May 27, 1969 P. SEATS 3,447,020

DARK TRACE STORAGE TUBE

Filed April 27, 1965

FIG. 2

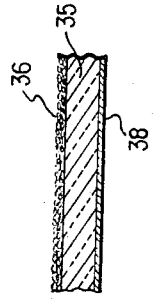


FIG. 4

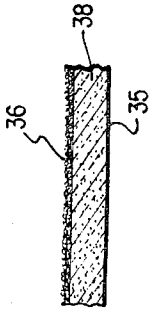


FIG. 3

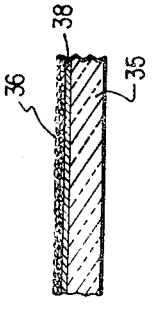
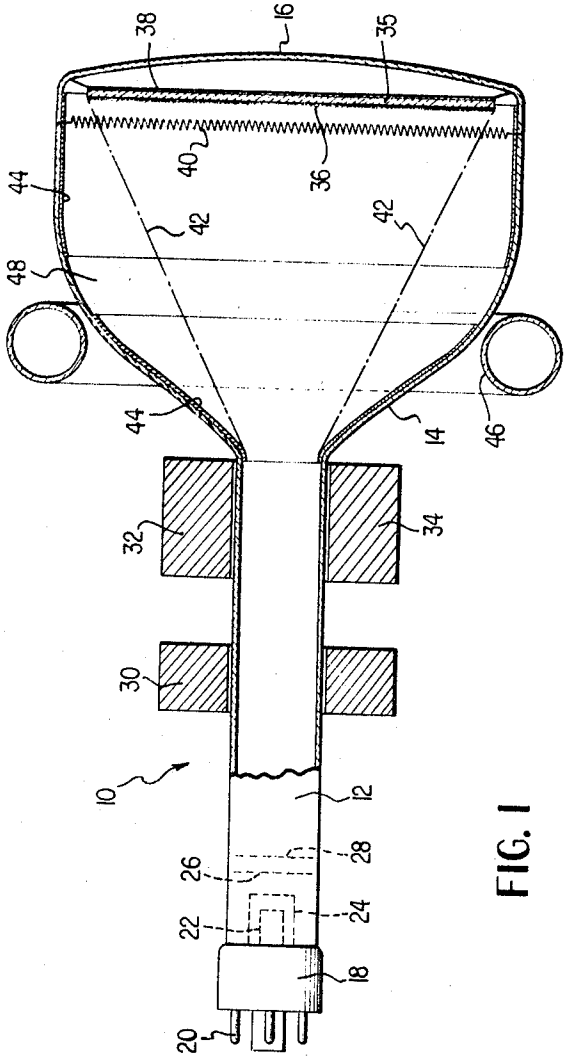


FIG. 1



INVENTOR
PETER SEATS

BY Diggins and O'Boyle

ATTORNEYS.

United States Patent Office

3,447,020

Patented May 27, 1969

3,447,020

DARK TRACE STORAGE TUBE

Peter Seats, Boonton, N.J., assignor to Thomas Electronics, Inc., Passaic, N.J., a corporation of New Jersey

Filed Apr. 27, 1965, Ser. No. 451,149
Int. Cl. H01j 31/26, 29/12
U.S. Cl. 315—10
10 Claims

ABSTRACT OF THE DISCLOSURE

The present invention relates to a dark trace storage cathode ray tube and novel screen combination utilizing radiant energy reflecting means for erasure of the screen without reducing the useful life or uniformity of operation of the tube. This dark trace storage tube and novel screen is superior to other prior art tube assemblies and is provided with a novel screen incorporating a simplified black body technique. The scotophoric layer of this invention is not subject to deterioration nor flaking, has long erasure life and in addition the tube asembly is provided with novel means for reflecting heat or radiant energy to impinge upon the screen so as to erase the opacity centers from the screen.

This invention relates to electron trace tubes and more particularly to so-called dark trace tubes employing a cathode ray responsive screen.

