June 8, 1948. D. R. DE TAR 2,443,025

CATHODE RAY APPARATUS

Filed July 30, 1945

Fig. 1.

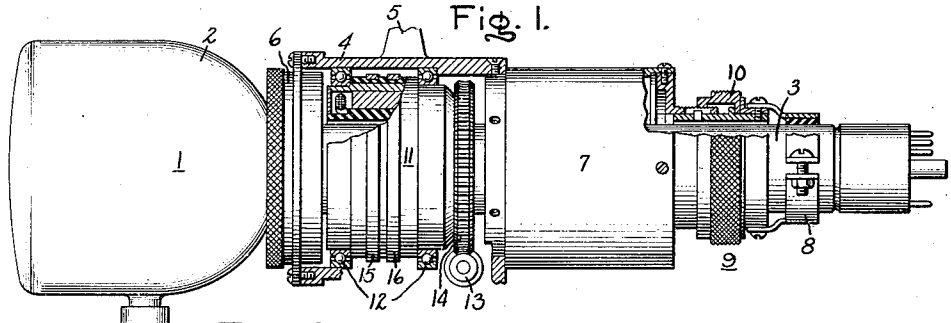


Fig. 3.

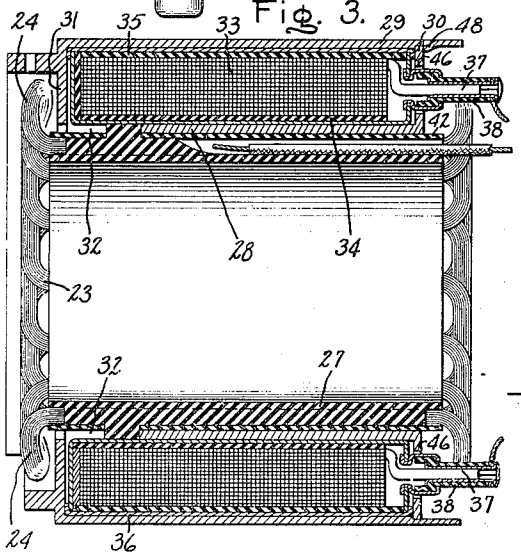


Fig. 2.

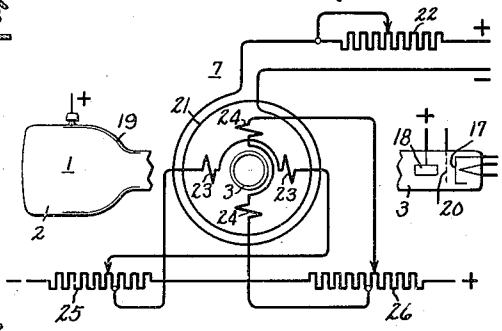
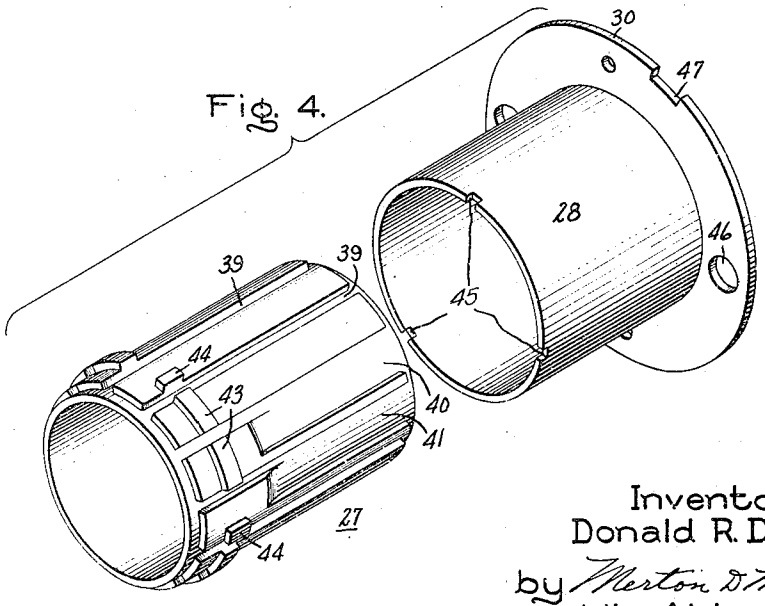


Fig. 4.



