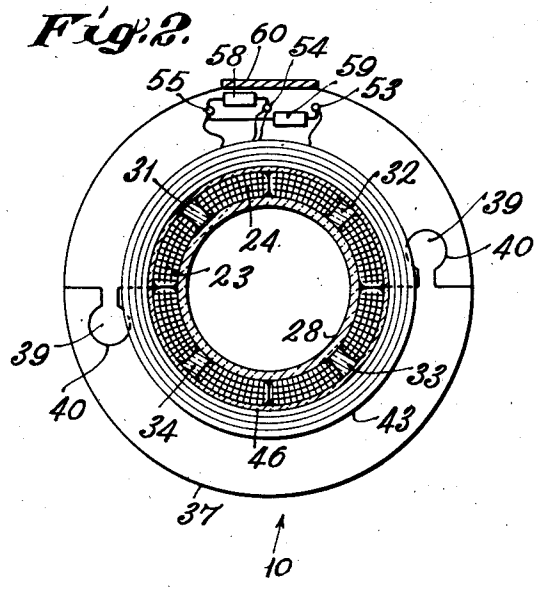
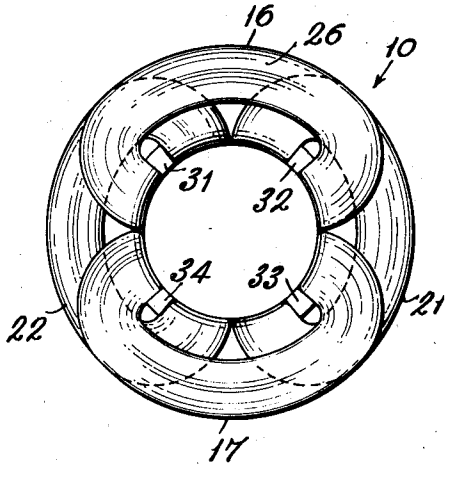


Fig. 3.



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Fig. 4.

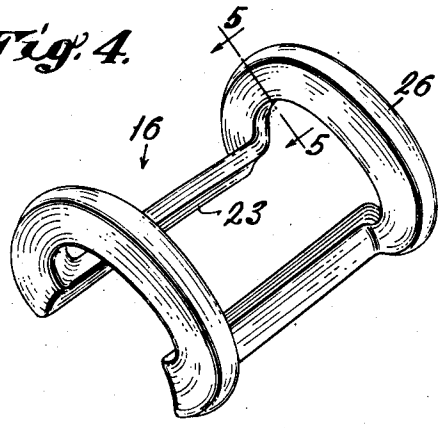


Fig. 5.

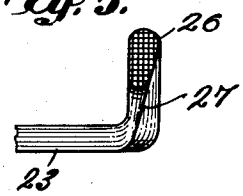
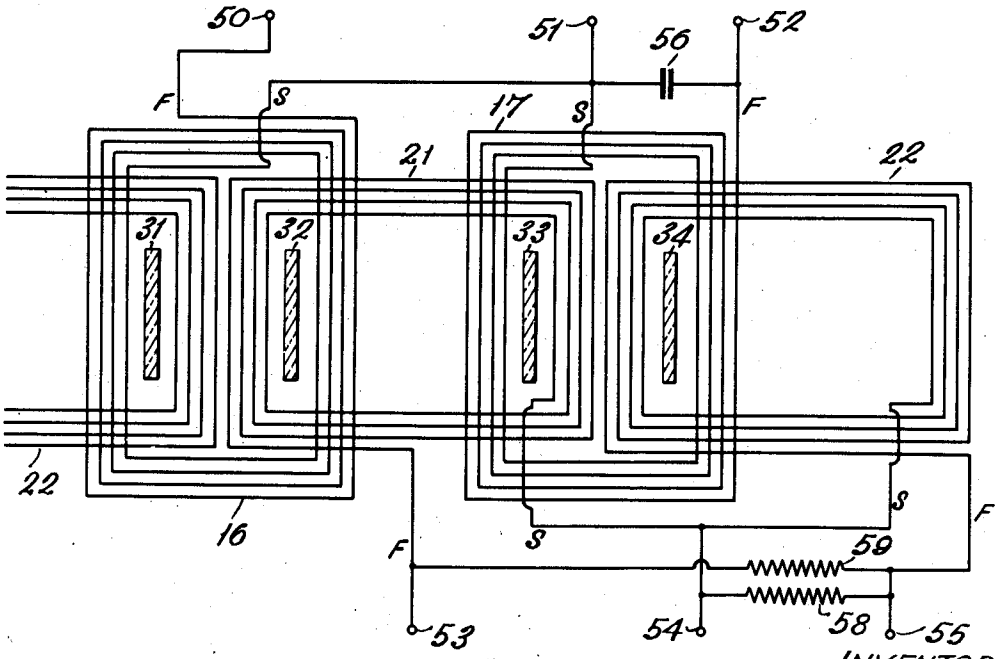


