July 31, 1951 K. SCHLESINGER 2,562,394

ELECTROMAGNETIC DEFLECTION YOKE

Filed Jan. 15, 1948

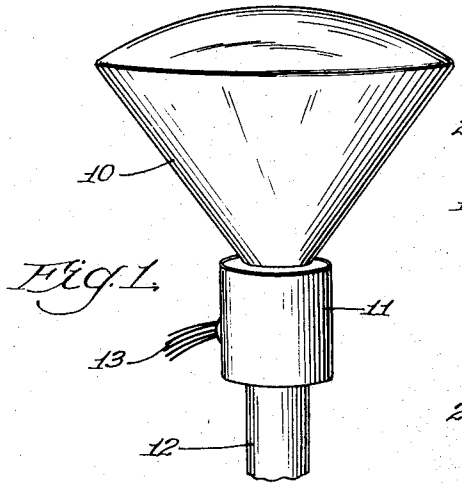


Fig. 1.

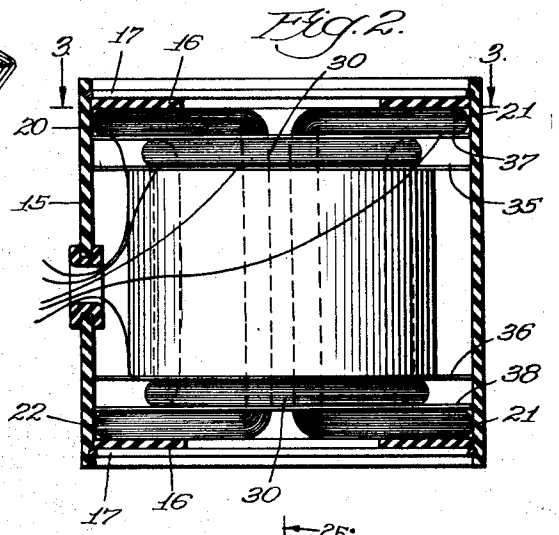


Fig. 2.

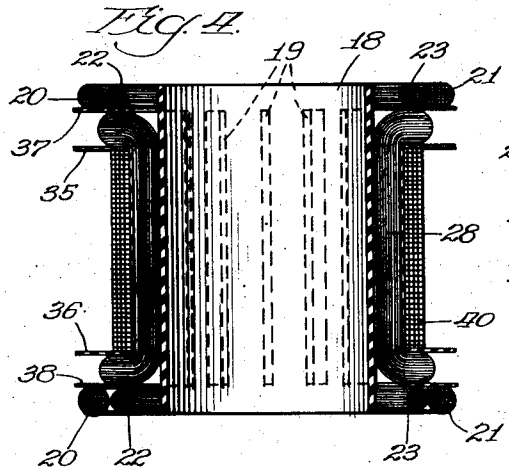


Fig. 4.

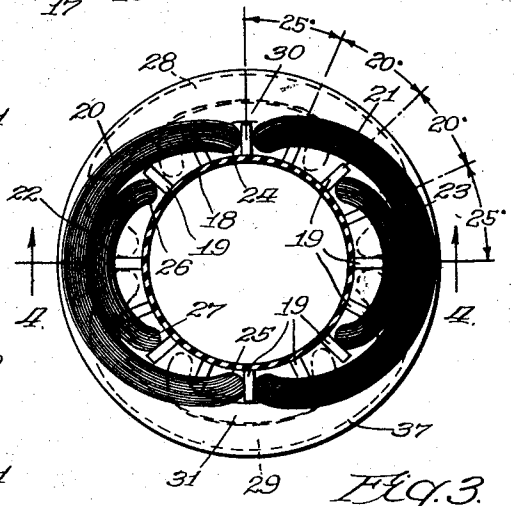


Fig. 3.

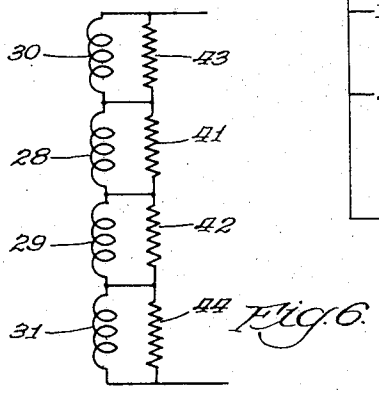


Fig. 6.

