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CATHODE RAY TUBES

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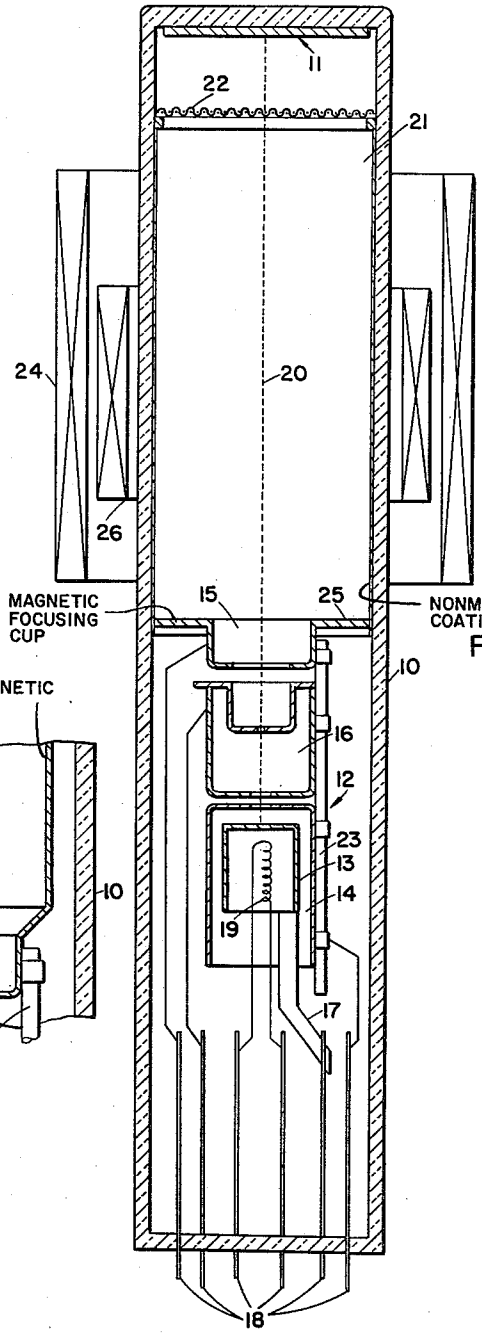


FIG. 1

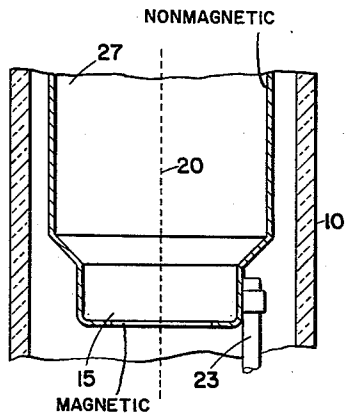


FIG. 2

INVENTORS
MARTIN ROME
HAROLD O. W. JORDAN

BY

AGENT

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CATHODE RAY TUBES

Martin Rome and Harold O. W. Jordan, Stamford, Conn., assignors to The Machlett Laboratories, Incorporated, Springdale, Conn., a corporation of Connecticut

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This invention relates to a cathode ray tube and more particularly to the electron gun structure for such a tube. Still more particularly this invention is concerned with an electron gun which is constructed and arranged so as to provide self-alignment of the electron beam which it produces.

In cathode ray tubes the electron gun is used to produce a beam of electrons which is focused upon and scans the surface of a photosensitive screen within the tube. For example, in a cathode ray tube of the vidicon type, such as is described particularly herein, the screen is located at one end of the tube envelope so as to receive on one side a radiant energy image, either visible or invisible. As the opposite side of the screen is scanned by the electron beam, electrical signals are produced corresponding to the image, in the usual manner of such tubes.

In conventional cathode ray tubes, means are provided external to the tube for focusing the electron beam and scanning the beam over the screen or target to form a raster. Such external means usually include a focus coil, a deflection yoke, and either an alignment coil or permanent magnets. An internal electrode which is permeable to the electron beam is positioned adjacent the screen and, during operation, functions together with the focus coil to insure that the electron beam in its final approach to the surface of the screen is normal thereto.