Fig. 6.



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UNITED STATES PATENT OFFICE

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DEFLECTION DEVICE FOR CATHODE-RAY TUBES

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Application January 31, 1945, Serial No. 575,369

7 Claims. (Cl. 250—156)

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The present invention relates to cathode ray tube beam deflecting devices and, more particularly, to a novel deflecting coil assembly in the form of a self-sustaining yoke.

The principal object of the invention is to provide a novel self-supporting deflecting yoke having horizontal and vertical deflecting coils, so called.

Another object is to provide a deflection coil yoke for use with a cathode ray tube in which the coils are interlocked so their initial geometrical relationship is maintained.

Still another object is to provide a cathode ray beam deflecting device having maximum inductor length located most effectively with respect to the neck of the cathode ray tube with which it is employed.

A further object is to provide a deflection coil assembly for use with a cathode ray tube, which assembly is self-supporting to eliminate thereby the need for conventionally used end-discs and thus to permit certain of the coils to be shaped to touch the flare of the tube end ahead of the reference line to reduce the possibility of neck-strike-shadow.

A still further object of the present invention is to provide a yoke which does not require electrostatic shielding between the sets of deflection coils.

A still further object is to provide a deflection coil assembly for use with a cathode ray tube in which the active portions of the coils parallel to the axis of the tube are of constant cross section, these active portions of the coils being adjustably spaced around the neck of the tube to adjust "barrel" and "pincushion" scan of raster for flat-faced or round-faced tubes.

A still further object is to provide for initially adjusting the shield capacitance in a cathode ray tube beam deflecting yoke to compensate for crosstalk unbalance.

A still further object of the present invention is to provide a yoke structure which will provide support for a cathode ray tube.

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 sectional view taken along the line 2—2 of Fig. 1;

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Fig. 3 is a view in end elevation of the yoke of Fig. 1, showing only the interlocked coils and spacers;

Fig. 4 is a perspective view of a horizontal deflecting coil of Fig. 1;

Fig. 5 is a fragmentary section of the coil end taken on line 5—5 of Fig. 4; and

Fig. 6 shows, schematically, the electrical relationship of the coils.

Referring to Figs. 1, 2, and 3, 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, and also, two diametrically opposed vertical deflecting coils 21 and 22 of somewhat similar construction. The terms "horizontal" and "vertical" as used herein in connection with the deflection of a cathode ray beam are relative only and refer to the two components of movement imparted to the beam irrespective of absolute direction. In general, "horizontal deflection" refers to the deflection which occurs at a higher frequency to provide a line by line scan of the raster with each line extending substantially in a horizontal direction.

The active portions of all of the coils are of substantially the same dimensions in cross section as is best illustrated in Fig. 2. The cross section of the active portion of the coil 16 is designated 23, and the cross section of the active portion of the coil 22 is designated 24 (Fig. 2). The fragmentary section of one of the horizontal coils, namely coil 16 which is similar to coil 17, is shown in Fig. 5 of the drawings to illustrate the shaping of a turned up coil end 26 which is formed to have a recess 27 so that the entire yoke 10 may be mounted on the neck of a cathode ray tube 28 (Fig. 1) with the flaring portion of the tube received in the recess 27 thus producing the optimum deflecting effect by the fluxes of the coils.

The coil ends of all of the coils are upturned as shown and may be formed by any known winding and bending procedure which is convenient and produces a coil of the shape required by the invention. Preferably, the coils comprising the yoke 10 are wound and formed simultaneously by a coil winding machine embodying features disclosed and claimed in the copending application for Letters Patent of the United States, Serial No. 570,663, entitled "Art of winding odd-shaped coils," and filed December 30, 1944, in the name of Harry V. Knauf, Jr.