As is well known, dark trace tubes employ a screen consisting of a layer of crystals which exhibit tenebrescence or formation of dark color centers when bombarded by relatively high velocity electrons from an electron gun. Examples of such crystal screens are those of the alkali halide type formed of crystals of an alkali halide or mixture of such halides, for example potassium iodide, potassium chloride and the like.

Once an opacity center is formed on the screen of a dark trace tube it tends to remain dark or opaque until measures are taken to restore the individual darkened areas to their normal light conduction or light reflection condition. Two methods are normally used to effect the erasure of the drak trace record. One such method uses an electron beam to effect the erasure.

A customary way of effecting erasure by an electron beam is to use the same electron gun that is used for the dark trace recording, and to greatly increase the beam current for erasure as compared with the beam current for recording. Due to the extraordinary high beam current necessary for erasure the life and uniformity of the gun are severely curtailed with this method. In order to lengthen the life of the tube a second gun similar to the recording or writing gun but which comes into operation only during erasure is sometimes used when the electron erasure method is employed. But the use of a separate erasure gun also introduces a number of disadavantages. First the additional space needed for location of the separate gun is as a practical matter not available in the customary cathode ray tube construction and a separate tube neck must be used to house the separate gun. This requires separate deflection and beam focussing coils on the two necks with the likelihood of undesirable mutual interaction. Secondly the provision of two separate necks complicates the manufacture and assembly and greatly increases the cost of the finished tube. The tube becomes unwieldy to handle and requires extensive change in the mechanical and electrical design of the associated equipment with which it is to work. Perhaps the chief objection to the employment of an electron beam to effect erasure is the need of providing a high wattage high

voltage power supply in order to provide the high current necessary.

The second method to effect the erasure of the dark trace record, and the method used in the present invention, employs heat adjacent the dark trace screen to restore the screen to its normal condition. While this method does avoid the disadvantages inherent in the previous electron erasure systems, until the discovery of the present invention this method had not proven entirely satsifactory. In previous systems utilizing heat to restore the dark trace screen to its normal condition the screen has been made up of a sheet of mica or glass which carries the coating of a tenebrescent material such as an alkali halide, this alkali halide layer has been covered with a coating of aluminum of critically controlled thinness for absorbing energy for erasing the dark trace of the tenebrescent layer. These previous dark trace tubes were subject to early switching life failure related to mechanical and electrical instability of the alkali halide screen and associated layers resulting in progressive physical screen deterioration including discoloration and flaking. It was found that these failures resulted from the fact that while thin aluminum coatings deposited on glass or mica are normally ductile enough to resist shear when the substrate expands uniformly, the alkali halide layer appears to shear transversely (as well as possibly laterally) after about two thousand erasure cycles, to assume a fine criss cross or "crazed" texture. The aluminum layer deposited on the alkali halide is correspondingly sheared as the local alkali halide fissures appear and consequently, as "islands" form in the aluminum coating, electrical discontinuity results. Thus, when the screen is scanned with an electron beam, very high field gradients will appear across the fissures and current flow will be accompanied by arcing over, producing destructive effects. As the erosion of the aluminum layer continues, severe-nonuniform screen charging arises causing defocusing, discoloration, tracking and other effects.

An effective erasure system for dark trace storage tubes employing heat must provide for not only a fast decay or erasure rate but must rapidly dissipate the heat utilized to effect the erasure dissipated in order to allow a new trace to appear on the screen. While it is relatively easy to raise the temperature sufficiently to erase the screen, previously difficulty has often arose in dissipating this heat rapidly for the formation of a new trace.

It is the primary object of the present invention to provide an improved arrangement for enabling the record on the screen of a dark trace tube to be erased without reducing the useful life or uniformity of operation of the tube and without greatly increasing the cost of manufacture as has been the case with previous tubes of this type.

Another object is to provide an improved construction of dark trace tubes wherein the erasure can be effected with rapidity and wherein the erasing action does not introduce any undesired coloring effect on the screen.

It is another object of the present invention to provide an improved dark trace storage tube wherein the erasing action does not produce deterioration and flaking of the screen.

