

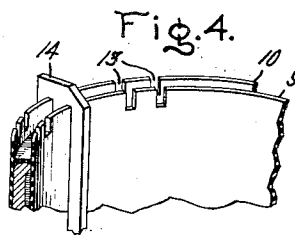
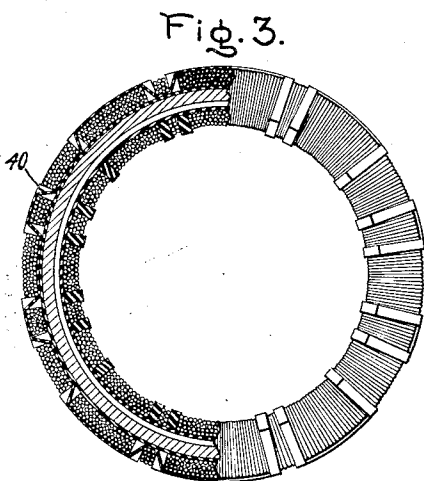
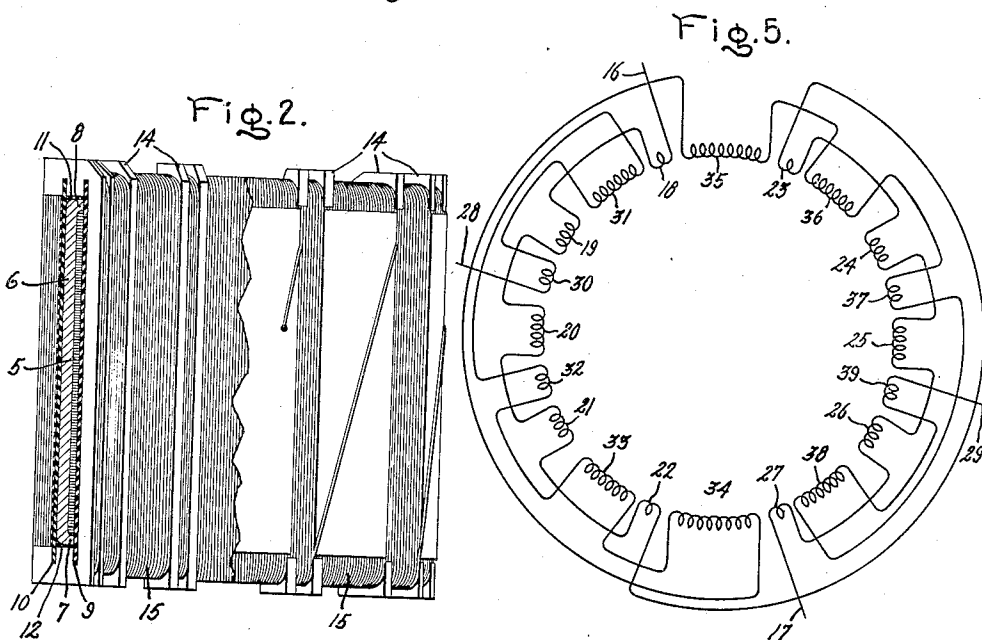
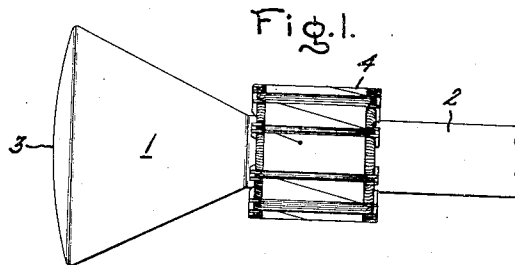
March 9, 1948.

R. B. GETHMANN

2,437,513

DEFLECTION COIL AND YOKE FOR CATHODE RAY TUBES

Filed Oct. 12, 1946



Inventor:
Richard B. Gethmann,
by *Morton D. Morse*
His Attorney.