Inventor:
Donald R. DeTar,
by Merton D. Morse
His Attorney.

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CATHODE-RAY APPARATUS

Donald R. De Tar, Stratford, Conn., assignor to General Electric Company, a corporation of New York

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5 Claims. (Cl. 250—161)

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This invention relates to cathode ray apparatus and particularly to devices for focusing and for centering the cathode ray beam in electron discharge devices of the cathode ray type.

Cathode ray tubes such as those employed in television apparatus are commonly provided with a so-called "electron gun" for producing a cathode ray beam and for projecting the beam onto a luminescent screen. A device is provided for concentrating or focusing the beam and may take the form of a coil wound about the neck of the cathode ray tube between the point of origin of the beam and the deflecting members which are provided to direct the beam to selected portions of the screen. It is also desirable to provide a device for centering the beam, so that it strikes the fluorescent screen at a predetermined desired point whenever the deflecting members are not energized. Centering may be accomplished in a cathode ray tube having magnetic deflecting coils by providing a direct current circuit for the horizontal and vertical deflecting coils so that the direct current flowing through these coils may be adjusted, thereby adjusting the position of the beam. In some types of cathode ray apparatus, however, the deflecting members are required to rotate about the envelope of the cathode ray tube and the adjustment or centering of the beam by varying the direct current in the deflecting coils is no longer possible. In such apparatus it has been the practice to mount the focusing coil so that its axis may be tilted or to provide an additional magnetic member or set of coils arranged about the neck of the tube ahead of the focusing coil. This latter arrangement, however, requires that the tube have a substantially longer neck portion. Cathode ray tubes are employed in viewing apparatus of the projection type such as those employing the system known as the Schmidt optical system wherein the image is projected from a curved mirror in front of the screen back along the outside of the envelope parallel to the tube axis. In these projection systems it is desirable that the tube be as short as possible and of as small a diameter as possible, whereas both the tilted coil and additional centering devices require extra space. Accordingly, it is an object of this invention to provide a focusing and centering unit for cathode ray electron discharge devices which shall occupy a minimum space.

It is another object of the invention to provide a simple and effective focusing and centering unit for cathode ray tubes having rotatable deflecting members which shall be of simple and rugged construction and make possible the remote control of the focusing and centering functions.

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The novel features which are believed to be characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, 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 drawing in which Fig. 1 represents a cathode ray tube in its supporting assembly and provided with a focusing and centering unit embodying this invention; Fig. 2 is a schematic diagram illustrating the arrangement of the elements of the tube and the control circuit for the focusing and centering unit; Fig. 3 is an enlarged longitudinal sectional view of the focusing and centering unit; and Fig. 4 is an exploded perspective view of a portion of the unit shown in Fig. 3.

Referring now to Fig. 1 of the drawing, a cathode ray tube 1 having a bowl portion 2 and a neck portion 3 is mounted in a supporting frame 4 which is secured to a supporting structure (not shown) by a plurality of arms a portion of one of which is indicated at 5. The illustrated arrangement for mounting a cathode ray tube is suitable for use in connection with an optical projection system of the Schmidt type, the supporting arms 5 of the mounting being made as thin and narrow as practicable and not more than three such arms being employed in order to offer a minimum obstruction to the light. The tube 1 is secured within the frame 4 by a suitable chucking mechanism 6 which engages the neck 3 of the tube near the bowl 2. At the end of the frame 4 is mounted a focusing and centering unit 7 embodying the invention, and the tube is located with respect to the unit 7 by a clamp 8 engaging the neck portion 3 and connected to the unit 7 through an adjustable optical focusing device 9. When the tube is first placed within its support, it is located in the approximate desired position and the clamp 8 is secured about the neck 3, the chuck 6 being arranged to permit longitudinal sliding movement of the tube therein. The tube is then focused with respect to the optical system by turning an adjusting collar 10 of the focusing device 9. The adjustment of this collar moves the tube longitudinally with respect to the supporting structure. The deflecting coil assembly 11 is provided for deflecting the cathode ray beam, and this assembly is rotatably mounted within the frame 4

on ball bearings 12, the rotation being effected through a worm 13 and gear 14 driven in a required manner by a suitable motor (not shown). Connections to the deflecting coil are made through slip rings 15 and 16 which are engaged by stationary brushes (not shown). Because the deflecting coils are mounted in a rotating structure, it is not possible to vary the direct current components of the deflecting coil current in order to center the cathode ray beam and a separate centering device must be provided. For this purpose centering coils are included in the structure of the unit 7, which also includes the focusing coil for concentrating or focusing the cathode ray beam.