Alignment coils or permanent magnets have heretofore been believed necessary to function cooperatively with the focus coil to insure that the electron beam from the electron gun will emerge on the axis of the system. More particularly, the alignment coil or permanent magnets are provided to position the emerging electron beam in axial alignment with the magnetic field created by the focus coil. A misaligned beam in which this condition is not met results in poor focusing conditions over substantial portions of the screen, with a consequent decrease in image detail. The alignment coil or magnets must, therefore, be properly adjusted and located with respect to both the tube and the focus coil for optimum conditions.

In accordance with this invention the alignment coil and permanent magnets are eliminated and the beam is aligned in the electron gun. In this way not only are the alignment coil and magnets dispensed with but, also, since the gun is fixedly mounted within the tube, there is no need for additional adjustments to position the aligning means properly with respect to the tube and the focus coil, as is required with conventional tubes. In addition, by virtue of the magnetic nature of the self-aligning electrode, the electron beam is almost completely insensitive to stray and disturbing magnetic fields.

Accordingly, it is a primary object of this invention to provide a cathode ray tube with novel built-in electron beam-aligning means and shielding means for rendering the beam less affected by stray magnetic fields.

Another object is to provide a novel electron gun for cathode ray tubes, which gun is so constructed and arranged as to provide aligning and shielding means for the scanning electron beam which it produces.

Another object is to provide a cathode ray tube with a self-aligning electron beam-producing and magnetic shielding electron gun whereby the electron beam emerging from the gun is axially aligned with respect to the magnetic field created by a focus coil located in external encircling relation to the tube.

A further object is to provide a cathode ray tube structure of the above character which is relatively simple and inexpensive and which eliminates the necessity of certain additional accessory features required of conventional devices of this type.

Other objects and advantages will become apparent from the following description taken in connection with the accompanying drawing, wherein

FIG. 1 is an axial sectional view of a cathode ray tube embodying the invention; and

FIG. 2 is a fragmentary enlarged view of a modified tube embodying the invention.

In the drawing there is shown a pickup tube comprising an evacuated envelope **10** having a target **11** in one end and having within the other end an electron gun **12** which is adapted to form an electron beam for the purpose of scanning the target **11**.

The target **11** may be of any suitable type comprised of photosensitive material capable of reaction under the influence of visible or invisible radiation. For example, it may comprise a layer of transparent conductive material such as tin oxide coated with a layer of photoconductive material, responsive to either visible light or invisible radiations, such as selenium, antimony sulphide or any of the other materials which are known to be responsive to visible light, X-rays, gamma rays, or other radiation.

The electron beam from the electron gun **12** scans the adjacent surface of the target, whereupon electrical signals are formed in accordance with the radiant energy image impinging upon the opposite side of the target, in the normal manner of a tube of this type, which signals may be carried externally by means of suitable leads and terminals (not shown).

The electron gun **12** includes a cathode **13**, a control or grid electrode **14**, a first focusing electrode **15** and, generally, at least one accelerating grid electrode **16** between the focusing and control electrodes.

The cathode **13** is preferably a cuplike member having its closed end directed toward the target, the member being supported by suitable connecting means **17** upon one of a plurality of rods or terminals **18** mounted in and extending through the adjacent end of the envelope or bulb **10**.

A filament or heater **19** within the cathode **13** is supported by two other terminals **18** and is adapted to heat the cathode to the temperature necessary to liberate a copious supply of electrons from the surface of the cathode. The electrons are drawn through the electrodes and are formed into a beam **20** which is adapted to scan the target **11**. In passing through the tube from the first focusing electrode **15** to the target **11**, the electron beam **20** is in the constant potential field of a second focusing electrode **21** which is in the form of a vaporized nonmagnetic metallic coating, such as aluminum or silver, on the inner wall of the bulb, extending from the first focusing electrode to a point adjacent the target **11**. At the target end of the coating **21** is a transversely disposed disc-like grid structure **22** which is secured throughout its periphery to the inner wall of bulb **10**. The grid structure **22** may be connected to the coating **21** so as to be maintained at the same potential as the coating. However, the grid may be entirely separate from the coating, if desired, whereupon it will be necessary to provide additional means for supplying a suitable potential to the grid, such as a lead extending through the adjacent wall of the envelope.

