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FIELD CONCENTRATOR HAVING CONDUCTIVE LOOP PROXIMATE BEAM

Filed Nov. 8, 1963

FIG. 1

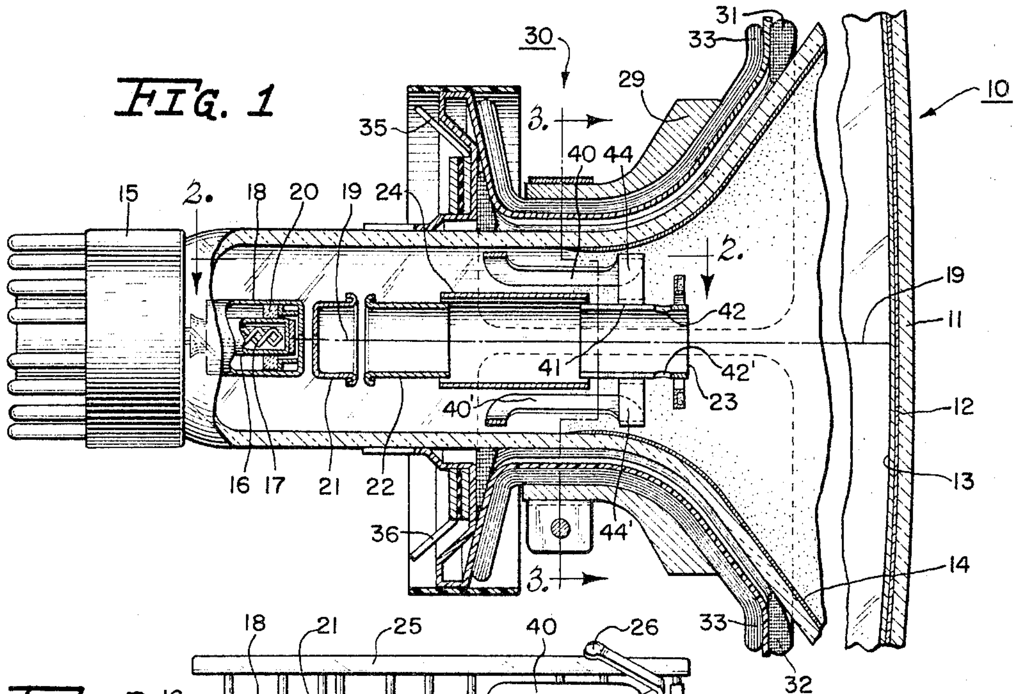


FIG. 2

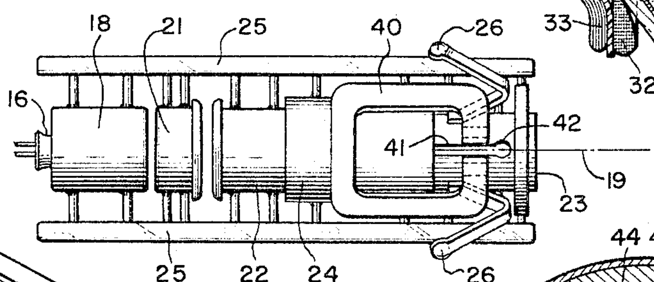


FIG. 3

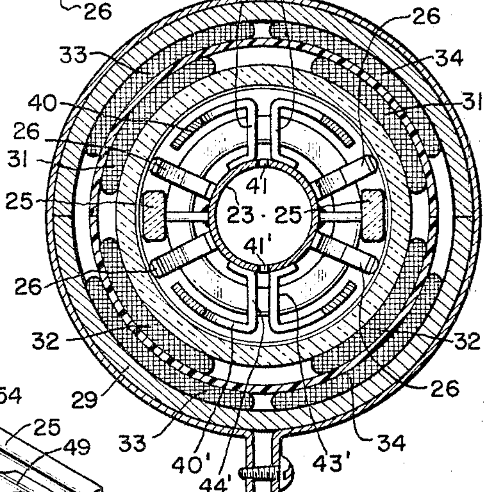


FIG. 4

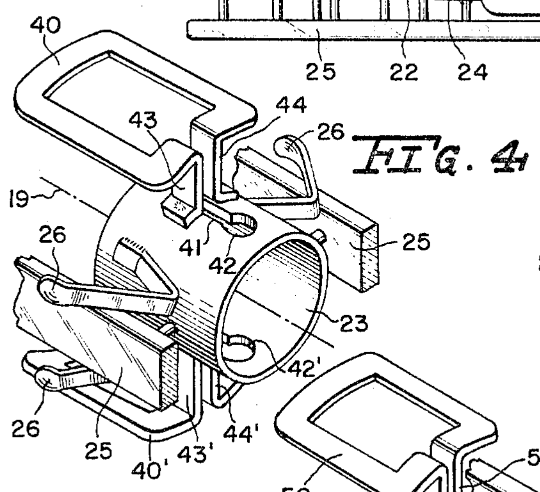
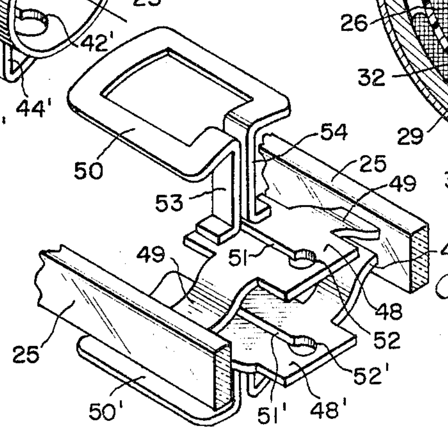


FIG. 5



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3,274,418

FIELD CONCENTRATOR HAVING CONDUCTIVE LOOP PROXIMATE BEAM

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6 Claims. (Cl. 313—75)

The present invention is directed to magnetically deflected cathode-ray tubes and is concerned most particularly with field concentrators for use with such tubes.

A cathode-ray tube employed for image reproduction in television receivers comprises an envelope with an electron gun located at one end for developing and directing a beam of electrons to a viewing screen usually in the form of a phosphor deposited on an end section of the envelope facing the gun. Of course, it is necessary to deflect the beam over the screen area in order to synthesize an image, and while this deflection may be accomplished electrostatically or magnetically, magnetic deflection is by far the more popular. Where the beam is deflected or scanned magnetically, a deflection yoke encompasses the neck portion of the tube envelope and two pairs of deflection windings included in the yoke are energized to create the deflection fields required to cause the beam to traverse the screen area in both horizontal and vertical directions at desired scanning frequencies. Some difficulty and loss of efficiency is experienced, however, because of the distance or space separation of the deflection coils from the electron beam which means that a very substantial amount of deflection power is required to scan the beam over the desired screen area.

Efforts to improve the efficiency and reduce the deflection power requirements have featured the use of internal pole pieces. That is to say, the deflection system takes the form of a magnetic structure that is energized by one or more windings to which the scanning signals are applied and pieces of magnetic material are secured within the neck portion of the tube to serve as extensions of the pole pieces of the magnetic structure in the deflection system. This approach has not been particularly attractive because of the difficulties of extending the magnetic structure through the tube envelope. Also, it requires the addition of structural elements within the tube solely for deflection purposes whereas it would be much more desirable if structural components otherwise required within the tube could be employed for improving deflection efficiency.

Accordingly, it as an object of the present invention to provide an improved deflection structure for a cathode-ray tube of the magnetically deflected type.

It is another object of the invention to provide a field concentrator for such a cathode-ray tube which improves the deflection efficiency.

A specific object of the invention is to provide a field concentrator within the cathode-ray tube envelope which minimizes the number of structural elements required by utilizing a part of the electron gun as an element of the concentrator.