Referring now to Fig. 2 the cathode ray tube 1 has been shown with a portion of the neck 3 broken away to include a diagrammatic illustration of the coils and control resistors for the focusing and centering unit 7, this unit, for purposes of illustration, being shown as turned at right angles to its actual position. The deflecting coil has been omitted from Fig. 2 to avoid complication of the figure. The cathode ray tube 1 is provided with suitable electrodes for producing a cathode ray beam and including a cathode 17, a first anode 18 and a second anode 19. The intensity of the beam is controlled by energization of a control electrode or grid 20. In order to concentrate the beam and to focus it upon the luminescent screen, provided at the end of the bowl portion 2 in accordance with common practice, a focusing coil 21 is provided in the unit 7. The focusing coil comprising a large number of turns about the neck 3 arranged on a suitable magnetic core to produce a focusing field having an axis in alignment with the longitudinal axis of the tube 1. The intensity of the focusing field may be changed by adjustment of a variable resistor 22 in the direct current circuit of the coil 21. Also included in the unit 7 is the set of centering coils comprising a first centering coil 23 and a second centering coil 24, one half of each of the coils being arranged on diametrically opposite sides of the neck 3 of the tube; the coils 23 and 24 have axes at right angles to each other and to the axis of the tube. The intensity and direction of the centering field produced by the coils 23 may be adjusted by operation of a potentiometer 25, and the intensity and direction of the field produced by the coil 24 may similarly be varied by adjustment of a potentiometer 26.

During the operation of the cathode ray tube shown in Figs. 1 and 2, suitable potentials are applied to the anodes 18 and 19 and a cathode ray beam is projected against the screen at the left-hand end of the tube. This beam is concentrated and focused on the screen by adjustment of the rheostat 22 to control the energization of the focusing coil 21, and if the beam is not in the required center position it is brought into such position by suitable adjustment of the potentiometers 25 and 26. Since the focusing and centering unit 7 is fixed with respect to the tube and its support, the control resistances 22, 25 and 26 may be located on a control board remote from the cathode ray apparatus. The deflecting coil assembly 11 may then be rotated to provide deflections in any direction.

As shown in Figs. 3 and 4, the centering coils 23 and 24 are mounted on an insulating form 27 so that the magnetic core structure of the focusing coil serves also as the core structure for the centering coils. This magnetic core structure

comprises an inner cylindrical sleeve member 28 and an outer cylindrical sleeve member 29. The inner member is provided with an outwardly extending end flange 30 which engages the outer member 29, and the outer member is provided with an inwardly extending flange 31 at its opposite end. The inner member 28 is shorter than the outer member 29 and provides an annular air gap as indicated at 32. The focusing coil comprising a large number of turns is arranged within the hollow toroidal core structure formed by the members 28 and 29 as indicated at 33. This general type of focusing coil and core structure is well known in the art and provides a concentrated magnetic field about the annular poles provided by the magnetic structure on either side of the air gap 32. The field thus produced tends to concentrate the cathode ray beam along the central longitudinal axis of the coil. The focusing coil is enclosed in inner and outer insulating sheaths 34 and 35 respectively and is enclosed and sealed in a metallic container 36 which completely surrounds the coil, the leads for the coil indicated at 37 being brought out through sealed connecting posts 38.

During the assembly of the unit 7, the centering coils 23 and 24 are wound on the form 27 where they are located in suitable longitudinal slots 39 milled in the form. Two of the slots 39 are widened as indicated at 40 and 41 to provide for the terminal connections to the coils. After the coils have been wound on the form 27, a layer of suitable insulating material is wound about the coils over the form as indicated at 42. Outwardly projecting segments 43 are provided near the left end of the form 27 and constitute an annular ring of stops which engage the left end of the magnetic core or cylinder 28 when the centering coil assembly is inserted in the cylinder. Three additional outwardly projecting segments or lugs 44 are provided, two of which are shown, and these projections extend through notches 45 in the end of the core 28 and lock the coil form against rotation in the core. The focusing coil 33 in its metal container 36 is then placed over the core cylinder 28 with the terminal posts 38 extending through openings 46 in the flange 30. The core cylinder 28 with the coils thereon is then inserted in the outer cylinder 29 with a notch 47, shown in Fig. 4, slipping over a punched out projection 48, shown at the upper right-hand corner of Fig. 3. After the core 28 is in position in the core 29, it may be rotated so that the projection 48 locks the cores together and prevents withdrawal of the coil assembly. The cores 28 and 29 may be locked together in any suitable manner, for example, by punching in a portion of the core 29 to enter the notch 47 in its rotated position and prevent further rotation.

