July 17, 1956 N. F. FYLER 2,755,407

DARK TRACE CATHODE RAY TUBE

Filed March 3, 1955 3 Sheets-Sheet 1

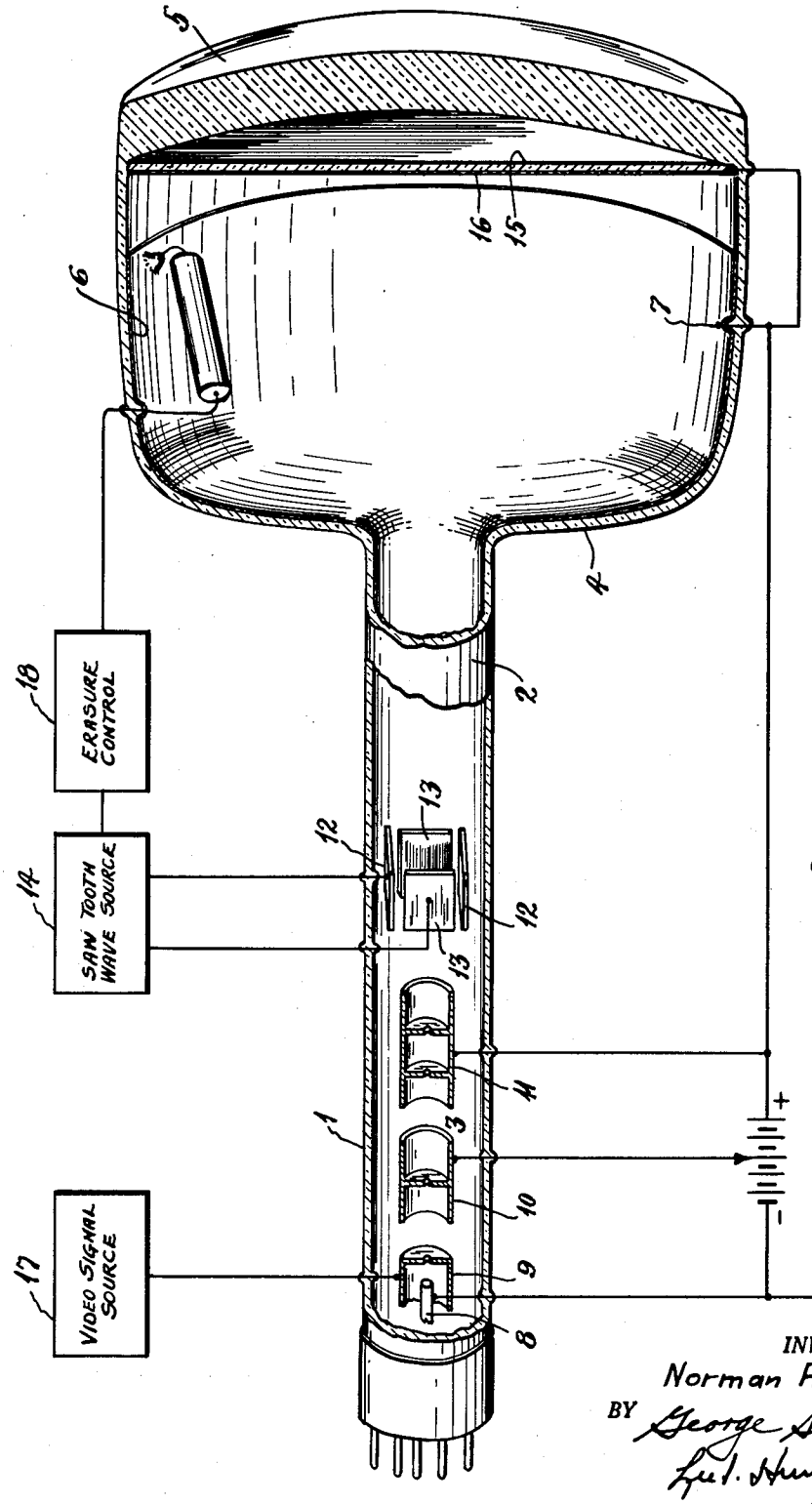


Fig. 1

INVENTOR.
Norman F. Fyler
BY George Sipkin
Fred. Hunsberger

July 17, 1956 N. F. FYLER 2,755,407

DARK TRACE CATHODE RAY TUBE

Filed March 3, 1955 3 Sheets-Sheet 2

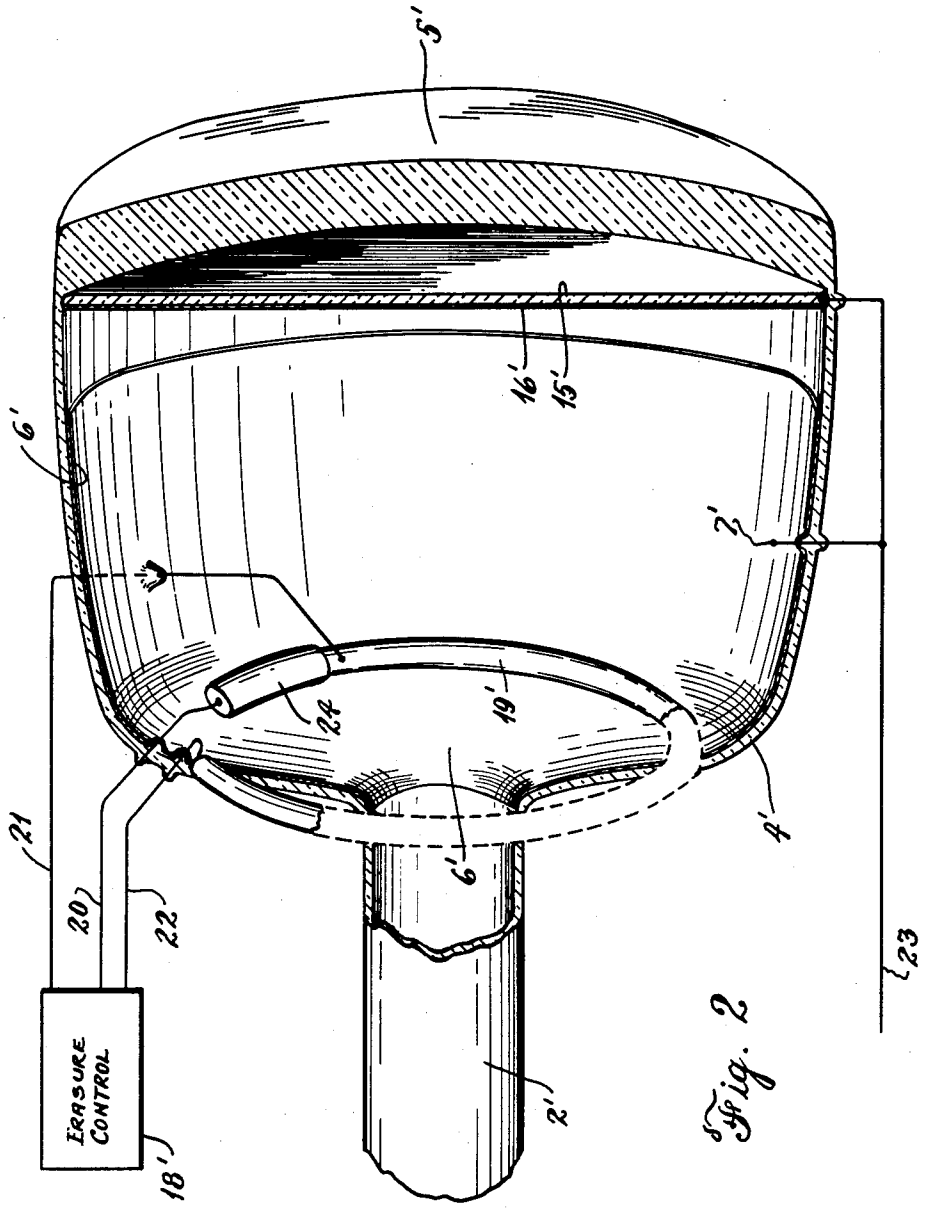


