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Grant

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[54] CATHODE RAY TUBE SYSTEM

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[52] U.S. Cl. .... 313/2, 313/92 R, 313/92 LF, 313/95, 313/105
[51] Int. Cl. H01j 29/18
[58] Field of Search..................... 313/105, 92 LF, 2

[56] References Cited

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3,249,784 5/1966 Burns.................................. 313/86

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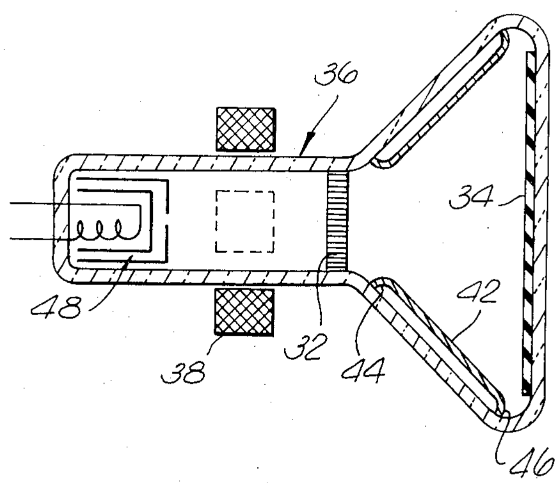
[57] ABSTRACT

A cathode ray tube system having a source of electrons and a phosphor screen. A michrochannel plate having secondary emissive surfaces is positioned in the cathode ray tube so that the source of electrons is directed towards the microchannel plate. Output electrons from the microchannel plate are directed towards the reduced cross-sectional end of a magnification tube interposed between the microchannel plate and the phosphor screen which is at the enlarged end of the magnification tube. The resulting structure allows a reduced cross-sectional area microchannel plate to be used in the cathode ray tube system. Alternatively, the system may be manufactured of two envelopes with the first envelope containing the source of electrons which is directed to the microchannel plate. Electrons are then directed from the microchannel plate towards a phosphor screen adjacent thereto and light energy from the phosphor screen transmitted to a fiber optic structure at the end of the first envelope. A second fiber optic structure in the second envelope is adjacent the first fiber optic structure. Light emanating intothe fiber optic structure then appears at a photosensitive device adjacent the second fiber optic structure. The photosensitive device emits electrons into a magnitication tube in the second envelope which are directed towards a phosphor screen in the other end of the second envelope.

3 Claims, 3 Drawing Figures



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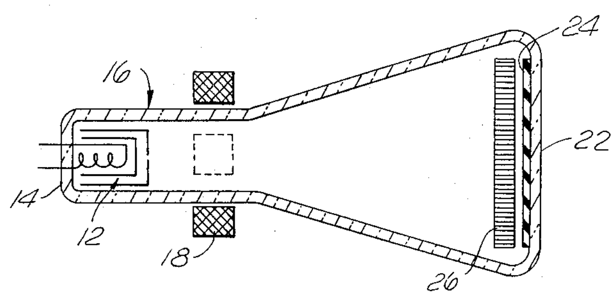

Fig. 1.

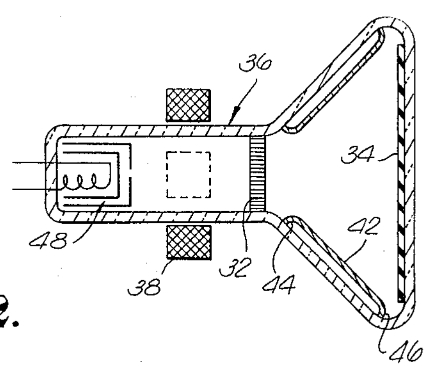

Fig. 2.

