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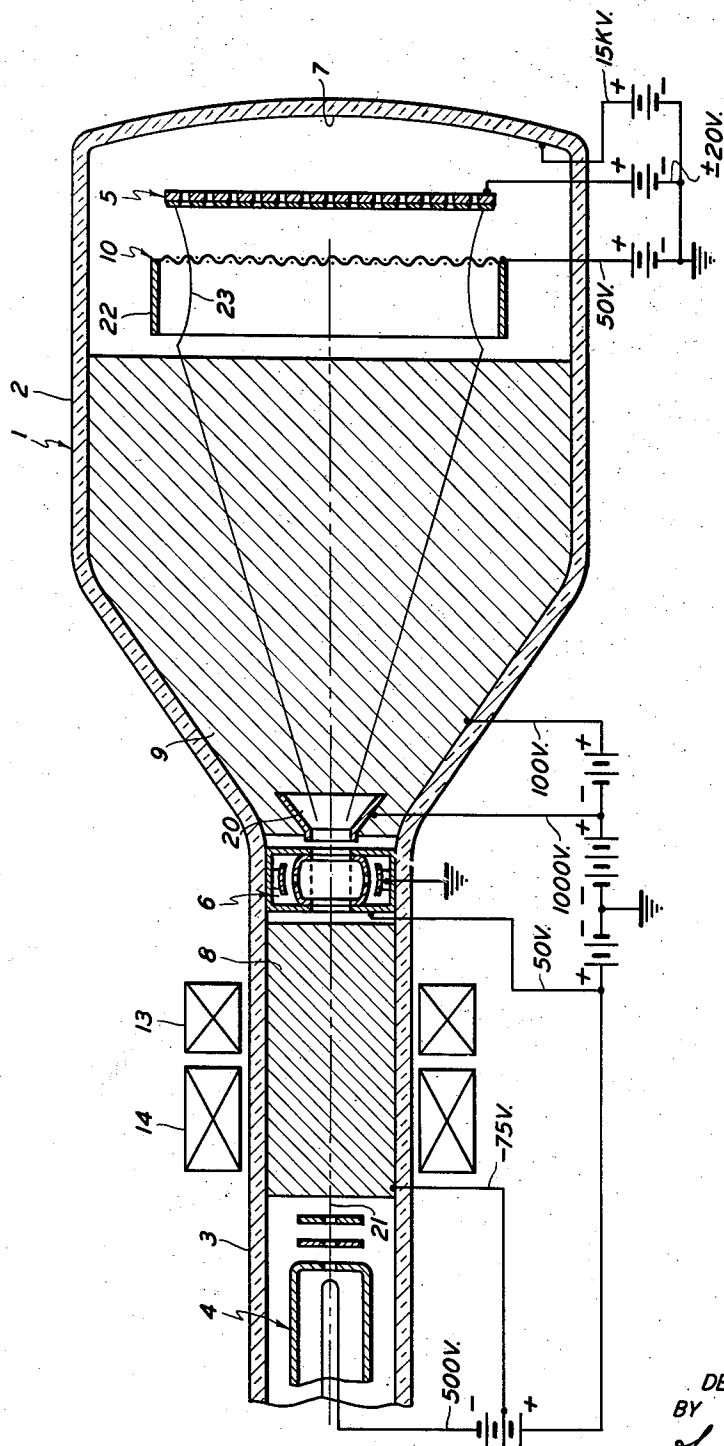
D. W. DAVIS