A field concentrator in accordance with the invention is particularly applicable to a magnetically deflected cathode-ray tube having an envelope with an electron gun located at one end for developing and directing an electron beam along a given path to a screen which is located at the other end. The concentrator comprises a first conductive loop positioned closely adjacent the periphery of a particular section of the envelope to be inductively coupled to a deflection yoke that surrounds that section of the envelope. This first loop may be positioned externally or internally of the envelope although the latter arrangement will be particularly described. There is a second conductive loop which is disposed substantially parallel and in very close proximity to the beam path. A pair of conductors serially connect these first and second loops to define therewith a shorted turn and the dimensions of the second loop provide a flux density that is very high compared with the flux density of the first loop so that the magnetic flux of the shorted turn is concentrated within the second loop and is directed across the beam path.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing, in the several figures of which like reference numerals identify like elements, and in which:

FIGURE 1 is a fragmentary cross-sectional side elevation view of a cathode-ray tube having a field concentrator embodying the subject invention;

FIGURE 2 is a plan view of the electron gun and field concentrator shown in FIGURE 1;

FIGURE 3 is a view taken along section line **3—3** of FIGURE 1;

FIGURE 4 is a detailed perspective view of the field concentrator included in the structure of FIGURE 1; and

FIGURE 5 is a view, similar to that of FIGURE 3, of a modified form of the field concentrator.

Referring more particularly to FIGURE 1, the cathode-ray tube there represented has an envelope **10** of conventional shape, having a neck portion of narrow diameter in which an electron gun is mounted and further having a conically shaped portion terminating in a face plate that supports a screen. The face plate is designated **11** and is coated with a screen **12** comprising a layer of fluorescent material which, in turn, is backed by a layer **13** of aluminum in the usual way. It is also customary to coat the conical portion of the envelope with a layer **14** of graphite or Aquadag but these structural features are of no concern to the present invention and need not be described in greater detail. The opposite end of the envelope terminates in the usual base **15** having terminal pins through which electrical connections are made to the heater and electrode elements of the electron gun.

The electron gun located in the narrow neck end of the tube envelope develops and directs an electron beam along a given beam path to screen **12** at the opposite end of the envelope. This gun is of conventional design and comprises a cathode cylinder **16** within which is supported a heater element **17**. One end of the cathode cylinder is closed and suitably treated or coated to serve as an electron source. The cathode structure is concentrically mounted within a first grid **18** which is also a cylindrical electrode closed at one end except for a small centrally located aperture through which electrons emitted from the cathode may be directed along beam path **19** to the screen. Insulator **20** is the usual ceramic support for properly positioning and locating the cathode cylinder within the first grid.

Following the first grid is a second grid cylinder **21** which is likewise closed at one end except for a small contrally located beam aperture. Next along the beam path is an unipotential lens having a pair of open cylindrical electrodes **22** and **23** and an intermediate, as well as overlapping, electrode **24**. The several electrodes of the gun are mechanically secured to a pair of insulating support posts **25** which do not appear in FIGURE 1, but do show in the detail views of FIGURES 2–4. Contact springs **26**, which also appear only in FIGURES 2–4, may extend from lens electrode **23** and contact the Aquadag coating to extend the final anode voltage to the lens electrodes, and may also serve to center the gun within the tube neck.

The tube under consideration is of the magnetically deflected type and a yoke assembly **30** is associated with it being slipped over the neck and positioned at the juncture of the neck and conical sections of the envelope. The yoke includes a pair of horizontal deflection windings **31, 32** as well as a pair of vertical windings **33, 34.** In addition to the windings, the yoke has a ferromagnetic core **29** and a mechanical shell accommodating the usual beam centering magnets **35, 36** which are annular in form and provided with tabs to permit their relative rotation. Except for the fact that a reduction in the physical size of the yoke is realized because of the invention, the construction of the yoke follows conventional practice and, per se, constitutes no part of the present invention. This size reduction obtains by virtue of the fact that the invention provides a field concentrator which renders the deflection system more efficient to the end that the deflection power requirements may be reduced.

While the field concentrator to be described may be employed in both the horizontal and vertical deflection systems, it has its greatest benefit in the horizontal system which operates at a much higher scanning frequency. Accordingly, the structure shown in the drawing illustrates the application of such a concentrator to the horizontal system only. Structurally, the concentrator includes two devices each of which constitutes a shorted turn inductively coupled to an associated one of the horizontal deflection coils of yoke **30.** Since these devices are identical, it is sufficient to describe only one.