UNITED STATES PATENT OFFICE

2,437,513

DEFLECTION COIL AND YOKE FOR
CATHODE-RAY TUBESRichard B. Gethmann, Bridgeport, Conn., assign-
or to General Electric Company, a corporation
of New York

Application October 12, 1946, Serial No. 703,055

9 Claims. (Cl. 250-157)

1

My invention relates to cathode ray tube deflecting devices of the electromagnetic type and it has for its primary object to provide a new and improved electromagnetic deflecting coil and yoke.

In receivers for television signals, it is customary to use a cathode ray tube in which the electron beam is modulated in accordance with a received picture signal. Means are employed for deflecting the beam to scan the fluorescent end wall of the tube both horizontally and vertically. Such deflecting means are usually either of the electrostatic or electromagnetic type. One of the problems in the latter type of deflection system is to maintain as large a percentage as possible of the magnetic flux established by the windings or coils of the deflection device within the neck of the cathode ray tube for control of the electron beam therein. To this end various core constructions have been employed. It is an object of my invention to effect certain improvements in core constructions for an electromagnetic deflecting device for a cathode ray tube.

It is still another object of my invention to provide a new and improved electromagnetic deflecting device for a cathode ray tube in which the reluctance of the flux path external to the neck of the cathode ray tube is large relative to the reluctance of the flux path through the cathode ray tube.

It is a further object of my invention to provide a new and improved winding for an electromagnetic deflecting device for a cathode ray tube.

One of the features of my improved electromagnetic yoke consists in constructing an annular core in which a non-magnetic shield is provided to increase the reluctance of the flux path external to the cathode ray tube. The core is surrounded by a toroidal winding having a plurality of sections of different peripheral length, alternate sections being connected to form two circuits deflecting the beam of the cathode ray tube in two transverse directions so that the cathode ray beam of the tube may be deflected horizontally and vertically for scanning purposes in a television receiver.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, both as to its organization and method of operation, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings in which Fig. 1 is a longitudinal view of a cathode ray

2

tube employing my improved deflecting device; Figs. 2 and 3 are, respectively, vertical and plan views, partly in section, of my beam deflecting device; Fig. 4 is a perspective view of a portion of the core structure of the deflecting device of Fig. 2; and Fig. 5 is a circuit diagram of the coils employed in the device of Fig. 2.

Referring to Fig. 1, I have shown a cathode ray tube 1 having a neck portion 2 along which an electron beam is projected toward the fluorescent end wall 3 of the tube. In order to deflect the electron beam rapidly in horizontal and vertical directions, I provide an electromagnetic beam deflecting device 4, the exact construction of which is better illustrated in Figs. 2-4.

Referring to Figs. 2-4 jointly, the beam deflecting device 4 comprises an annular core structure comprising a flat steel wire or ribbon 5 which is wound into a coil or solenoid with the longer dimension of the ribbon lying in a plane transverse to the longitudinal axis of the wound coil. Preferably, the ferromagnetic metal of which the wire 5 is formed has a high permeability so that the wound coil forms a low reluctance flux path. The gaps between adjacent of the turns of the wire 5 are sufficient to reduce eddy currents which otherwise would increase the reluctance of the path. In order to increase the reluctance of the flux path external to the wires 5 without affecting the reluctance of the path internal to the solenoid, I provide a non-magnetic conductive sleeve 6 surrounding the stacked turns of the wire 5. The inner diameter of the sleeve 6 is equal to the outer diameter of the turn of the wire 5 so that the wire fits snugly within the sleeve 6. The ferromagnetic core may be held in position within the sleeve 6 by flaring over the ends 7, 8 of the sleeve.

The core comprising the stacked turns of wires 5 and the copper tube 6 is enclosed by a pair of annular insulators 9, 10 located, respectively, on the inner and outer surfaces of the core. End insulators 11, 12 are provided, respectively, at the upper and lower ends of the core. These insulators may be formed of any suitable molded dielectric material, such as for example molded cellulose acetate. As may best be seen in Fig. 4, the insulators 9, 10 are provided with a plurality of spaced notches 13 along their upper and lower edges to receive and position a corresponding member of C-shaped guides or separators 14. The vertical portion of the C-shaped guide is adapted to lie on the inner surface of the spacer 9 with the two arms projecting outwardly and

lodging in aligned notches 13 in the edges of the insulators 9 and 10. Preferably, the guides 14 are likewise formed of a suitable molded dielectric material, such as cellulose acetate. Disposed between the guides 14 are a plurality of coils of wire 15 tightly wound about insulators 9, 10, each coil preferably being of the same depth and of varying peripheral length.