Fig. 2

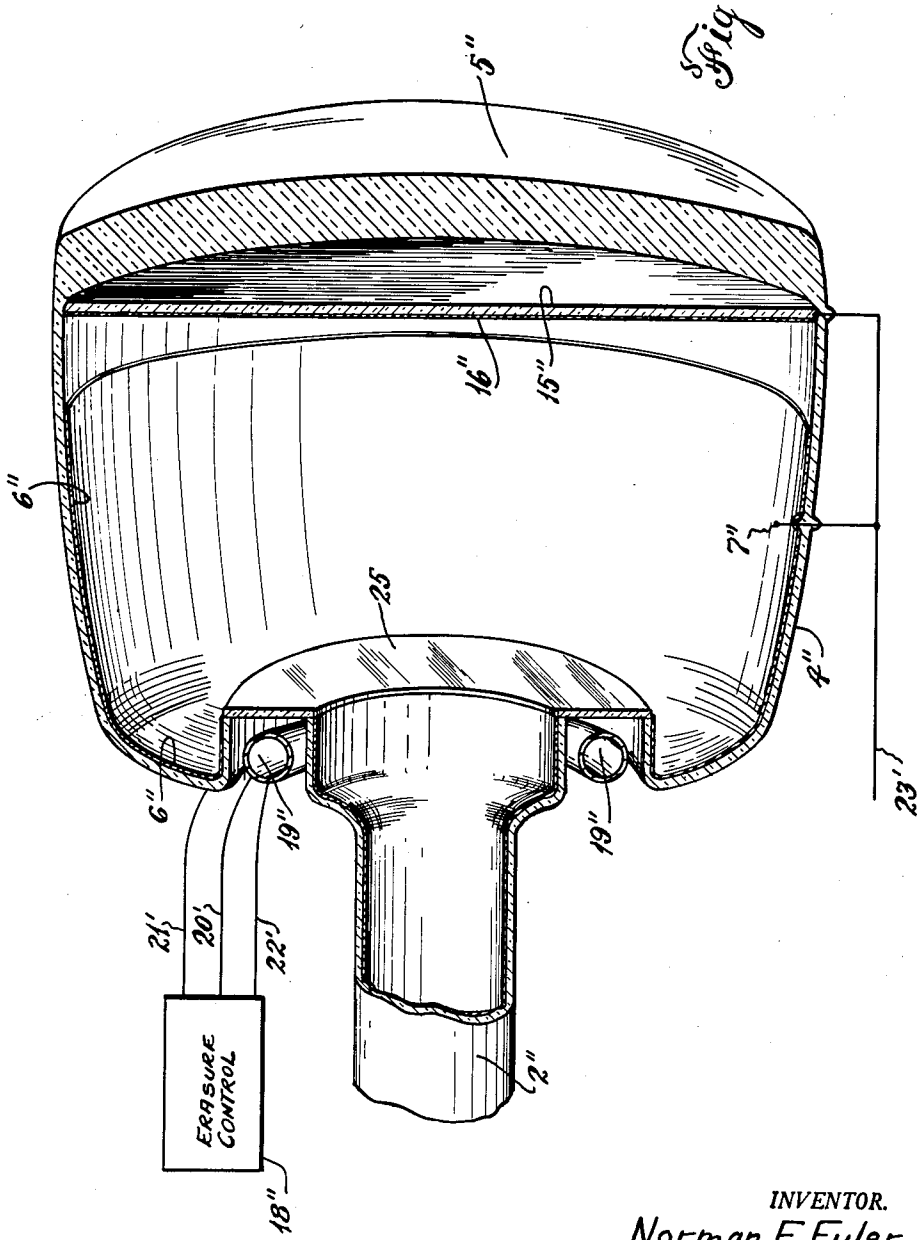
INVENTOR.
Norman F. Fyler
BY George Sixbin
Lee P. Huntzberger

July 17, 1956 N. F. FYLER 2,755,407

DARK TRACE CATHODE RAY TUBE

Filed March 3, 1955 3 Sheets-Sheet 3

Fig. 3



INVENTOR.
Norman F. Fyler
BY George Sipkin
Lee I. Huntzberger

United States Patent Office 2,755,407 Patented July 17, 1956

2,755,407

DARK TRACE CATHODE RAY TUBE

Norman F. Fyler, Newburyport, Mass., assignor, by mesne assignments, to the United States of America as represented by the Secretary of the Navy

Application March 3, 1955, Serial No. 492,057

4 Claims. (Cl. 315—1)

This invention concerns dark trace cathode ray tubes.