It is another object of the present invention to provide an improved dark trace storage tube having a screen including a thin sheet of mica, a layer of alkali halide crystals and a black body light absorbing layer for erasing the alkali halide crystal layer, with the black body layer positioned on the screen facing the cathode ray tube faceplate and the alkali metal halide layer positioned on the beam side of the screen.

It is another object of the present invention to provide a dark trace storage cathode ray tube including means to

illuminate the screen from the rear so as to increase contrast of the screen.

It is another object of the present invention to provide a dark trace storage cathode ray tube in which the inner surface of the funnel of the CRT possesses an aluminum coating for focusing and reflecting radiant energy forward to the screen.

It is another object of the present invention to provide an improved dark trace storage tube having a screen including a thin sheet of mica, a layer of alkali halide crystals and a black body light absorbing layer for erasing the alkali halide crystal layer with the black body layer positioned on the screen facing the cathode ray tube faceplate and the alkali metal halide layer positioned on the beam side of the screen, and a tungsten filament for providing the source of energy necessary for erasing the screen positioned about the periphery of the screen so as to avoid casting any shadow on the screen.

It is another object of the present invention to provide an erasure system for a dark trace storage tube providing a fast decay rate and rapid dissipation of heat from the screen so that a new trace may be formed.

Other objects and advantages of the present invention will become apparent from the following description taken in conjunction with the drawings which accompany and form part of the specification.

In the drawings:

FIGURE 1 is a plan view partly in section, of a typical dark trace tube embodying the invention.

FIGURE 2 is a magnified sectional view of the screen of FIGURE 1.

FIGURES 3 and 4 represent respective modifications of the screen of FIGURES 1 and 2.

Briefly the present invention pertains to a dark trace storage cathode ray tube in which a conventional electron gun and control means are employed for bombarding a screen with electrons and heat is used to erase the screen. Included in this tube is a source of radiant energy, a dark trace screen consisting of a thin sheet of mica or glass, a layer of tenebrescent material such as an alkali halide facing the electron gun which darkens under electron bombardment and a black body light absorbing layer on the side of the screen facing the CRT faceplate to effect with radiant energy emitted from the radiant energy source a sufficient temperature rise directly within the mica to cause erasure of the layer of tenebrescent material, a coating of aluminum on the flared portion of the cathode ray tube for reflecting and focusing the radiant energy forward from the source to the screen and means for providing rear lighting for improving the contrast on the screen including means for varying said contrast.

Referring to FIGURE 1, there is indicated by the numeral **10** any well-known form of cathode ray tube envelope, comprising the elongated neck portion **12** joined to the flared portion **14**, which is closed by the transparent end wall **16**. Attached to the neck **12** is any well-known plug in base **18** carrying the usual contact prongs **20**. The various lead-in wires and electrode support wires (not shown) are sealed through the stem or header (not shown) which closes off the neck **12** and through which the tube can be evacuated in known manner. Mounted within the neck is any well known form of electron beam forming means comprising for example the electron emitting cathode **22**, control grid **24**, first accelerating anode **26**, and second accelerating anode **28**. These electrodes for simplicity of showing are indicated schematically in FIGURE 1, since their actual structure is wellknown. Suffice it to say that by suitable heating of the cathode, and by suitable energization of the anodes by direct current voltage, the electrons from the cathode are formed into a beam which can be focused upon the recording screen by the conventional focusing yoke **30**. Surrounding the neck are the usual magnetic yokes **32**, **34**, for subjecting the focused beam to the desired point-by-point scanning motion over the screen.

Mounted at the end of the tube adjacent the end wall **16**, in the dark trace recording screen and erasure assembly according to the invention. The screen proper, comprises a transparent sheet or support **35** of mica or thin glass which is coated on the side facing the electron gun with a layer **36** of tenebrescent material such as potassium iodide crystals, potassium chloride crystals, or crystals of other tenebrescent halide or halides. On the side of the tenebrescent layer **36** away from the electron gun and facing the faceplate of the cathode ray tube a black body light absorbing layer **38** is provided such as chromium oxide or Nichrome. While the black body **38** is preferably applied to the opposite side of the mica sheet from that of the tenebrescent layer **36**, it may also be positioned between the tenebrescent layer and the mica sheet or the black body light-absorbing material may be intermixed with the mica. However, it is important that the black body be positioned between the tenebrescent layer and the faceplate of the cathode ray tube rather than between the tenebrescent layer and the electron gun for if the black layer were positioned between the tenebrescent layer and the electron gun it would interfere with the electron beam and the resolution of the dark trace in the tenebrescent layer. The use of mica in the screen structure provides for rapid dissipation of heat from the screen and consequently a fast cooling rate.

