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DIVIDED SCREEN DISPLAY TUBE FOR STORE/NON-STORE INFORMATION PRESENTATION

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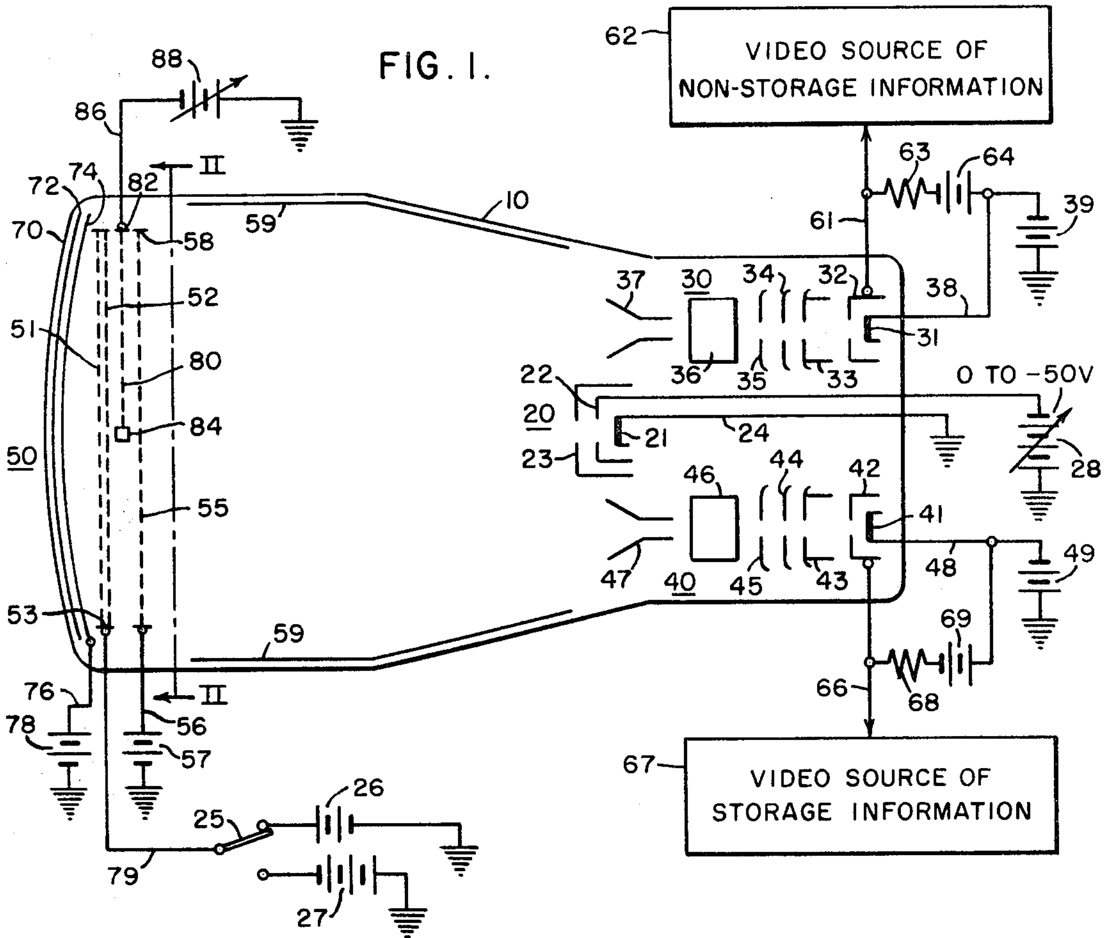

FIG. 1.