When a beam of electrons or cathode rays impinge upon normally transparent "ionic crystal" material, the "ionic crystal" material develops localized opacity areas. The crystals may be the halides of the alkaline metals or of the alkaline earth metals. They may also be certain salts of silver, as silver bromide.

The term "dark trace" tube is defined herein as a cathode ray tube having an image screen composed, at least in part, of "ionic crystal" material. The term "ionic crystal" is defined herein as being productive of localized opacity areas in response to impinging electrons.

Dark trace cathode ray tubes of the prior art utilize infrared (heat) radiation, among other methods, to erase or "bleach out" a dark trace on the image screen. When infrared radiation is utilized for erasing a dark trace, a considerable time is required for the image screen to return to operating temperature after completion of the erasing process. Additional intelligence may not be produced upon the image screen by the electron beam before the image screen has returned to its operating temperature. This thermal time lag necessitated the utilization of fragile and expensive image screens of low heat inertia. Thus, prior art dark trace tubes utilizing infrared erasing methods operate under the hindrances of thermal time lag and weak image screen construction.

The principal object of the present invention is the provision of a dark trace cathode ray tube utilizing a new and improved method of dark trace erasure.

An object of the present invention is the provision of a dark trace cathode ray tube utilizing ultraviolet radiation for dark trace erasure.

An object of this invention is the provision of a dark trace cathode ray tube utilizing ultraviolet radiation for both dark trace erasure and projection screen illumination.

Another object of this invention is the provision of a dark trace erasure-incorporating dark trace cathode ray tube of sound and sturdy construction.

A further object of this invention is the provision of a dark trace erasure-incorporating dark trace cathode ray tube free of thermal time lag.

Other objects and many of the attendant advantages of this invention 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 wherein:

Fig. 1 is a dark trace cathode ray tube utilizing the ultraviolet radiation of the present invention for dark trace erasure;

Fig. 2 is a modified version of a dark trace cathode ray tube utilizing the ultraviolet radiation of the present invention for dark trace erasure; and

Fig. 3 is a modified version of a dark trace cathode ray tube utilizing the ultraviolet radiation of the present invention for dark trace erasure.

The dark trace cathode ray tube has an evacuated enclosing envelope 1, a diverging neck portion 2 and a body portion 4. An electron gun 3 is positioned within the neck portion 2; the body portion 4 of the dark trace tube is closed off by viewing end face 5. For purposes known in the art, the interior surface of the neck portion 2 and part of the body portion 4 is coated with a conductive material 6. A connection lug 7 makes electrical contact, in a customary manner, with the conductive coating 6.

The electron gun 3 is of a type well known in the art and includes an electron emitting cathode 8, an apertured beam intensity control electrode 9, a first accelerating and beam focussing anode 10 and a second, or high potential, accelerating and focussing anode 11. Horizontal deflecting plates 12 and vertical deflecting plates 13 are utilized for moving the focussed electron beam in a desired scanning trace, or pattern, in a manner well known in the art. The horizontal and vertical deflecting plates are connected to a source of sawtooth deflecting voltage 14 for recurrently deflecting the electron beam at a desired line scanning rate and at a desired frame scanning rate, in a manner well known in the art.

An image screen 15 of light transparent conductive material is positioned adjacent the viewing end face 5. The image screen 15 is mounted to intercept the beam produced by the electron gun 3, which is focussed in a minute scanning spot on the image screen. A layer of ionic crystals 16, such as potassium chloride, is evaporated onto the inner surface of the image screen 15.

The image screen 15 and the conductive coating 6 are connected to the second anode potential. The electron gun 3, being signal responsive, controls the production of dark trace images on the crystal layer 16. The beam intensity control electrode 9 is connected to a source of video signals 17 and is suitably biased to produce a predetermined electron density in the beam produced by the electron gun, in a manner well known in the art. The electron beam current varies in accordance with the video signals applied to the beam intensity control electrode 9.

The erasure control unit 18 is electrically connected to the sawtooth wave source 14 and to the ultraviolet light source 19, which is sealed into the body portion 4 of the dark trace tube. The erasure control unit 18 controls the operation of the ultraviolet light source 19 at desired instants of time. The ultraviolet light source 19 may be any suitable source of ultraviolet radiation, such as a mercury vapor lamp. The ultraviolet light source 19 may be utilized to illuminate a projection screen, not shown in Fig. 1, by projection through the dark trace crystal layer 16 and the image screen 15.