The electrodes **14**, **15** and **16** are all apertured members which are maintained in prealigned and properly spaced

relation by insulating means such as ceramic posts **23** to which each electrode is secured independently of the other electrodes. The control electrode **14** and accelerating electrode **16** may be of any desired shape suitable for their respective purposes, but, in accordance with this invention, they both are preferably formed of a nonmagnetic metal such as Nichrome or nonmagnetic stainless steel. The first focusing electrode **15**, however, is of a magnetic material which under the influence of a suitable electrical potential and, in conjunction with a focus coil **24**, forms a magnetic field which not only focuses the electron beam **20** but also aligns the beam with respect to the magnetic field created by the focus coil **24**, which coil encircles the tube between the electron gun **12** and grid **22**.

To accomplish this, in accordance with this invention, the first focusing electrode **15** is formed of Kovar, steel or other magnetic metal and is provided with a cuplike shape having a flat bottom and parallel cylindrical side walls. The bottom is apertured to allow passage of the electron beam **20** and is directed toward the accelerating electrode **16**. The outer circumference of electrode **15**, preferably the edge encircling the opening formed by the open end thereof, is provided with an outstanding flange **25** which is mounted throughout its periphery immovably upon the inner wall of the bulb **10** to rigidly support electrode **15** in electrical contact with the coating **21**.

The longitudinal axis of the cuplike focusing member **15** is located so that the parallel side walls create a magnetic field which directs the electron beam along the axis of the tube or, more particularly, toward the center of the target. In this way the electrons emerging from the member **15** are initially directed so as to enter the magnetic field created by focus coil **24** in alignment therewith.

Deflection of the beam is accomplished by deflection coils **26** so that the beam scans the target **11** in the normal operation of a tube of this type. However, grid **22** functions cooperatively with the focus coil **24** to insure that the electron beam in its final approach to the target **11** is properly focused and is normal to the target surface.

By providing the described first focusing electrode **15** with magnetic characteristics and providing the second focusing electrode **21** with nonmagnetic characteristics, and by proper initial axial alignment of the electron gun, and particularly of the first focusing electrode **15**, the electron beam produced by the gun is self-aligned without the use of separate alignment coils or permanent magnets, and is substantially shielded from stray or undesirable magnetic fields.

In FIG. 2 there is shown a structure wherein the magnetic focusing electrode **15** is sealed to one end of a tubular nonmagnetic extension **27**, the other end of which terminates adjacent the target **11**. The tubular extension **27** thus replaces the coating **21** in the structure of FIG. 1. If desired, in this modified construction the target end of the extension **27** may carry the grid **22** so that the grid, extension and focusing electrode are all maintained at the same potential. It is important, however, that the extension **27** be nonmagnetic and the focusing electrode **15** be magnetic in order that the electron gun will accomplish beam alignment in accordance with this invention.

It will be apparent from the foregoing description that all of the objects and advantages of this invention have been achieved in the described structures wherein self-alignment and shielding of the electron beam is accomplished without external coils or magnets.

It is to be understood, however, that modifications and changes may be made by those skilled in the art without departing from the spirit of the invention as expressed in the accompanying claims.

We claim:

1. A cathode ray tube comprising an evacuated dielectric envelope, an electron gun in one end of the envelope, and a target in the opposite end of the envelope and arranged to be scanned by an electron beam passing through the envelope along a controlled path from the electron gun, the electron gun including a cathode electrode, a grid adjacent the target side of the cathode electrode and having an aperture therein, and a first focusing electrode at the end of the gun nearest the target and apertured to permit passage of the electron beam from the grid aperture, a hollow cylindrical second focusing electrode extending from the first focusing electrode to a point adjacent the target and encircling the path of the electron beam, said first focusing electrode being of magnetic material and said second focusing electrode being of nonmagnetic material whereby the electron beam passing from the first focusing electrode will be automatically aligned with respect to a given longitudinal axis.