The wiring diagram of the coils 15 is shown in Fig. 5. From this diagram, it is apparent that adjacent coils 15 are connected in different deflecting circuits. The winding which provides horizontal deflection of the cathode ray beam of the tube is connected between the terminals 16, 17 and includes, on the left-hand side of the toroidal structure, the serially connected coils 18—22 and, on the right-hand side, serially connected coils 23—27. The output terminal of the coil 22, the lowermost of the left-hand coils, is connected to the input terminal of coil 23, the upper of the right-hand group of coils. The coils 18—27 are provided with a different number of turns, the number in each coil or sector of the winding being adjusted to give a substantially uniform flux pattern in a horizontal plane. The coils of the vertical deflection winding are connected between terminals 28, 29 and comprise coils 30—39 connected in series in numerical order between these terminals. The coils of the vertical winding likewise have a different number of turns in different sectors, the same considerations applying in the number of turns thereof on the core, namely, that a substantially uniform flux pattern in a vertical direction is obtained. In winding the coils on the core structure preferably the coils of the vertical winding are wound first. Thereafter an insulator 40 is wrapped around the assembly and the horizontal deflection coils are wound in position between adjacent of the guides 14.

In using the deflection device described on a cathode ray tube employed in a television receiver, the coils of the winding which produces horizontal deflection are provided with a high frequency sawtooth wave, the frequency being usually of the order of 15,750 cycles per second. Since, in this type of coil, it is desired to keep the inductance of the resultant coil at a minimum, it is desirable to use the smallest number of turns per sector of horizontal coil winding which gives the desired strength of magnetic field within the neck of the cathode ray tube. I reduce the amount of magnetic flux external to the core structure by utilizing the copper sleeve 6 to increase the reluctance of the external flux path. With this construction the flux internal to the coils is increased and the flux external to the coils is reduced so that a major portion of the magnetic energy is used for beam deflecting purposes. The vertical deflection coil employed for a cathode ray tube in a television receiver normally is provided with a sawtooth wave having a frequency of the order of 60 cycles. Accordingly, for the coils of the sectors 30—39, the primary consideration is avoiding flux linkages with the horizontal deflection windings so that a minimum amount of higher frequency voltage is picked up by the vertical deflection windings. At the same time, it is desired that the resistance of the coil be a minimum so that the power required for deflection purposes is kept as small as possible. This is achieved in my improved core construction by the compact arrangement of core and coils in which a minimum volume of iron is required. By using windings of uniform depth,

the core diameter and air gap are kept to minimum values.

An important advantage of my improved construction of a deflection device is that the turns of the individual sectors can be adjusted to obtain an optimum sweep pattern by controlling the number of turns in each sector and adjusting the width of the sector.

Another important advantage consists in the improved core construction by which a maximum amount of the magnetic flux is confined to a path internal to the coils so that a small amount of energy is required to deflect the cathode ray beam. By constructing the deflecting device as a toroidal winding, a minimum amount of core material is required and the overall diameter of the deflection coils and the yoke is kept to a relatively small dimension.

While I have shown and described one particular embodiment of my invention, it will of course be understood that I do not wish to be limited thereto, since various changes and modifications may be made without departing from my invention, and I contemplate in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An electromagnetic yoke for deflecting the electron beam of a cathode ray tube comprising an annular core comprising a plurality of turns of ferromagnetic wire, a non-magnetic conductive sleeve surrounding said wire, a conductor wound on said core comprising a plurality of adjacent sections, alternate of said sections being connected to form a pair of circuits for deflecting the beam of the cathode ray tube in two transverse directions.