The operation of the dark trace cathode ray tube of Fig. 1 is one well known in the art and produces projected images on a suitable screen (not shown in Fig. 1).

The operation of the dark trace erasure method of the dark trace cathode ray tube of Fig. 1 is as follows.

The erasure control unit 18 operates the ultraviolet light source 19 at a low energy level or at a high energy level, as desired. When it is operated at a low energy level, the light source 19 produces a low level intensity illumination, or radiation, which is utilized to illuminate an image projection screen (not shown in Fig. 1). When it is operated at a high energy level, the light source 19 produces a high level energy intensity illumination, or radiation, which is utilized to erase, or "bleach out," a dark trace on the crystal layer 16. The light source 19 thus operates at high intensity radiation to erase an image produced on the image screen 15 by an electron beam from the electron gun 3.

Fig. 2 is a modified version of a dark trace cathode

ray tube utilizing the ultraviolet radiation of the present invention for dark trace erasure.

The dark trace cathode ray tube is similar to that shown in Fig. 1 and utilizes the same electron gun 3 (shown in Fig. 1), the same electron gun component control means (shown in Fig. 1), and the same electron beam control means (shown in Fig. 1). The dark trace cathode ray tube has a diverging neck portion 2' and a body portion 4'. The electron gun 3 (shown in Fig. 1) is positioned within the neck portion 2'; the body portion 4' of the dark trace tube is closed off by a viewing end face 5'. The interior surfaces of part of the body portion 4' are coated with a conductive and reflective metallic film such as aluminum. A connection lug 7' makes electrical contact, in a customary manner, with the conductive coating 6'.

An image screen 15', of light transparent conductive material, is positioned adjacent the viewing end face 5'. The image screen 15' is mounted to intercept the beam produced by the electron gun 3 (shown in Fig. 1), which is focussed in a minute scanning spot on the image screen. A layer of ionic crystals 16', such as potassium chloride, is evaporated onto the inner surface of the image screen 15'.

The image screen 15' and the conductive (aluminum) coating 6' are connected to the second anode potential by the electrical conductor 23. The electron gun 3 (shown in Fig. 1), being signal responsive, controls the production of dark trace images on the crystal layer 16'. The beam intensity control electrode 9 (shown in Fig 1) is connected to a source of video signals 17 (shown in Fig. 1) and is suitably biased (as shown in Fig. 1) to produce a predetermined electron density in the beam produced by the electron gun, in a manner well known in the art. The electron beam current varies in accordance with the video signals applied to the beam intensity control electrode 9 (shown in Fig. 1).

The erasure control unit 18' is electrically connected to the sawtooth wave source 14 (shown in Fig. 1) and to the ultraviolet light source 19', which is sealed into the body portion 4' of the dark trace tube, by the electrical conductors 20, 21, and 22. The erasure control unit 18' controls the operation of the ultraviolet light source 19' at desired instants of time. The ultraviolet light source 19' may be any suitable source of ultraviolet radiation, such as a mercury vapor lamp. The ultraviolet light source 19' utilizes an attenuation filter 24 and may be utilized to illuminate a projection screen, not shown in Fig. 2, by projection through the dark trace crystal layer 16' and the image screen 15'.

The operation of the dark trace cathode ray tube of Fig. 2 is one well known in the art and is similar to the operation of the tube of Fig. 1. The tube of Fig 2, as does the tube of Fig. 1, produces projected images on a suitable screen (not shown in Fig. 2).

The operation of the dark trace erasure method of the dark trace cathode ray tube of Fig. 2 is as follows.

The erasure control unit 18' operates the ultraviolet light source 19' at a low energy level or at a high energy level, as desired. When the common terminal electrical conductor 20 and the starting and illumination terminal electrical conductor 21 are energized by the erasure control unit 18', the attenuation filter 24 produces a low level intensity illumination, or radiation, which is utilized to illuminate an image projection screen (not shown in Fig. 2). This is due to the absorption of the erasing spectrum of the lamp 19' by the attenuation filter 24. The attenuation filter 24 performs the additional function of an ionizing source to maintain the lamp 19' at proper operating temperature and ionization density. This insures a rapid response when the erasure control unit 18' applies a signal to the lamp 19' for high intensity radiation.