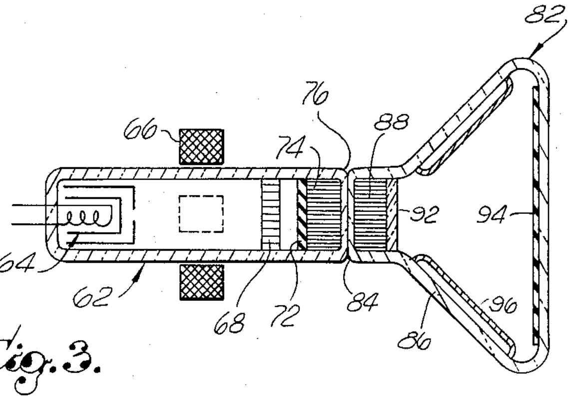

Fig. 3.

CATHODE RAY TUBE SYSTEM

The invention relates in general to cathode ray tube systems and more particularly to electro-optical brightener intensifiers for use in a cathode ray tube.

BACKGROUND OF THE INVENTION

In conventional cathode ray tubes the output brightness display of a fast response tube is determined by the beam current density falling on the phosphor and the energy at which that beam is delivered. The density of the electron beam is normally determined by the perveance, P, of the electron gun. The perveance is normally defined by the formula $P = I/V^{3/2}$, where:

I is the electron gun beam current; and

V is the accelerating voltage.

It will be noted that higher beam densities, of course, imply higher voltages. The higher voltage, in turn, results in the stiffness of the beam, that is, more power is required for deflection.

In prior art devices, which have been utilized to obtain greater brightness in a cathode ray tube, it has been suggested to position an electron multiplier in the vicinity of the phosphor screen. The electron multiplier produces electron gain, and the beam requirements to produce an output display are substantially reduced. However, by placing the electron multiplier in proximity with the phosphor screen, it has been found that the large electron multiplier results in an uneconomical device, as a large electron multiplier device is required.

In order to overcome the attendant disadvantages of prior art high output brightness display systems, the present invention provides a high output brightness display which does not require high voltages in the cathode ray tube. Thus, a minimum of power is required for deflection of the electron beam produced by the electron gun of the cathode ray tube. Further, an electron multiplier is so positioned in the tube that its size is a minimal size and can be produced economically. Moreover, the present invention produces a relatively high output brightness display while a minimum of power is required to deflect the electron beam of the cathode ray tube.

The advantages of the invention, both as to its construction and mode of operation, will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings in which like referenced numerals designate like parts throughout the figures.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 depicts a prior art cathode ray tube utilizing an electron multiplier therein;

FIG. 2 illustrates a cathode ray tube made in accordance with principles of the invention; and

FIG. 3 shows an alternative arrangement of a cathode ray tube system of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings there is shown a cathode ray gun **12** which is positioned at one end **14** of an evacuated envelope **16.** Electrons emitted from the gun **12** are deflected by means of a magnetic deflection coil **18** so that they will travel towards a window **22** having a phosphor surface **24** thereon.

Positioned adjacent the phosphor surface **24,** between the gun **12** and the surface **24** is a microchannel plate **26.** The microchannel plate is of conventional design and may be of the type described in U.S. Pat. No. 3,260,876. The electron beam scans the microchannel plate and the electrons are amplified by the microchannel plate. The microchannel plate is positioned sufficiently close to the phosphor surface **24** so that as the amplified electrons leave the microchannel plate, they are proximity focused on the phosphor surface. The microchannel plate and the surface **24** are normally biased in the manner taught by the aforementioned patent. Thus, the electron beam is amplified by the microchannel plate, and the beam density required to produce the desired display brightness need not be as great as when the microchannel plate is not utilized.

As can readily be seen in the embodiment of FIG. **1,** the microchannel plate size is almost the same dimensions as the window **22.** While the system of FIG. **1** reduces the need for large voltages to obtain the desired brightness, it has been found that large microchannel plates needed for such systems are expensive so that the entire cost of the cathode ray tube becomes noncompetitive.

Referring now to FIG. **2,** there is shown an alternative embodiment of a cathode ray oscilloscope containing a microchannel plate. In FIG. **2,** the microchannel plate **32** is much smaller than the phosphor coated window **34** of an envelope **36,** and is positioned closer to the deflection coil **38.**

A focusing cone **42** is positioned between the microchannel plate **32** and the window **34.** The end **44** of the cone **42** is of approximately the same inner dimensions as the plate **32** and diverges outwardly to the other end **46** adjacent the window **34** and is approximately the same size as the window. The cone **42** can be determined from existing electro-optic designs. An applicable design is used in the Delft magnification tube manufactured by Aerojet-General Corporation.