2. An electromagnetic yoke for deflecting the electron beam of a cathode ray tube comprising an annular core comprising a plurality of turns of a wire having magnetic properties, a non-magnetic conductive sleeve surrounding said wire, a conductor wound on said core on the inner and outer surfaces thereof comprising a plurality of turns extending longitudinally of said core to form adjacent sections, alternate of said sections being connected to form a pair of circuits adapted to deflect the beam of the cathode ray tube in two transverse directions.

3. In a magnetic yoke for deflecting the electron beam of a cathode ray tube, a magnetic core comprising a solenoid comprising a plurality of closely wound turns of wire having magnetic properties, a conductive sleeve surrounding said solenoid, and a conductor wound longitudinally along the inner and outer surfaces of said core to form a plurality of coils of substantially the same depth, adjacent of said coils having different peripheral length and alternate of said coils being connected to form a pair of circuits adapted for deflecting the electron beam of a cathode ray tube in two perpendicular directions.

4. A winding for producing a uniform field to deflect the electron beam of a cathode ray tube comprising a plurality of coils arranged to form a toroidal winding, all of said coils being of substantially the same thickness, adjacent of said coils being of different peripheral length, and alternate of said coils being connected to form a pair of circuits adapted to establish transverse magnetic fields.

5. A magnetic deflecting yoke for producing a

pair of uniform transverse magnetic fields for the deflection of an electron beam in a cathode ray tube comprising a solenoid comprising a plurality of turns of wire having magnetic properties, means for increasing the reluctance of the magnetic flux path of said solenoid along the outer surface thereof comprising a conductive sleeve disposed along the outer surface of said solenoid, a conductor wound alternately on the inner and outer surfaces of said solenoid and extending longitudinally of the axis thereof, means dividing said conductor into a plurality of discrete coils, alternate of said coils being connected to form a pair of continuous windings, one of said windings reversing in direction about the periphery of said solenoid.

6. In a magnetic yoke for deflecting the electron beam of a cathode ray tube, a magnetic core comprising a solenoid comprising a plurality of turns of a flat wire having magnetic properties, the major dimension of said wire lying in a plane transverse to the axis of said solenoid, a non-magnetic conductive sleeve closely surrounding said solenoid and having its end extending inwardly to maintain said turns in closely spaced relation, and a plurality of coils wound longitudinally along the inner and outer surfaces of said core, all of said coils being of substantially the same depth and adjacent of said coils having different peripheral length.

7. An electromagnetic yoke for deflecting the electron beam of a cathode ray tube comprising an annular core comprising a plurality of turns of ferromagnetic wire, a non-magnetic conduc-

tive sleeve surrounding said wire, a plurality of coils wound on said core along the inner and outer surfaces thereof, all of said coils being of substantially the same depth, insulating means positioned between said coils, and alternate of said coils being connected to form a pair of circuits adapted for deflecting the electron beam of the cathode ray tube in two transverse directions.

8. An electromagnetic yoke for deflecting the electron beam of a cathode ray tube comprising, a magnetic core comprising a plurality of turns of a flat wire having magnetic properties, said wire having a major dimension lying in a plane transverse to the axis of said core, means for increasing the reluctance of the magnetic flux path of said core along the outer surface thereof comprising a nonmagnetic conductive sleeve closely surrounding said core, and a plurality of coils wound longitudinally along the inner and outer surfaces of said core to form a pair of circuits for deflecting the beam of the cathode ray tube in two transverse directions.

9. A magnetic deflecting yoke for a cathode ray tube comprising a core comprising a plurality of closely spaced turns of a flat metal strip having magnetic properties, said strip having its major dimension lying in a plane transverse to the axis of said core, a non-magnetic conductive sleeve surrounding said core, and a plurality of coils wound longitudinally along the inner and outer surfaces of said core to form a pair of circuits for deflecting the beam of the cathode ray tube in two transverse directions.

RICHARD B. GETTMANN.