When the common terminal electrical conductor 20 and the high intensity terminal electrical conductor 22 are energized by the erasure control unit 18', the ultraviolet light source 19' produces a high level intensity illumination, or radiation, which is utilized to erase, or "bleach out," a dark trace on the crystal layer 16'. The light source 19' thus operates at high intensity radiation to erase an image produced on the image screen 15' by an electron beam from the electron gun.

The aluminum coating 6' serves purposes known in the art, as it is similar to the conductive coating 6 of the tube of Fig. 1. The aluminum coating 6' performs the further function of reflecting radiation from the ultraviolet light source 19' back to the image screen 15' from the rear of the body portion 4' of the tube.

Fig. 3 is a modified version of a dark trace cathode ray tube utilizing the ultraviolet radiation of the present invention for dark trace erasure.

The dark trace cathode ray tube is similar to that shown in Fig. 1, except that the ultraviolet light source 19'' is positioned outside the tube envelope, and utilizes the same electron gun 3 (shown in Fig. 1), the same electron gun component control means (shown in Fig. 1) and the same electron beam control means (shown in Fig. 1). The dark trace cathode ray tube has a diverging neck portion 2'' and a body portion 4''. The electron gun 3 (shown in Fig. 1) is positioned within the neck portion 2''; the body portion 4'' of the dark trace tube is closed off by a viewing end face 5''. The interior surfaces of part of the body portion 4'' are coated with a conductive material. A connection lug 7'' makes electrical contact, in a customary manner, with the conductive coating 6''.

An image screen 15'' of light transparent conductive material is positioned adjacent the viewing end face 5''. The image screen 15'' is mounted to intercept the beam produced by the electron gun 3 (shown in Fig. 1), which is focussed in a minute scanning spot on the image screen. A layer of ionic crystals 16'', such as potassium chloride, is evaporated onto the inner surface of the image screen 15''.

The image screen 15'' and the conductive coating 6'' are connected to the second anode potential by the electrical conductor 23'. The electron gun 3 (shown in Fig. 1), being signal responsive, controls the production of dark trace images on the crystal 16''. The beam intensity control electrode 9 (shown in Fig. 1) is connected to a source of video signal 17 (shown in Fig. 1) and is suitably biased (as shown in Fig. 1) to produce a predetermined electron density in the beam produced by the electron gun, in a manner well known in the art. The electron beam current varies in accordance with the video signals applied to the beam intensity control electrode 9 (shown in Fig. 1).

The erasure control unit 18'' is electrically connected to the sawtooth wave source 14 (shown in Fig. 1) and to the ultraviolet light source 19'', which is positioned outside the body portion 4'' of the dark trace tube by the electrical conductors 20', 21' and 22'. The ultraviolet light source 19'' is positioned adjacent an ultraviolet light transmitting window 25. The erasure control unit 18'' controls the operation of the ultraviolet light source 19'' at desired instants of time. The ultraviolet light source 19'' may be any suitable source of ultraviolet radiation such as a mercury vapor lamp. The ultraviolet light source 19'' utilizes an attenuation filter 24 (shown in Fig. 2) and may be utilized to illuminate a projection screen, not shown in Fig. 3, by projection through the dark trace crystal layer 16'' and the image screen 15''.

The operation of the dark trace cathode ray tube of Fig. 3 is one well known in the art and is similar to the operation of the tube of Figs. 1 and 2. The tube of Fig. 3. as do the tubes of Figs. 1 and 2, produces projected images on a suitable screen (not shown in Fig. 3).

The operation of the dark trace erasure method of the dark trace cathode ray tube of Fig. 3 is as follows.

The erasure control unit **18''** operates the ultraviolet light source **19''** at a low energy level or at a high energy level, as desired. When the common terminal (shown in Fig. 2) electrical conductor **20** and the starting and illumination terminal (shown in Fig. 2) electrical conductor **21** are energized by the erasure control unit **18''**, the attenuation filter **24** (shown in Fig. 2) produces a low level illumination, or radiation, which is utilized to illuminate an image projection screen (not shown in Fig. 3). This is due to the absorption of the erasing spectrum of the lamp **19''** by the attenuation filter **24** (shown in Fig. 2). The attenuation filter **24** (of Fig. 2) performs the additional function of an ionizing source to maintain the lamp **19''** at proper operating temperature and ionization density. This insures a rapid response when the erasure control unit **18''** applies a signal to the lamp **19''** for high intensity radiation.