The entire yoke 10, as illustrated in Fig. 1, is assembled by interfitting the active portions of

all of the coils as best shown in cross section by Fig. 3 of the drawings. Spacers 31 to 34, which are of an insulating material such as wood, Bakelite, or the like are inserted between adjacent horizontal and vertical coils. The dimensions of these spacers are such that they insure positioning of the coils in a manner to correct distortion of the flux pattern and therefore reduce or otherwise control "pincushioning" and "barrel" effects.

Retaining rings 36 and 37 are provided which fit snugly against the opposite upturned ends of the vertical deflecting coils 21 and 22. In order to facilitate assembly of these rings, each ring is divided into two parts as shown in Fig. 2 of the drawings, each part being provided with a tongue 39 and an opening 40 of corresponding shape so that the rings may be assembled together in position on the yoke after the coils have been positioned with respect to each other as shown by Fig. 3.

The coil assembly is surrounded by a covering of iron 43 which is preferably in the form of a plurality of layers of iron wire wrapped directly on the active conductor bundles of the coils which, as shown in Fig. 2, are substantially cylindrical in outline. The structure of the yoke 10 is of substantially uniform diameter axially whereby the iron covering 43 is radially equidistant from the center of the tube neck at all points. A protective layer 46 (Fig. 1) of any suitable insulating material may be placed between the iron covering 43 and the exposed parts of the coils. This insulating layer may be composed of paper, reconstituted cellulose, or the like. It will be noted that the iron covering is more closely coupled to the vertical deflecting coils than to the horizontal deflecting coils, but this is substantially offset by the fact that the horizontal deflecting coils have more effective length parallel to the beam.

The uniform cross section of the ring or shell of conductors provided by successive active portions of the coils and the cylindrical configuration of the iron covering with the interposed insulating layer 46 may be employed to adjust capacity by grounding the iron covering and avoid direct coil capacity coupling through a floating iron shell. This may most conveniently be done by grounding the end of the iron wire forming the covering, for example, on the hereinafter described bar 60. The thickness of the insulating material 46 may be selected so as to obtain the desired capacity adjustment. If paper or the like is employed, the number of layers placed on the yoke will conveniently adjust the thickness of the insulating material.

Fig. 6 shows a horizontal development of the windings of the yoke 10, the interconnections of the coils and terminal arrangements being indicated schematically. One edge of coil 22 is repeated at the left hand side of the diagram to show that it interlinks coil 16. In order to simplify the diagram, only four turns per coil have been shown. The start and finish of each coil is marked S and F, respectively. It will be noted that the finish turn of one coil is adjacent the finish turn of the next coil of the completed winding; whereas the start turn of any coil is adjacent the start turn of the next successive coil in the finished winding.

The retaining rings 36 and 37 serve as mountings for terminals to which the coil ends are connected. For example, the terminals 50, 51, and 52 for the horizontal windings 16 and 17 are preferably mounted on the retaining ring 36

so that there will be little danger of contact with these terminals since they are in a more or less inaccessible location. The terminals 53, 54, and 55, which usually carry a lower voltage, are mounted on the retaining ring 37. In this manner, the terminal connections are well separated and easily identifiable. The coil terminals on the retaining rings provide a convenient means for mounting compensating elements of the several kinds usually required in a deflection device. For example, a condenser 56, shown schematically on Fig. 6 of the drawings, may be mounted as indicated in Fig. 1 on the ring 37. This condenser serves to compensate for the unsymmetrically distributed capacity of the horizontal windings with respect to ground. A resistor 58 and a resistor 59, shown schematically on Fig. 6 of the drawings, may be mounted as shown in Fig. 1 on the retaining ring 37 with the aid of the coil terminal lugs. The purpose of these resistors is to dissipate in the vertical coils residual crosstalk energy coupled from the horizontal coils.

A bar 60 or other supporting means may be secured at each of its ends to the rings 36 and 37 to provide a convenient means for supporting the yoke 10 and the neck of the tube 28. Such a yoke and tube support employing a bar 60 having added structural features is disclosed and claimed in a copending application for Letters Patent entitled "Cathode ray tube support" filed January 31, 1945, Serial No. 575,497, by E. B. Cain.