Mounted in front of the screen on the side facing the electron gun **12** is a source of radiant energy **40** for uniformly heating the entire surface of the black body light-absorbing layer **38** by radiant energy so as to provide a sufficient temperature rise directly within the mica to cause erasure of the layer of tenebrescent material **36**. In accordance with the invention the source **40** is a fine wire tungsten filament which can be connected to a suitable current supply source (not shown) to heat the filament to a temperature at which it acts as an efficient source of radiant energy. In order that the erasure filament **40** shall not cast a shadow on the screen or otherwise interfere with the recording, it may be in the form of a very fine wire annular or toroidal winding which is positioned around the periphery of the screen and is outside the maximum deflection angle of the beam **42**.

An aluminum coating **44** on the inner wall of the flared portion of the cathode ray tube focuses and reflects the radiant energy forward to the screen.

Since the optimum mica dark coating or black body layer results in approximately a 25% transmittance the screen would appear dark with only conventional front lighting.

In the present invention rear lighting **46** facilitated by a clear window **48** in the cathode ray tube coating has the effect of furnishing the necessary brightness with a dark trace ratio equal to or somewhat greater than that formerly attained by previous dark trace storage tubes. Since cast on the screen has the tendency to bleach the trace away, the use of a light which emits excess heat must be avoided. A circular green phosphor fluorescent lamp for rear lighting is therefore utilized providing cool uniform lighting with minimal heating and excellent contrast on the screen.

Provision for varying the intensity or the rear lighting **46** and as a result the contrast of the dark trace tube is provided by varying the area of the window **48** into the CRT by masking or mechanical shutter means.

Thus, the present invention provides a new improved dark trace storage tube which while employing heat adjacent the dark trace screen as an erasure means is not subject to the early switching life failure prevalent in previous dark trace tubes of this type.

The thin layer of aluminum which was subject to deterioration and flaking has been eliminated from the screen and the new screen structure in combination with the rear lighting means not only provides longer switching life but affords improved means for adjusting the

screen contrast as well as greater efficiency by decreasing the erasure time.

While the preferred embodiment of the invention is illustrated it is obvious that various changes and modifications may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. Cathode ray tube apparatus comprising in combination, an enclosing evacuated envelope, means to develop a beam of electrons, a screen upon which said beam impinges to make a record, said screen including a tenebrescent layer of material facing said beam which develops opacity centers when said beam impinges thereon, and means to erase said centers, the last mentioned means including a heatable filament within said envelope for emitting radiant energy, a reflective coating on the flared portion of said tube for reflecting and focusing said radiant energy to said screen and a black body light absorbing layer of material forming part of said screen for providing sufficient heat to erase opacity centers in the tenebrescent layer, said screen being sufficiently transparent to permit the passage of visible light.

2. A cathode ray tube apparatus comprising in combination, an enclosing evacuated envelope, means to develop a beam of electrons, a screen upon which said beam impinges to make a record, said screen including a tenebrescent layer facing said beam which develops opacity centers when said beam impinges thereon, a thin sheet of mica supporting said tenebrescent layer, rear lighting means positioned about the flared portion of said cathode tube so as to increase the contrast of said screen and means to erase said opacity centers on said screen, the last mentioned means including a heatable filament within said envelope for emitting radiant energy, a coating of aluminum on the flared portion of said tube for reflecting and focusing said radiant energy to said screen and a black body light-absorbing layer of material forming part of said screen positioned between said tenebrescent layer and the faceplate of said cathode ray tube for providing sufficient heat to erase the opacity centers in the tenebrescent layer.