When the common terminal (shown in Fig. 2) electrical conductor **20** and the high intensity terminal (shown in Fig. 2) electrical conductor **22** are energized by the erasure control unit **18''**, the ultraviolet light source **19''** produces a high level intensity illumination, or radiation, which is utilized to erase, or "bleach out," a dark trace on the crystal layer **16''**. The light source **19''** thus operates at high intensity radiation to erase an image produced on the image screen **15''** by an electron beam from the electron gun.

The ultraviolet light transmitting window **25** transmits the ultraviolet radiation of the ultraviolet light source **19''** to the crystal layer **16''**, thereby permitting the positioning of the light source outside the tube.

The invention is not limited to the production of images of pictures, graphic or printed matter, but is capable of use in producing a stored record of any intelligence signals which are to be rapidly erased from the storing surface.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

I claim:

1. Electro-optical translation means comprising a cathode ray tube having an electron gun for developing a scanning cathode ray beam with a signal modulated intensity between predetermined limits and a storage screen of the ionic crystal signal storage type located within the envelope of said tube, said screen comprising a layer of dark trace ionic material responsive to an impinging cathode ray beam to develop elemental areas of corresponding variable opacity on a backing of a sheet of light transparent electrically conducting material, in combination with erasing and projection illumination means comprising a source of ultraviolet radiation positioned within the envelope of said tube, and means electrically connected to said source of ultraviolet radiation for selectively energizing said source of ultraviolet radiation to a first energy radiating condition at which said source of ultraviolet radiation illuminates said layer of said storage screen and to a second energy radiating condition at which said source of ultraviolet radiation erases said layer of said storage screen.

2. Electro-optical translation means comprising a cathode ray tube having an electron gun for developing a scanning cathode ray beam with a signal modulated intensity between predetermined limits and a storage screen of the ionic crystal signal storage type located within the envelope of said tube, said screen comprising a layer of dark trace ionic material responsive to an impinging cathode ray beam to develop elemental areas of corresponding variable opacity on a backing of a sheet of light transparent electrically conducting material, in combination with erasing and projection illumination means comprising a source of ultraviolet radiation positioned within the envelope of said tube to illuminate said layer of said storage screen, said source of ultraviolet radiation being a mercury vapor lamp of toroidal configuration.

3. Electro-optical translation means comprising a cathode ray tube having an electron gun for developing a scanning cathode ray beam with a signal modulated intensity between predetermined limits and a storage screen of the ionic crystal signal storage type located within the envelope of said tube, said screen comprising a layer of dark trace ionic material responsive to an impinging cathode ray beam to develop elemental areas of corresponding variable opacity on a backing of a sheet of light transparent electrically conducting material, in combination with erasing and projection illumination means comprising a source of ultraviolet radiation positioned within the envelope of said tube to illuminate said layer of said storage screen, said source of ultraviolet radiation being a mercury vapor lamp of toroidal configuration embodying an attenuation filter around a portion thereof, said lamp including means whereby the portion of said lamp having the filter and the portion of said lamp not having the filter may be separately energized.

4. Electro-optical translation means comprising a cathode ray tube having an electron gun for developing a scanning cathode ray beam with a signal modulated intensity between predetermined limits and a storage screen of the ionic crystal signal storage type located within the envelope of said tube, said screen comprising a layer of dark trace ionic material responsive to an impinging cathode ray beam to develop elemential areas of corresponding variable opacity on a backing of a sheet of light transparent electrically conducting material, in combination with erasing and projection illumination means comprising a source of ultraviolet radiation positioned within the envelope of said tube to illuminate said layer of said storage screen, and a coating of a conductive material of good reflectance on a portion of the interior surface of said tube.

References Cited in the file of this patent

UNITED STATES PATENTS

2,402,762	Leverenz	June 25, 1946
2,473,825	Smith	June 21, 1949
2,533,381	Levy et al.	Dec. 12, 1950
2,563,472	Leverenz	Aug. 7, 1951
2,569,911	Ziebolz	Oct. 2, 1951
2,661,437	Beckers	Dec. 1, 1953
2,663,012	Beers	Dec. 15, 1953