From the foregoing description, it will be seen that the yoke 10, which is designed to serve as a device for deflecting the electron beam developed within cathode ray tubes, is of relatively rigid construction in which the several elements maintain their fixed positions one with respect to the other throughout the life of the device. Such slight adjustment as may be needed is made initially at the time of manufacture by selecting spacers 31 to 34 of required dimensions to eliminate crosstalk between the pairs of coils and to insure the kind of flux distribution which is desired. Normally, this distribution is to be uniform but it may be varied as noted above.

In the foregoing description of the yoke of the present invention, coils 16 and 17, which are of greater length than the coils 21 and 22, are shown as being positioned and connected to provide horizontal deflection of a cathode ray beam since this is a preferred construction due to the higher efficiency of the longer coils. However, it is within the scope of the invention to employ the shorter coils 21 and 22 to provide horizontal deflection.

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 cathode ray beam deflecting device comprising a plurality of pairs of coils, each coil having sides and ends; the coils of one pair being longer in the direction of their sides than the coils of the next adjacent pair positioned progressively around the device, the sides of all of said coils being a conductor bundle of substantially uniform cross section the conductors serving as inductors for producing a useful ray deflecting field, the bundles being arranged adjacent each

other to provide an annulus of conductors whereby said coils are interlocked, and the ends of said coils lying in a plane substantially perpendicular to the axis of the annulus.

2. A cathode ray beam deflecting device comprising two pairs of coils each coil having sides and ends; the sides of all of said coils being of uniform substantially rectangular cross section, the conductors therein serving as inductors for producing a useful ray deflecting field, the coils of one pair being in opposed relationship in the device and being longer in the direction of their sides than the coils of the remaining pair, the latter pair also being in opposed relationship on an axis substantially perpendicular to the axis of the longer oppositely arranged coils, the sides of the coils being arranged adjacent each other to provide an annulus of conductors whereby said coils are interlocked, and the ends of all of said coils lying in a plane substantially perpendicular to the axis of the annulus.

3. A cathode ray beam deflecting device comprising a plurality of pairs of coils each coil having sides and ends, the sides of one pair lying adjacent in the device and alternating with the sides of another pair, the sides of all of said coils being a conductor bundle of substantially uniform cross section serving as inductors for producing a useful ray deflecting field, the bundles arranged adjacent each other to provide an annulus of conductors of substantially uniform radial thickness, and a plurality of insulating spacers, each spacer being located between the side of one pair of coils and the side of the next adjacent pair of coils.

4. The deflecting device of claim 3 in which the thickness of each spacer circumferentially of the annulus of conductors is chosen to provide a desired magnetic flux distribution from the pairs of coils, and thereby to produce a predetermined scanning raster of the deflected beam.

5. An electromagnetic electron beam deflecting device for use with a cathode ray tube comprising a pair of oppositely disposed horizontal deflecting coils, a pair of oppositely disposed vertical deflecting coils, each pair of coils being positioned on an axis substantially at right angles to the axis of the other pair of coils, each coil having

upturned ends so that the ends of all of the coils lie in a plane substantially perpendicular to the axis of the device, a pair of ring members, each member being spaced axially of the device and being in contact with the inside of the ends of at least one of the pairs of coils, and a magnetic shield of substantially uniform radial thickness extending between and in abutment with the end rings to hold them in position, conductors extending from the coils for providing electrical connections thereto, and terminals to serve as external electrical circuit connectors, the conductors from said coils being conductively secured in a predetermined order to the terminals.

6. The combination of claim 5 wherein compensating elements comprising resistors and capacitors are electrically secured to the terminals to be carried by the end rings.

7. A self-supporting electromagnetic electron beam deflection device for use with a cathode ray tube comprising pairs of opposed coils each coil having active sides which are effectively parallel and at least one upturned end, the coils being arranged in interlocked relationship so that the coil sides are in the form of an annulus having substantially uniform inside and outside diameters, the neck of the cathode ray tube with which the device is to be employed being receivable snugly within said annulus and in physical contact with the sides of the coils, and the upturned ends of the coils at one end of the device being formed to receive the flaring end of the cathode ray tube with which the device is to be employed.

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