Referring to FIGURE 4, one such field concentrator device comprises a first conductive loop **40** formed of a flat or ribbon type conductor and defining a relatively large loop which is positioned closely adjacent the periphery of that section of the tube envelope which is surrounded by deflection yoke **30.** As shown in FIGURE 1, loop **40** is enclosed within the envelope and positioned at the inner periphery of the tube neck to be inductively coupled through the envelope itself with horizontal deflection coil **31** of the yoke. The loop is preferably dimensioned to have maximum coupling to the deflection coil.

The concentrator also includes a second conductive loop which preferably is positioned parallel to the beam path in close proximity to the electron beam traversing that path. In order to minimize the number of structural elements within the tube, this second conductive loop comprises an electrode of the electron gun. More specifically, lens electrode **23,** which is formed of a conductive material, is provided with a cutaway having the general configuration of a keyhole and comprising a slotted section **41** extending from the rear of the lens and terminating in a circular or loop portion **42** located near the opposite end of the electrode. A pair of conductors **43** and **44** serially connect the conductive elements forming the two loops and define therewith a shorted turn. The second loop, namely, that defined by portion **42** of lens electrode **23,** is dimensioned to have a flux density very high compared with that of first loop **40** so that the magnetic flux of the shorted turn, including these loops, is concentrated within loop **42** and is directed across beam path **19.** More particularly, the area enclosed by loop **42** is very small compared to that enclosed by loop **40** and the flux density is high at loop **42,** much higher than that of loop **40.**

As shown in FIGURE 4, there is another field concentrator positioned in diametrically opposed relation to the one that has been described and the large loop of this concentrator is inductively coupled with horizontal winding **32** of the yoke. In order to distinguish the field concentrator elements for deflection winding **32** from those associated with winding **31,** the former are identified by primed reference numerals.

In operation, energization of horizontal windings **31, 32** by the usual scanning signals, induces similar signals into the two field concentrators by transformer action in which each concentrator has the role of a single-turn secondary. Since the flux density is high in the conductor segments defining small loops **42, 42′,** the predominant inductance of the shorted turn secondary is, in effect, concentrated at the small loop section and the strongest flux field is established there. This flux is directed across the beam path so that field changes with time under the influence of the scanning signals accomplishes deflection of the electron beam and scansion of the screen area of the tube.

If one chooses not to integrate the field concentrator with the electron gun structure, the modification of FIGURE 5 may be employed. In this embodiment the field concentrator may be supported by insulating posts **25,** otherwise included within the neck of the tube as supports for the gun electrode elements. The concentrator for horizontal winding **31** includes a large loop **50** which is formed from a ribbon-type conductor as in the principal embodiment. The small loop, however, is provided by a conductive element **48** having tabs **49** extending therefrom into mechanical engagement with support posts **25** and a slotted section **51** which communicates with a loop **52.** A pair of conductors **53, 54** serially connect loops **50, 52** to define a shorted turn. In this arrangement, as with the first described embodiment, loop **52** not only parallels the beam path but also is in general parallel relationship to the larger loop **50,** and the area of loop **52** is small compared to that of loop **50.** This condition results in a much higher flux density in loop **52** than in the larger loop **50** as required to concentrate the flux in the area immediately adjacent to and transverse of the beam path. A field concentrator for horizontal deflection winding **32** employs similarly constructed elements identified by like but primed reference numerals.

There is considerable latitude in orienting the loop elements **40, 42,** or loops **50, 52** as the case may be, so that this approach may be adopted whether the tube is of the short-necked variety or has a longer neck in which the axial length of the field concentrator is of no particular concern. The concentrator results in a more efficient utilization of deflection power so that a given screen area may be scanned with less deflection power than otherwise required if the beam is subjected to the deflection fields of windings **31, 32** of the yoke without the benefit of the field concentrator.

Moreover, since the loops **40** and **42** may be displaced relative to one another in fabricating the concentrator, there is some flexibility in positioning the center of deflection of the tube. This is particularly advantageous in the design of short-neck tubes.

In particular, this invention allows displacement of the center of deflection toward the screen, relative to the position of the external deflection yoke, which in turn allows displacement of the gun assembly toward the screen, resulting in a substantial reduction in the length of the neck portion of the tube relative to the remaining conical portion.

While there have been described particular embodiments of the invention, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspects, and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of the invention.