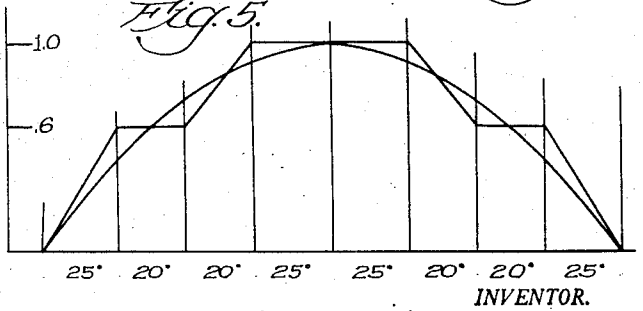


Fig. 5.

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ELECTROMAGNETIC DEFLECTION YOKE

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3 Claims. (Cl. 313—76)

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This invention relates to coils for producing magnetic fields and more particularly to a coil structure adapted to be used as a scanning yoke for a cathode ray tube as, for example, in a television receiver.

In present television systems a scanning yoke is provided about the cathode ray tube for producing fields at right angles to each other for causing horizontal and vertical deflection of the beam of the cathode ray tube. Such yokes include coils arranged so that the fields are superimposed on each other with the horizontal and vertical deflection of the cathode ray beam taking place in substantially the same space. In such yokes the magnetic fields produced by the coils are somewhat distorted with the result that when using wide angles of deflection as in present tubes, defocusing occurs in the outer part of the picture. This effect is similar to stigmatism produced by uncorrected lenses and results in poor picture reproduction. Although it is known that these defocusing effects and stigmatism can be reduced if the coils producing the fields can be arranged about the cathode ray tube in such manner that the lines in each of the fields produced are substantially parallel, it is very difficult to provide such a distribution in a small inexpensive yoke structure.

It is, therefore, an object of the present invention to provide an improved scanning yoke for a cathode ray tube which provides sharp focusing of the beam through wide angles of deflection.

A further object of this invention is to provide a yoke for a cathode ray tube in which the coils are arranged so that a sinusoidal distribution of ampere turns about the neck of the tube is approximated in a simple and inexpensive structure.

A feature of this invention is the provision of a scanning yoke including a cylindrical form on which separate coil systems for horizontal and vertical deflection are positioned and in which each coil system comprises two main coils and two secondary coils.

A further feature of this invention is the provision of a scanning yoke including a cylindrical coil form on which are supported main coils each having sides on substantially diametrically opposite sides of the form and secondary coils intermediate the main coils with the coils being connected in series and the secondary coils having substantially two-thirds as many turns as the main coils so that a sinusoidal distribution of ampere turns about the coil form is approximated.

A still further feature of this invention is the

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provision of a scanning yoke including horizontal and vertical deflecting coils for producing fields at right angles to each other in which said coils are split into main and secondary windings to produce a sinusoidal distribution of ampere turns about the tube with damping resistors connected across the vertical coils to suppress oscillations induced therein by the horizontal coils.

Further objects, features and advantages will be apparent from a consideration of the following description taken in connection with the accompanying drawings in which:

Fig. 1 is a perspective view of a cathode ray tube utilizing a yoke in accordance with the invention;

Fig. 2 is an elevation view of the scanning yoke showing the housing therefor in cross section;

Fig. 3 is a plan view showing the position of the coils of the yoke on the coil form;

Fig. 4 is a cross-sectional view along the lines 4—4 of Fig. 3;

Fig. 5 illustrates the distribution of ampere turns about the coil form; and

Fig. 6 illustrates the connection of resistors across the yoke.

In practicing the invention there is provided a scanning yoke suitable for use on the neck of a cathode ray tube for deflecting the beam thereof which includes a cylindrical coil form having ribs thereon providing troughs in which the coils of the yoke may be positioned. Separate sets of coils are provided for horizontal and vertical deflection with each set including two main windings and two secondary windings. The main windings have the sides thereof positioned on substantially diametrically opposite sides of the form and the secondary windings are positioned between the sides of the main windings. The main windings and secondary windings are connected in series and the secondary windings include substantially two-thirds as many turns as the main windings and are so positioned to provide a substantially sinusoidal distribution of ampere turns about the coil form. All of the windings are positioned about the coil form in a single layer and surrounded with soft iron wire which provides a low reluctance return path for the fields produced. The entire structure including damping resistors for the vertical windings are provided in an annular insulating housing to provide a compact unit.

Referring now to the drawings, in Fig. 1 there is illustrated a cathode ray tube 10 having an annular yoke 11 positioned about the neck 12 thereof. The tube may be any suitable tube

adapted for wide angle deflection such as commercially available tubes in which deflection angles of 50 degrees are produced. Fig. 2 shows the specific construction of the yoke 11 as including a housing having an outer cylindrical shell 15 and annular end members 16 which are secured to the outer shell by snap rings 17. In Figs. 3 and 4, the cylindrical coil form 18 for the yoke is illustrated as having radially extending ribs 19 which form troughs about the cylindrical form for the windings. The radial position of the ribs is shown in Fig. 3 in which the angles between the adjacent ribs are specified.