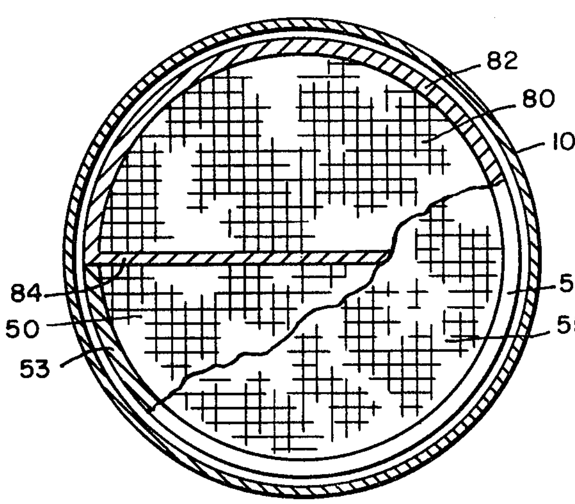

FIG. 2.

WITNESSES

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DIVIDED SCREEN DISPLAY TUBE FOR STORE/NON-STORE INFORMATION PRESENTATION

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ABSTRACT OF THE DISCLOSURE

The invention is a direct view storage tube incorporating a grid element establishing independent display areas for stored and non-stored information.

BACKGROUND OF THE INVENTION

Field of the invention

The invention relates in general to direct view storage tubes and in particular to storage tubes capable of displaying both stored and non-stored information simultaneously.

DESCRIPTION OF THE PRIOR ART

Presently dual information display in storage tubes is achieved through the use of long persistence phosphors. These phosphors are selectively settled on the interior of the tube face of the storage tube creating the two screen areas for displaying stored and non-stored information. In conjunction with the separated phosphor areas; holding guns, a collimation system, a write gun, and circuitry to control the storage, decay and readout of information are needed for proper information. This device presents a low display brightness which makes viewing difficult in any environment other than a lower ambient or with a hood for display shading. Since the storage media is a continuous layer the resolution of stored information depends on the lateral leakage of this material. If precise control of this process does not exist, performance duplication is difficult to obtain. The layer consistency will also have an effect on display uniformity.

SUMMARY

The invention is a storage tube employing a control electrode to effectively blank the phosphor storage tube screen and prevent flood beam electrons from striking select portions of the screen. The screen area bombarded by the flood beam electrons is utilized for the display of stored information whereas the remainder of the screen is utilized for the display of non-stored information.

Furthermore it is an object of this invention to provide a display tube which has independently adjustable persistency in the two separate screen areas for displaying two types of information at different decay rates.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic view of a storage tube embodying the present invention; and

FIG. 2 is a vertical section view taken along the line 2—2 of FIG. 1 with parts broken away to show the physical relationship of the grids **50**, **55** and **80**.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring in detail to FIG. 1, there is shown a storage tube comprising an evacuated envelope **10** of suitable shape and configuration and of a suitable material. Positioned at one end of the envelope **10** are a plurality of electron guns **20**, **30** and **40**. In the specific embodiment shown, two electron guns **30** and **40** are provided

for generating a pencil type electron beam which may be used to scan select portions of the surface of a storage grid **50** positioned at the opposite end of the envelope **10**. The third gun **20** centrally located within the envelope **10** is provided for generating a flooding beam so as to flood a portion of the surface of the storage grid **50**. The two pencil type electron beam generating guns **30** and **40** are essentially identical in structure and only one will be described for purposes of this invention.

The upper electron gun **30** as shown in FIG. 1, which may be referred to as the write through gun is comprised of a cathode **31**, a control grid **32** and beam forming and accelerating electrodes **33**, **34** and **35**. Electrostatic deflection means in the form of two pairs of plates **36** and **37** are provided in front of the beam forming electrodes for deflecting the electron beam generated within the electron gun **30** so as to scan a raster on a portion of the storage grid **30**. Suitable voltages are applied to the electrodes **31**, **32**, **33**, **34** and **35** in a well known manner to provide proper focusing and control of the electron beam. The cathode **31** of the write-through gun **30** is connected by means of a lead-in conductor **38** to the negative terminal of a voltage source illustrated as a battery **39**. The potential of the battery **39** may be of the order of 2.5 kilovolts and the positive terminal is connected to ground. The control grid **32** is connected by means of a lead-in conductor **61** to a video information source **62** of a non-storage information. The grid **32** is also connected through a resistor **63** to the negative terminal of a battery **64**. The potential of the battery **64** may be of the order of 60 volts with the positive terminal of the battery **64** connected to cathode **31**.