It will be observed that the focusing and centering coil unit 7 provides a compact structure which may be arranged closely about the neck 3 and will provide minimum interference with the light rays from an optical projection system, for example. Furthermore, by constructing the centering coils in a manner so that they may utilize the same magnetic core structure as the focusing coil, it is unnecessary to increase the length of the tube neck in the usual manner to accommodate an additional coil assembly along the axis of the tube. The structure of the unit 7 is simple and rugged, and when the core 28 is locked within the core 29 the centering coils are located in their required position by the engage-

ment of the projections 43 and 44 with the end of the core 28 and the notches 45, and furthermore the ends of the coils 23 and 24 which are bent outwardly over the flange 31, after insertion in the core further serve to prevent movement of the centering coil to the left as shown in Fig. 3. The focusing coil is locked within the hollow toroidal core structure and cannot accidentally be removed or displaced with respect to the remaining parts of the unit.

While a particular embodiment of the invention has been described and illustrated, it will, of course, be understood that it is not desired to limit the invention thereto since different modifications will occur to those skilled in the art. It is therefore intended by the appended claims to cover all modifications which fall within the spirit and scope of the invention.

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

1. A cathode ray electron discharge device comprising an envelope, an electron gun for projecting a cathode ray beam in said envelope, a fluorescent screen arranged in the path of the beam, a hollow annular magnetic core closely surrounding said envelope, a focusing coil positioned within said core for concentrating said beam, and a pair of coils arranged between said core and said envelope on axes at right angles to each other and to the axis of said beam whereby the position of said beam may be changed by adjusting the excitation of the coils of said pair of coils.

2. A cathode ray electron discharge device comprising an envelope having a cylindrical neck portion, means arranged within said portion for projecting a cathode ray beam into the body portion of said envelope, a fluorescent screen arranged in the path of the beam, a focusing coil surrounding said neck portion for concentrating said beam, a hollow toroidal magnetic core surrounding said coil and having a portion thereof arranged between said coil and said envelope, and a pair of coils arranged between said portion of said core and said neck portion, said coils of said pair being arranged to produce magnetic fields at right angles to each other and to the axis of said beam whereby the position of the beam may be changed by adjusting the excitation of the coils of said pair of coils.

3. A combined focusing and centering coil assembly for a cathode ray tube comprising a cylindrical form of insulating material arranged to be mounted about the neck of a cathode ray tube, a pair of centering coils mounted on said form, a hollow toroidal core of magnetic material mounted about said coils, a focusing coil within said core, and means for retaining said coils and said form and said core in fixed relation to one another as a unitary assembly.

4. A combined focusing and centering coil assembly for a cathode ray tube comprising a cylindrical form of insulating material arranged to be mounted about the neck of a cathode ray tube, a pair of centering coils mounted on said form, a hollow toroidal core of magnetic material mounted about said coils, said core comprising an internal member having an outwardly extending flange and an external member having an inwardly extending flange, a focus coil arranged to fit about said internal member within said core, means for locking said internal member to said external member, and means including a portion of said form for locking said centering coils in position against axial movement with respect to said core.

5. A combined focusing and centering coil assembly for a cathode ray tube comprising a cylindrical insulating form arranged to be mounted about the neck of a cathode ray tube, a pair of centering coils mounted on said form and having axes at 90° from each other and from the axis of said form, a cylindrical magnetic core surrounding said coils and having an outwardly extending flange at one end, a focusing coil mounted on said core and extending axially beyond the end remote from said flange, a second cylindrical magnetic core surrounding said focusing coil and engaging the outer portion of said flange, said second core having an inwardly extending flange enclosing said focusing coil and providing an annular air gap between its inner edge and said other end of said first core, said coil form having an outwardly extending lug thereon entering said air gap for preventing axial removal of said centering coil from said core, and means for retaining said second core in engagement with said outwardly extending flange.

DONALD R. DE TAR.

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