2. A cathode ray tube comprising an evacuated dielectric envelope, an electron gun in one end of the envelope, a target in the opposite end of the envelope and arranged to be scanned by an electron beam from the electron gun, the electron gun including a cathode electrode and an apertured grid electrode spaced longitudinally of the envelope inwardly from the cathode electrode, and means for aligning said electron beam from the electron gun with respect to a given longitudinal axis and for directing the beam toward the target comprising a first focusing electrode of magnetic material located at the end of the gun nearest the target, and a nonmagnetic second focusing electrode extending from the first focusing electrode to a point adjacent the target.

3. A cathode ray tube comprising an evacuated dielectric envelope, an electron gun in one end of the envelope, a target in the opposite end of the envelope and arranged to be scanned by an electron beam passing through the envelope along a controlled path from the electron gun, the electron gun including a cathode electrode and an apertured grid electrode spaced longitudinally of the envelope inwardly from the cathode electrode, and means for aligning said electron beam from the electron gun with respect to a given longitudinal axis and for directing the beam toward the target comprising a first focusing electrode of magnetic material located at the end of the gun nearest the target and apertured to permit passage of the electron beam from the apertured grid electrode, and a nonmagnetic second focusing electrode extending from the first focusing electrode to a point adjacent the target and throughout its length substantially completely encircling the path of the electron beam from the first focusing electrode.

4. A cathode ray tube comprising an evacuated dielectric envelope, an electron gun in one end of the envelope, a target in the opposite end of the envelope and arranged to be scanned by an electron beam passing through the envelope along a controlled path from the electron gun, the electron gun including a cathode electrode and an apertured grid electrode spaced longitudinally of the envelope inwardly from the cathode electrode, and means for aligning said electron beam from the electron gun with respect to a given longitudinal axis and for directing the beam toward the target comprising a cup-shaped focusing electrode of magnetic material located at the end of the gun nearest the target with its open end directed toward the target and having an aperture in its closed end for passage of the electron beam from the apertured grid electrode, and a nonmagnetic tubular focusing electrode extending from the first focusing electrode to a point adjacent the target, the cup-shaped electrode being joined throughout its periphery to the end of the tubular focusing electrode whereby the path of the beam is enclosed and shielded from the point of entry of the beam into the cup-shaped electrode to the point of exit at the end of the tubular electrode nearest the target.

5. A cathode ray tube comprising an evacuated dielectric envelope, an electron gun in one end of the envelope, a target in the opposite end of the envelope and arranged

to be scanned by an electron beam passing through the envelope along a controlled path from the electron gun, the electron gun including a cathode electrode and an apertured grid electrode spaced longitudinally of the envelope inwardly from the cathode electrode, and means for aligning said electron beam from the electron gun with respect to a given longitudinal axis and for directing the beam toward the target comprising a cup-shaped focusing electrode located at the end of the gun nearest the target with its open end directed toward the target and having an aperture in its closed end for passage of the electron beam from the apertured grid electrode, the cup-shaped electrode being of magnetic material and having substantially cylindrical side walls so as to align the electron beam with respect to said given axis, and a nonmagnetic tubular focusing electrode extending from the first focusing electrode to a point adjacent the target, the cup-shaped electrode being joined to the end of the tubular electrode at its periphery whereby the path of the beam is enclosed from the closed end of the cup-shaped electrode to the end of the tubular electrode nearest the target.

6. A cathode ray tube substantially as set forth in claim 5 wherein said cathode electrode and apertured grid electrode of the electron gun are of nonmagnetic material.

7. A cathode ray tube substantially as set forth in claim 5 wherein the nonmagnetic tubular focusing electrode is a thin metal coating deposited upon the inner surface of the envelope.

8. A cathode ray tube substantially as set forth in claim 5 wherein the nonmagnetic tubular focusing electrode is a hollow metal cylinder sealed throughout one annular end to the periphery of the magnetic cup-shaped focusing electrode and supported thereby.

9. A cathode ray tube substantially as set forth in claim 5 wherein an additional grid electrode is mounted in the envelope adjacent the end of the nonmagnetic tubular focusing electrode nearest the target.

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