I claim:

1. A field concentrator for a magnetically deflected cathode-ray tube having an envelope with an electron gun located at one end for developing and directing an electron beam along a given path to a screen located at the other end, said concentrator comprising:

a first conductive loop positioned closely adjacent the periphery of a particular section of said envelope to be inductively coupled to a deflection yoke surrounding said section of said envelope;

a second conductive loop disposed substantially parallel and in closed proximity to said beam path;

and a pair of conductors serially connecting said first and second loops to define therewith a shorted turn, said second loop being dimensioned to have a flux density very high compared to that of said first loop so that the magnetic flux of said shorted turn is concentrated within said second loop and directed across said beam path.

2. A field concentrator for a magnetically deflected cathode-ray tube having an envelope with an electron gun located at one end for developing and directing an electron beam along a given path to a screen located at the other end, said concentrator comprising:

a first conductive loop within said envelope positioned closely adjacent the internal periphery of a particular section of said envelope to be inductively coupled to a deflection yoke surrounding said section of said envelope;

a second conductive loop within said envelope disposed substantially parallel and in close proximity to said beam path;

and a pair of conductors serially connecting said first and second loops to define therewith a shorted turn, said second loop being dimensioned to have a flux density very high compared to that of said first loop so that the magnetic flux of said shorted turn is concentrated within said second loop and directed across said beam path.

3. A field concentrator for a magnetically deflected cathode-ray tube having an envelope with an electron gun located at one end for developing and directing an electron beam along a given path to a screen located at the other end, said concentrator comprising:

a first conductive loop positioned closely adjacent the periphery of a particular section of said envelope to be inductively coupled to a deflection yoke surrounding said section of said envelope;

a second conductive loop positioned in close proximity to said beam path and in parallel relation to both said first loop and said beam path;

and a pair of conductors serially connecting said first and second loops to define therewith a shorted turn, said second loop being dimensioned to have a flux density very high compared to that of said first loop so that the magnetic flux of said shorted turn is concentrated within said second loop and directed across said beam path.

4. A field concentrator for a magnetically deflected cathode-ray tube having an envelope with an electron gun located at one end for developing and directing an electron beam along a given path to a screen located at the other end, said concentrator comprising:

a first conductive loop positioned closely adjacent the periphery of a particular section of said envelope to be inductively coupled to a deflection yoke surrounding said section of said envelope;

a second conductive loop disposed substantially parallel and in close proximity to said beam path;

and a pair of conductors serially connecting said first and second loops to define therewith a shorted turn, said second loop enclosing an area very small compared to said first loop, wherefore the magnetic flux of said shorted turn is concentrated within said second loop and directed across said beam path.

5. A field concentrator for a magnetically deflected cathode-ray tube having an envelope with an electron gun located at one end for developing and directing an electron beam along a given path to a screen located at the other end, said concentrator comprising:

a first conductive loop positioned closely adjacent the periphery of a particular section of said envelope to be inductively coupled to a deflection yoke surrounding said section of said envelope;

a conductive element constituting a part of said electron gun and providing a second conductive loop disposed substantially parallel and in close proximity to said beam path;

and a pair of conductors serially connecting said first and second loops to define therewith a shorted turn, said second loop being dimensioned to have a flux density very high compared to that of said first loop so that the magnetic flux of said shorted turn is concentrated within said second loop and directed across said beam path.

6. A field concentrator for a magnetically deflected cathode-ray tube having an envelope with an electron gun located at one end for developing and directing an electron beam along a given path to a screen located at the other end, said concentrator comprising:

a first pair of conductive loops positioned closely adjacent diametrically opposed peripheral portions of a particular section of said envelope to be inductively coupled to a deflection yoke surrounding said section of said envelope;

a cylindrical electrode, constituting a part of said electron gun, having a pair of diametrically opposed longitudinally extending slots terminating in cut away sections which provide a second pair of conductive loops disposed in close proximity to, substantially parallel with and on opposite sides of said beam path;

and conductors connecting one loop of each pair of loops in series with the corresponding loop of the other pair to define therewith two similar shorted turns, said second pair of loops being dimensioned to have a flux density very high compared to that of said first pair of loops so that the magnetic flux of each said shorted turn is concentrated within said associated second loop and directed across said beam path.

No reference cited.

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