Separate coils are provided for horizontal and vertical deflection of the beam of the cathode ray tube with each of the coils being of elongated configuration and having the opposite sides thereof positioned about the cylindrical coil form. More specifically, horizontal deflection is provided by the main coils 20 and 21 and the secondary coils 22 and 23. It is noted that the main coil 20 includes sides 24 and 25 which are spaced on substantially diametrically opposite sides of the coil form 18. In a construction as illustrated, the sides of the main coil 20 extend at substantially 155 degrees with respect to each other. The main coil 21 is identical to the main coil 20 being positioned on the other side of the cylindrical coil form. The secondary coil 22 includes elongated sides 26 and 27 which are also positioned adjacent the cylindrical coil form intermediate the sides 24 and 25 of the main coil. The sides of the secondary coil in the structure shown are spaced by an angle of substantially 70 degrees. It is to be noted that the main and secondary coils are symmetrically positioned about the coil form.

The vertical deflecting coils correspond generally with the horizontal deflecting coils and include main coils 28 and 29 and secondary coils 30 and 31. It is apparent from a consideration of Figures 2 and 4 that the horizontal deflecting coils 20 to 23, inclusive, are longer than the vertical deflecting coils 28 to 31, inclusive. This is because the ends of the coils must be turned up and all of the ends cannot be placed in the same plane. In order to properly insulate the ends of the coils from each other, annular insulating members 35, 36, 37 and 38 are provided with the ends of the horizontal coils being turned up between the insulating members 37 and 38 and the end plates 16 of the housing and the ends of the vertical deflecting coils being turned up between the pairs of insulating members. The plan view of Fig. 3 shows clearly the manner in which the ends of the coils are turned up with the ends of the main coils extending around the ends of the secondary coils. By this construction substantially all of the length of the yoke is effectively utilized for horizontal deflection and a substantially large portion is utilized for vertical deflection. As greater deflection is required in the horizontal direction than in the vertical direction due to the aspect ratio of the picture, the arrangement illustrated provides a very satisfactory result.

As previously stated, in order to provide optimum deflection with as little stigmatism as possible, the ampere turns of the windings should be distributed about the coil form in a sinusoidal manner. Fig. 5 illustrates the ampere turn distribution of the yoke in accordance with the invention with a sine wave being shown superimposed thereon by dotted lines. It is apparent that the distribution in the yoke above described approximates a sine wave very closely and it has been proven by various tests that the distribution is sufficiently exact to provide very good results. In order to provide the distribution of ampere turns as shown in Fig. 5 with a structure having coils positioned as illustrated in Fig. 3, the secondary coils must include substantially two-thirds as many turns as the main coils. In Fig. 5 the scale shows the turns of the main coil to be six-tenths that of the coils in combination. It is noted that the ribs on the coil form are spaced to provide wider troughs for the main coils than for the secondary coils so that the entire space around the coil form is effectively untilized. More specificially, the 90 degrees in each quadrant around the cylindrical coil form is divided into two 25 degree sections for one vertical and one horizontal main coil and two 20 degree sections for a horizontal and vertical secondary coil.

In order to increase the sensitivity of the yoke in accordance with the invention, a plurality of layers of soft iron wire may be provided about the windings to provide a low reluctance return path for the magnetic field. This is illustrated at 40 in Fig. 4 which illustrates four layers of soft iron wire which are wound about the body of the yoke. As the windings are all provided in a single layer about the coil form this soft iron has a great effect in reducing the reluctance of the flux path and thereby increasing the sensitivity of the yoke. In actual tests it has been shown that the use of the soft iron wire about the yoke in the manner illustrated has increased the sensitivity by more than 20 per cent.

In order to eliminate the effects of high frequency oscillations which are induced in the vertical coils from the horizontal windings, individual damping resistors are placed across the coils of the vertical windings. This is illustrated in Fig. 6 wherein the resistors 41 and 42 are bridged across the main windings 28 and 29 and the resistors 43 and 44 are bridged across the secondary windings 30 and 31 of the vertical deflecting coils. When a low source impedance is used, damping resistors across one main winding and one secondary winding may be sufficient. The damping resistors may be placed within the housing 15 for the yoke to provide a completely self-contained unit. As the windings of the horizontal coils are in series, a pair of leads is all that is required for energizing the same. Similarly a pair of wires are required for the vertical coils. An additional wire may be provided for grounding the soft iron wires making a total of five wires to be brought out of the yoke. The soft iron shell may be left ungrounded if high flyback speed is desired. Grounding of the shell reduces the flyback or retrace speed but also reduces the kick voltage produced thereby. It is desirable to reduce this voltage in many instances to permit the use of tubes having low plate insulation.