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CATHODE RAY AMPLIFIER

Filed Jan. 27, 1955

2 Sheets-Sheet 1



INVENTOR
DEAN W. DAVIS
BY
George L. Lust
ATTORNEY

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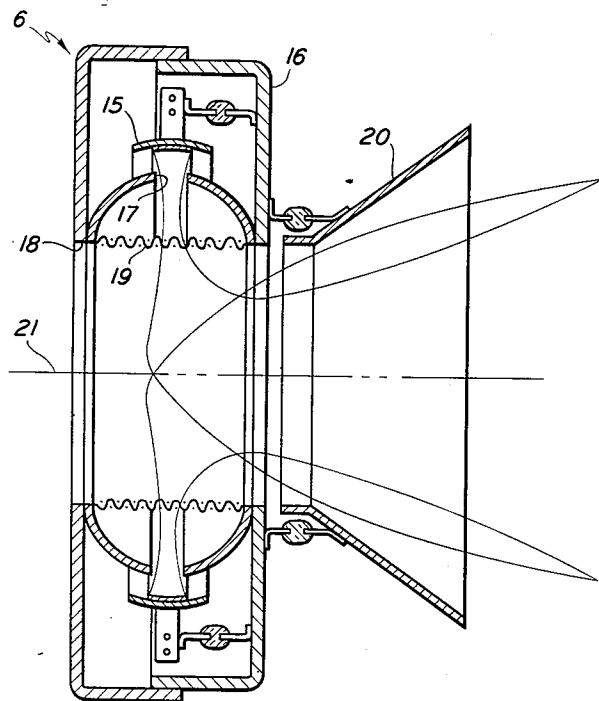


FIG. 2

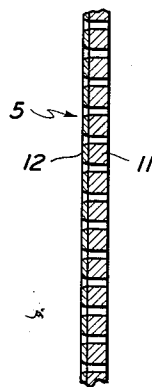


FIG. 3

INVENTOR.
DEAN W. DAVIS
BY
George L. Lust
ATTORNEY

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2,808,526

CATHODE RAY AMPLIFIER

Dean W. Davis, Fort Wayne, Ind., assignor to International Telephone and Telegraph Corporation

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4 Claims. (Cl. 313—71)

The present invention relates to a cathode ray amplifier, and more particularly to a cathode ray tube for amplifying an electron image.

This invention relates generally to the art of image storage tubes as disclosed and claimed in Farnsworth Patent No. 2,228,388. Other characteristic disclosures are found in Farnsworth Patent No. 2,251,124 and in Farnsworth et al. applications Serial Nos. 197,612 and 362,473, filed Nov. 25, 1950, and June 18, 1953, respectively. One of the primary problems encountered in the operation of storage tubes is distortion in the image display normally caused by the flood gun being offset from the writing-beam gun. In order to overcome this distortion, it is desirable to position the writing and flood guns on the tube axis. This has been attempted in the past in devices such as that depicted in the Farnsworth Patent No. 2,228,388, but without complete success. One difficulty resides in the fact that normal scanning of the writing beam causes unwanted deflecting movement of the flood beam.

This invention provides a construction whereby the flood and writing guns are so disposed and operated that flood beam deflection does not occur when the writing beam is deflected.

In view of the foregoing it is an object of this invention to provide a cathode ray amplifier which constitutes an improvement over prior art devices.

It is another object of this invention to provide a cathode ray amplifier wherein the flood and writing beams are coaxially disposed such as to uniformly impinge the image-storage element.

Other objects will become apparent as the description proceeds.

To the accomplishment of the above and related objects, my invention may be embodied in the forms illustrated in the accompanying drawings, attention being called to the fact, however, that the drawings are illustrative only, and that specific change may be made in the specific constructions illustrated and described, so long as the scope of the appended claims is not violated.

In the drawings:

Fig. 1 is a sectional illustration of one embodiment of this invention;

Fig. 2 is a cross-sectional view of the flood gun of Fig. 1; and

Fig. 3 is a sectional illustration of the image storage element.

Referring to Fig. 1, the cathode ray amplifier comprises an envelope 1 having an enlarged funnel-shaped portion 2 and a smaller diameter coaxially extending neck 3. Mounted in the end of the neck 3 is a beam-forming or writing electron gun assembly 4 which generates a beam of electrons of elemental cross-sectional area for impinging the image storage element or screen generally indicated by the reference numeral 5. A flood electron gun 6 is mounted in the neck 3 between the gun assembly 4 and the storage element 5, and is so arranged as to emit a flood of electrons which cover either a substantial portion