Electrons from a cathode ray gun **48** produce a directional electron beam which is deflected by coils **36** so that the point of impact moves along the microchannel plate **32.** The electrons are multiplied by the microchannel plate **32** and exit the channels of the plate toward the window **34.** The cone **42** focuses the electrons on the phosphor window **34,** thus in effect, magnifying or enlarging the electron pattern on the output side of the microchannel plate.

Referring now to FIG. **3,** there is shown an alternative embodiment of the device of FIG. **2,** wherein a pair of envelopes is joined to form a cathode ray tube system. The first envelope **62** contains a cathode ray gun **64** at one end of the tube. The electron beam from the gun is deflected by magnetic deflection coils **66** with the electron beam point of impact being a microchannel plate **68.** The amplified electrons then impinge on a phosphor screen **72** positioned on one side of a fiber optic output window **74.** The other side of the window **74** has formed thereon, the end surface **76** of the envelope **62.** The envelope is generally cylindrical in shape and the microchannel plate **68** and fiber optic output window **74** both are slightly smaller than the inner dimension of the envelope **62.**

A second envelope **82** has an input end **84** of approximately equal cross-sectional dimensions as the envelope **62** and a diverging output envelope cone **86** extending therefrom. The input end **84** of the envelope **82** abuts the end surface **76** of the envelope **62** and contains a fiber optic input window **88** similar to the window **74** in envelope **62.** The window **88** contains a photocathode **92** at its end adjacent the cone **86.** At the enlarged output end of the envelope **82** a phosphor surface **94** may be coated thereon. A focusing cone **96** of the Delft magnification tube type as described in FIG. **2** is mounted on the envelope cone portion **86.**

In operation, electrons from the gun are amplified by the microchannel plate **68** and impinge on the phosphor screen **72.** Light from the screen **72** is transmitted through the fiber optic output window **74** which normally may be formed to a plurality of light guiding fibers. The light signal is then transmitted to the window **88.** The light from the window **88** impinges on the photocathode **92.** Photocathode **92** in turn emits electrons which enter the focusing cone **96** and a magnified output appears on the phosphor screen **94.** It should be understood, of course, the elements of the system must be correctly biased so as to enable the electrons to travel from the gun **64** to the screen **94.**

What is claimed is:

1. A cathode ray tube system comprising:

a magnification tube having a first longitudinal section of reduced cross-sectional area and a second section of enlarged cross-sectional area;

a source of electrons at one end of said first section and a first phosphor screen at the opposite end of said second section;

a microchannel plate having secondary-emissive surfaces in the channels for multiplying electrons from said source, said microchannel plate being positioned within the other end of said first section;

electromagnetic deflection means around said first section between said electron source and microchannel plate for scanning electrons across said microchannel plate; and

conical electron focusing means in said second section extending outwardly from the reduced to the enlarged cross-sectional area between said microchannel plate and screen for focusing and directing multiplied electrons onto said screen to provide an enlarged image of increased brightness.

2. The cathode ray tube system in accordance with claim **1** further comprising fiber optic means adjacent said other end of said first section interposed between said microchannel plate and said other end, a second phosphor screen on one side of said fiber optic means facing said microchannel plate, and a photoemissive surface on the other side of said fiber optic means at said other end.

3. The cathode ray tube system in accordance with claim **2** wherein said magnification tube includes two adjacent longitudinal tubular envelopes having adjacent ends of reduced cross-sectional areas, said fiber optic means includes a first and second fiber optic device positioned adjacent each other in respective adjacent ends of said tubular envelopes, said first envelope containing said source of electrons, said microchannel plate, said second phosphor screen and said first fiber device, and said second envelope including said second fiber optic device and said photoemissive surface in said reduced cross-sectional area and said focusing means and said first phosphor screen in said enlarged area.

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