3. A cathode ray tube apparatus as defined in claim 2 wherein said heatable filament is made of tungsten and is positioned about the periphery of the dark trace screen.

4. A cathode ray tube apparatus as defined in claim 3 wherein said rear lighting means includes a circular green phosphor fluorescent tube.

5. Cathode ray tube apparatus comprising in combination, an enclosing evacuated envelope, means to develop a beam of electrons, a screen upon which said beam impinges to make a record, said screen including a tenebrescent layer of material facing said beam which develops opacity centers when said beam impinges thereon, rear lighting means to improve the contrast of said screen including a circular green phosphor fluorescent tube located about the periphery of the flared portion of said tube, a circular window in the flared portion of said cathode ray tube having a variable area for controlling the amount of rear light to the screen and means to erase said opacity centers on said screen, the last mentioned means including a heatable filament within said envelope for emitting radiant energy, a coating of aluminum on the flared portion of said tube for reflecting and focusing said radiant energy to said screen and a black body light-absorbing layer of material forming part of said screen positioned between said tenebrescent layer and the faceplate of said cathode ray tube for developing sufficient heat to erase the opacity centers in the tenebrescent layer.

6. Cathode ray tube apparatus as defined in claim 5 wherein said black body layer is made of chromium.

7. Cathode ray tube apparatus as defined in claim 5 wherein said black body layer is made of Nichrome.

8. In a dark trace storage cathode ray tube of the type using heat to erase the screen employing an electron gun and control means for bombarding a screen with electrons, a source of radiant energy, a dark trace screen consisting of a thin sheet of mica which is transparent to visible light, a layer of tenebrescent material which darkens under electron bombardment on the surface of said sheet facing said gun and a black body energy-absorbing layer to effect as a result of the radiant energy emitted from the radiant energy source a sufficient temperature rise directly within the mica to cause erasure of the layer of the tenebrescent material, a reflective coating on the flared portion of the cathode ray tube for reflecting and focusing the radiant energy forward from the source to the screen and means for providing rear lighting for improving the contrast on the screen including means for varying said contrast.

9. A cathode ray tube apparatus comprising in combination an enclosed evacuated envelope, means to develop a beam of electrons, a screen upon which said beam impinges to make a record, said screen including a tenebrescent layer facing said beam which develops opacity centers when said beam impinges thereon, a thin sheet of mica supporting said tenebrescent layer, a circular green phosphor fluorescent tube positioned about a flared portion of said tube so as to increase the contrast of said screen and means to erase said opacity centers on said screen, the last mentioned means including a heatable tungsten filament positioned about the periphery of the screen for emitting radiant energy, a coating of aluminum on the flared portion of said tube for reflecting and focusing said radiant energy onto said screen, including a window provided in the aluminum coating on the flared portion of said tube and mechanical means to vary the area of the window so as to vary the amount of rear lighting and a black body light-absorbing material forming part of said screen positioned between said tenebrescent layer and the face plate of said cathode ray tube for providing sufficient heat to erase the opacity centers in the tenebrescent layer.

10. A cathode ray tube screen for a dark trace storage tube consisting essentially of a thin supporting sheet incorporated with a black body material said sheet being transparent to visible light and said transparent sheet coated on the exterior and exposed surface which faces the electron gun of the tube with a tenebrescent layer of material that is capable of forming opacity centers thereon when bombarded with cathode rays.

References Cited

UNITED STATES PATENTS

2,755,404	7/1956	Levy	313—91
2,836,753	5/1958	Hodowanec	313—91
2,836,754	5/1958	Holborn et al.	313—91
3,148,281	9/1964	Fyler	315—10 X
3,253,497	5/1966	Dreyer	313—91 X
3,277,241	10/1966	Spencer	178—7.87 X

OTHER REFERENCES

IBM Technical Disclosure Bulletin, R. K. Mason, Dark Trace Tube Screen, vol. 7, No. 9, February 1965, p. 836.

RODNEY D. BENNETT, JR., *Primary Examiner.*

JEFFREY P. MORRIS, *Assistant Examiner.*

U.S. Cl. X.R.

313—91