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or the entire area of the screen 5. A luminescent screen 7 of conventional design and which fluoresces under the impact of electrons is provided in the envelope portion 2 at the end opposite the two electron gun assemblies 4 and 6, respectively. In tubes adapted to provide an electrical signal output rather than an optical display, an ordinary conductive plate may be substituted for screen 7. The terms "utilization electrode" or "electron-receiving anode" as used in the claims are intended to include both the screen 7 and such conductive plate. A conductive coating 8 is provided internally of the neck 3 to extend between the two gun assemblies 4 and 6, and serves the conventional purpose of accelerating the electrons from the gun 4 toward the storage screen 5. A second conductive coating 9 is provided internally of the envelope portion 2 and extends forwardly from the flood gun 6 to a point just short of the collector screen 10. This collector screen or electrode 10 is perforate and is preferably composed of a relatively large mesh metallic screen positioned adjacent and substantially parallel to the storage screen 5.

With suitable potentials applied to the electrodes thus far described, a positive charge image may be impressed on the storage screen 5 as it is simultaneously being flooded by electrons from the gun 6, the flood gun being maintained at a potential slightly positive with respect to the left-hand side of the screen 5. The electrons flowing therefrom will not be attracted to the screen itself, but instead will pass through the screen openings to impinge the anode 7. As the flood electrons pass through the respective screen perforations, they are modulated by the elemental charges surrounding the perforations and will, therefore, impinge the anode 7 with a density dependent upon such modulation. By this means, the charge image on the screen is optically reproduced on the anode 7.

The screen 5, as seen in Fig. 3, is composed of a metallic screen 11, of, for example, 500 mesh size, one side of this screen being covered by a dielectric material 12, such as quartz. Exact details of this construction are given in Farnsworth application Serial No. 197,612, filed Nov. 25, 1950, and further such screens are now being used in storage tubes commercially available on the open market.

A magnetic focusing coil 14 of conventional design surrounds the neck 3 for focusing the beam from the gun 4 onto the screen 5 and a suitable pair of deflection coils (only one coil 13 is shown) also surrounding the neck 3 are mounted adjacent the focusing coil 13 for controlling beam scanning of the screen 5. In this connection, any well-known raster-forming scanning techniques may be utilized.

Of particular moment is the fact that the focusing and scanning coils 14 and 13 are positioned rearwardly of the flood cathode 6 a distance sufficient to prevent the flood beam from being affected thereby.

The gun assembly 4 is conventional and serves its usual function of providing a pencil-like electron beam for scanning the storage screen 5. The flood gun assembly 6, however, is composed of an annular cathode 15 which coaxially surrounds the tube axis. It is well to note at this point that the undeflected beam emitted by the electron gun 4 coincides with this tube axis. This cathode 15 is preferably mounted in an annular housing 16 suitably anchored in the tube neck 3, this housing being provided with an annular aperture 17 positioned radially inwardly from the cathode 15. The central portion of the housing 16 is open as indicated by the reference numeral 18 to accommodate the deflecting movement of the electron beam from the gun 4. A suitable tubular screen 19 is mounted internally of the housing 16 to establish a uniform cylinder of potential for the writing beam passing through that region. The diameter of the

opening 18 is of such size as to accommodate the full scanning movement of the writing beam. Mounted adjacent to the housing 16 and in coaxial relation thereto is a funnel-shaped anode element 20.

The cathode 15 normally emits electrons radially inwardly through the annular aperture 17 toward the tube axis 21. These electrons may be considered as substantially filling the space internally of the housing 16 such as to form a cloud of electrons of uniform cross-section. Suitable potentials are applied to the anode elements 8, 9, 20 and to the cathode 15 such that this cloud of electrons will be directed toward the front of the tube to flood the storage screen 5. The light lines of Fig. 2 emanating from the cathode 15 depict the path followed by the electrons in changing direction from radial to axial flow.

The ring 22 extending rearwardly from the perimeter of the collector screen 10 in conjunction with the anode 9 constitutes an electron lens which collimates the diverging flood beam 23 as illustrated. This collimated beam impinges the storage screen 5 at substantially right angles, the electron lens being so positioned and controlled to image the source of the flood electrons appearing internally of the housing 16 in the plane of the storage screen 5. Stated in other words, the source or cloud of electrons inside the housing 16 is imaged in the plane of the storage screen 5, and since this source is of uniform cross-sectional density, the electron image produced on the screen 5 will be of uniform cross-sectional density. Suitable operating potentials for the various tube elements are indicated in Fig. 1.