In actual tests using the anti-stigmatic yoke in accordance with the invention the beam of a cathode ray tube was held in sharp focus throughout the entire area of the screen of the cathode ray tube at wide angles of deflection up to 55 degrees. When using standard yokes including a pair of coils for horizontal and a second pair of coils for vertical deflection on the same tube, more than one-half of the outside of the picture is out of focus with the outer one-fourth of the picture being very blurred. The improvement brought about by the anti-stigmatic yoke in accordance with the invention is very pronounced and results in greatly improved visual reproduction. By using the con-

struction as illustrated, the anti-stigmatic yoke is no larger than available yokes including only four windings, and the cost of the yoke is relatively small being only slightly greater than that of standard yokes. It is to be pointed out that the distribution of the field depends both upon the proportioning of the turns between the main and secondary windings and the particular position of the windings. The specific arrangement disclosed approximated the desired distribution so closely that substantially better results were not obtained by using a larger number of different windings as, for example, by using main, secondary, and tertiary windings. The use of more windings would, of course, make the yoke more complicated and expensive. It is apparent that the physical configuration of the yoke may differ in many respects from the construction shown as long as the distribution of the ampere turns remains substantially the same.

While I have described what is considered to be the preferred embodiment of my invention, it is apparent that various changes and modifications can be made therein without departing from the intended scope of the invention as defined in the appended claims.

I claim:

1. A deflection yoke for a cathode ray tube adapted to produce a first magnetic field extending in a first direction and a second magnetic field extending in a second direction substantially at right angles to said first direction, said yoke including in combination, a cylindrical insulating coil form having a plurality of radially extending ribs forming troughs about the surface of said form, first and second pairs of said ribs extending from said form on opposite sides thereof in said first and second directions respectively, other pairs of said ribs extending from said form on opposite sides thereof at angles of 25° and at angles of 45° from said first and second directions, and first and second coil assemblies for producing said magnetic fields in the space within said coil form, said first coil assembly including a pair of main deflection coils having elongated sides positioned in the troughs adjacent said first pair of ribs, said first coil assembly including a pair of secondary coils having elongated sides intermediate the sides of said main coils and positioned in troughs spaced by one trough therefrom, said second coil assembly including a pair of main deflection coils having elongated sides positioned in troughs adjacent said second pair of ribs, said second coil assembly including a pair of secondary coils having elongated sides intermediate said sides of said main coil and positioned in troughs spaced by one trough from said main coils, said main coils and said secondary coils of each assembly being connected in series, and said secondary coils having substantially two-thirds as many turns as said main coils.

2. A deflection yoke for a cathode ray tube adapted to produce a first magnetic field extending in a first direction and a second magnetic field extending in a second direction substantially at right angles to said first direction, said yoke including in combination, a cylindrical insulating coil form, and first and second coil assemblies for producing said magnetic fields in the cylindrical space within said coil form, each of said coil assemblies including a pair of main deflection coils and a pair of secondary coils with said main coils and said secondary coils of each assembly being connected in series, and said secondary coils having substantially two-thirds as many turns as said main coils, said main deflection coils of each assembly having elongated sides positioned adjacent each other on opposite sides of a radial plane extending through said cylindrical form in one of said directions, said secondary coils of each assembly having elongated sides intermediate the sides of said main coils and spaced therefrom to provide spaces for the sides of said secondary coils of the other coil assembly, the sides of each secondary coil being spaced apart to provide spaces for said adjacent sides of said main deflection coils, with all of said coil sides being provided in a single layer about said form and said sides of said main deflection coils having greater extent about said form than the sides of said secondary coils.

3. A deflection yoke for a cathode ray tube adapted to produce a pair of magnetic fields extending at right angles with respect to each other including, an insulating cylindrical coil form, a plurality of elongated coils having their sides positioned in a single layer on the surface of said coil form and substantially completely covering said surface, said coils being arranged in four pairs symmetrically positioned about said form, each of said pairs including a main coil having the sides thereof spaced about said form by approximately 155 degrees and a secondary coil within said main coil and having the sides thereof spaced about said form by approximately 70 degrees, said main coils of said first and second pairs having sides positioned adjacent each other and said main coils of said third and fourth pairs having sides positioned adjacent each other and positioned about said form by approximately 90 degrees from said main coils of said first and second pairs, said secondary coils of said third and fourth pairs having the sides thereof positioned between said main coils and said secondary coils of said first and second pairs, said main coil and said secondary coil of each pair being connected in series and said secondary coil having substantially two-thirds as many turns as said main coil.

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