The other pencil beam electron gun **40** may be referred to as the storage write gun and as previously indicated is similar in structure to the write-through gun **30**. The cathode **41** is connected by means of a lead-in conductor **48** to the negative terminal of a suitable voltage source illustrated as a battery **49**. The positive terminal of the battery **49** is connected to ground and the battery **49** may have a potential of the order of 2.5 kilovolts. The control grid **42** of the storage write gun **40** is connected by a lead-in conductor **66** to a video source **67** of storage information. The lead-in conductor **66** of the control grid **42** is also connected through a resistor **68** to the negative terminal of a battery **69**. The positive terminal of the battery **69** is connected to the negative terminal of the battery **49**. The battery **69** supplies the necessary biasing voltage to the control grid **42** of the storage write gun **40**. The electron gun **40** also has beam forming and focusing electrodes **43**, **44** and **45** and also deflection plate systems **46** and **47**.

The flood gun **20** is centrally located within the envelope **10** and consists of at least a cathode **21**, a control grid **22** and an anode **23**. The flood gun **20** produces a high current divergent beam so as to flood a select portion of the storage grid **50** with electrons substantially uniformly across the surface thereof. The cathode **21** of the flood gun **20** is provided with a lead-in conductor **24** to the exterior of the envelope **10** and is connected to ground. The control grid **22** is connected to a variable negative voltage source **28** adjustable from 0 to about —50 volts as a part of the display collimation.

Positioned on the opposite end of the envelope **10** with respect to the electron guns is a faceplate or viewing window **70** of a transparent material such as glass which also closes off the end of the envelope **10**. Deposited on the inner surface of the faceplate **70** is a coating of a suitable phosphor luminescent material. The coating **72** emits radiations normally in the visible region when bombarded by electrons. A suitable material for the coating **72** would be a phosphor material such as zinc sulfide activated with copper which emits radiations in the visible region. An electron permeable coating 74 of electrical conductive material such as aluminum may be deposited on the exposed surface of the phosphor layer 72. A lead-in conductor 76 is provided from the conductive coating 74 to the exterior of the envelope 10 to provide means of applying a suitable potential to the phosphor screen 72. The lead-in conductor 76 is connected to the positive terminal of the battery 78 with the negative terminal of the battery 78 connected to ground. The potential of the battery 78 should be of the order of 10 to 15 kilovolts in order to provide the necessary acceleration to the electrons so as to cause sufficient emission of light from the phosphor screen 74.

Positioned adjacent and parallel to the phosphor screen 74 is a formainated storage grid member 50 which consists of a conductive backplate 51 which may be in the form of a fine wire mesh screen having 200 or more openings per linear inch. On the surface of the conductive backplate 51 remote from the phosphor screen is deposited a coating 52 of a dielectric material which has a very high specific resistivity such as silica or magnesium fluoride. The coating 52 should also have secondary emissive properties. The foraminated backplate 51 may be manufactured by any suitable method to obtain an apertured member and may be of a material such as nickel or copper. The storage grid may also have the form of a self-supporting dielectric mesh of suitable resistivity and a second emission characteristic, coated with a conductive backplate. The storage grid 50 is provided with a lead-in conductor 79 to the exterior of the envelope 10 which is connected to a switch 25, one side of which is connected to the positive terminal of a 2 volt battery 26 and the negative terminal is connected to ground. The other switch terminal is connected to the negative terminal of a 4 volt battery 27 the positive terminal of which is connected to ground.

Positioned adjacent to and parallel to the storage grid 50 is a collector grid 55 which is normally in the form of a fine mesh having a comparable number of openings as the storage grid 50. A lead-in conductor 56 is also provided to the collector grid 55 and is connected to the positive terminal of a suitable voltage source illustrated as a battery 57. The negative terminal of the battery 57 is connected to ground and the battery 57 may be about 300 volts.