In operation, the beam of electrons emitted by the electron gun 4 is scanned over the screen 5 in the usual raster-forming manner by means of the deflection coils. The electrons in this beam are caused to travel at such velocity as to produce greater than unity secondary emission on the impinged elemental areas of the screen insulator 12, so that as the beam is scanned over the area of this screen, a charge pattern of positive potential is formed. The low velocity electrons from the flood gun 6 are repelled first by the anode 8 since the potential thereof is negative with respect to the flood electrons and simultaneously is attracted toward the anode 7 by reason of the accelerating potentials applied to the anode 20. These flood electrons pass through the openings of the screen 5 before striking the screen 7. The number of flood electrons passing through the individual openings are modulated in accordance with the charge pattern on the screen, the modulated electron flow thereby representing the charge pattern on the screen 5 and serving to excite the display of an equivalent image by the screen 7. The exact potential relationships of the writing and flood guns as well as the storage screen 5 and anode 7 are well known, and are fully described in Farnsworth et al. application Serial No. 362,473, filed June 18, 1953.

By reason of the fact that the writing gun 4 is mounted on the tube axis 21 and is coaxial with the flood gun 6, the usual distortion encountered by the use of an offset writing gun is eliminated. Furthermore, by positioning the focusing and deflecting coils 13 and 14 sufficiently far from the flood gun 6, the flood beam 23 will be substantially stationary and uniform in cross-sectional density. It may be desired to use a ferrous ring mounted on the neck 3 between the coils 13 and 14 and the flood gun 6 to further prevent interference of the magnetic fields with the flood beam 23.

What is claimed is:

1. An image signal tube comprising an electron-

receiving anode, an image storage element disposed adjacent said anode, an electron gun for producing an electron beam of elemental cross-sectional area directed at said storage element, an additional source of electrons coaxially surrounding said beam between said electron gun and said storage element directed radially inwardly toward said beam, electrode means disposed in operative relationship to said source for turning the radially inwardly directed electrons toward said storage element and causing such turned electrons to flood said storage element.

2. An image signal tube comprising an electron-receiving anode, an image storage element disposed adjacent said anode, an electron gun for producing an electron beam of elemental cross-sectional area directed at said storage element, an additional source of electrons coaxially surrounding said beam between said electron gun and said storage element, said source providing a vertical cathode coincident with the axis of said beam, said vertical cathode being composed of a cloud of electrons of uniform cross-sectional area which is symmetric about said axis, and electrode means adjacent to said source operative to direct and flood the electrons from said cloud onto said storage element, said electrode means including electron optic means which images said cloud in the vicinity of said storage element.

3. An image signal tube comprising an electron-receiving anode, an image storage element disposed adjacent said anode, an electron gun for producing an electron beam of elemental cross-sectional area directed at said storage element, said beam having an axial path from which it may be deflected for scanning said storage element, a flood cathode symmetrically surrounding said axis and being disposed between said electron gun and said storage element, said flood cathode directing electrons radially inwardly about said axis to form a cloud of electrons of uniform cross-sectional area, and electrode means adjacent to said flood cathode operative to direct and flood the electrons from said cloud onto said storage element, said electrode means including means which images said cloud in the vicinity of said storage element.

4. An image signal tube comprising an electron-receiving anode, an image storage element disposed adjacent said anode, an electron gun for producing an electron beam of elemental cross-sectional area directed at said storage element, said beam having an axial path from which it may be deflected for scanning said storage element, an annular flood cathode symmetrically surrounding said axis and being disposed between said electron gun and said storage element, the opening of said flood cathode being sufficiently large to accommodate deflecting movement of said beam without interference, and accelerating anodes on opposite sides of said flood gun serving to direct said beam onto said storage element, said flood cathode directing electrons radially inwardly to form a source of anodes about said axis, said accelerating electrons directing the electrons of said source toward said screen, and electron optical elements imaging said source on said storage element.

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