The collector grid 55 which is of a similar area of the storage grid 50 is provided with an annular metallic member 58 on the side thereof facing the electron guns and has a similar potential of about 300 volts above ground as collector grid 55. The member 58 and the wall coating 59 serve to collimate the electrons from the flood gun so that the electrons approach the storage grid 50 normal to the plane thereof. The conductive coating 59 on the inner surface of the envelope 10 between the collector grid 50 and the electron guns is maintained at a potential about 40 to 90 volts above ground.

Interposed between the collector grid 55 and the storage grid 50 is a transmission control electrode 80. The control electrode 80 has a comparable number of openings as the storage grid 50 and the collector grid 55, but the faceplate area shielded by the control grid 80 is less than that of the storage and collector grids and is determined by the ratio of the face panel area designated for store and non-store information presentation. The control electrode 80 is supported by a support member 82 which maintains the control grid in a relatively taut condition. A lead-in conductor 86 to the control grid is connected to a suitable voltage source illustrated as a battery 88. In tube operation the control electrode 80, depending on the applied voltage supplied by source 88, can be utilized to either establish well defined store and non-store information presentation on the face panel 70 or can be utilized to vary the decay of stored information displayed on two separate portions of the face panel 70.

The section view of the tube structure of FIG. 1 depicted in FIG. 2 clearly illustrates the grid assembly comprising storage grid 50, collector grid 55 and control grid 80.

The collector grid 55 is partially sectioned to expose the control electrode 80, which is illustrated as covering half of the active faceplate area, and the storage grid 50. The cross support member 84 of the control grid support member 82 defines the face panel area effected by the control electrode 80 and provides means for maintaining the control grid in a relatively taut condition. While the control electrode 80 is illustrated as shielding half of the face panel 70, it is apparent that the effect of the control grid on the tube face panel can be changed by increasing or decreasing the area of the control grid as required.

To explain the operation of the described tube, if it is assumed that the write-through gun 30 and the storage write gun 40 are biased to cutoff and the storage grid 50 is connected to the 2 volt battery through switch 25, then electrons will be emitted from the flooding gun 20 and be accelerated to the storage grid 50. The electrons will approach the storage grid with an energy of about 10 electron volts and strike a portion of said storage grid 50. Assuming however that the voltage supply 88 establishes a negative 5 volt bias on the control electrode 80 and the control grid 80 extends over half the tube face panel as illustrated in FIG. 1, the flood beam generated by flood gun 20 will not penetrate the control electrode 80, thus preventing electron bombardment of the upper half of the face panel by flood beam electrons. The bombarded surface of the storage insulator 52 of the storage grid 50 will charge in a negative direction to an equilibrium potential of about 0 volts or flood cathode 21 potential. When the switch 25 on the storage grid 50 is then connected to the other battery 27 which is at —4 volts, no electrons from the flooding gun 20 can be transmitted through the storage grid 50. This assumes that a negative 6 volts applied on the storage surface of the storage grid is cut-off for the planar triode.

It is now assumed that the storage video information is applied to the storage write gun 40, the electrons within the electron beam will be modulated in their current density and will strike the surface of the insulator 52 of the storage grid 50. Secondary electrons emitted by the insulator surface of the storage grid 50 as a result of the electron bombardment are removed from the vicinity by the electric fields of the collector grid 55 and the phosphor electrode 74. By the application of suitable voltages to the deflection plates 46 and 47 associated with the storage write gun 40, a positive charge pattern is written on the lower half of the insulator surface of the storage grid 50 corresponding to the storage information received from the video source 67.

The writing gun 40 produces a narrow beam of high velocity electrons which is moved across the lower half of the storage grid 50 in accordance with the input signal applied to the deflection plates 46 and 47 to produce a charge image on the storage grid. This charge image is stored and maintained by the electrons emitted by the flood gun 20 which are uniformly distributed over the lower half of the storage grid 50. This image will continue to appear or to be read out as long as the charge image remains on the storage grid 50. Frame erasures, either partial or complete, may be accomplished by pulsing either the cathode of a flooding gun 20 or the storage grid 50.

The writing of the non-store information for viewing on the upper half of the tube face panel 70 is accomplished by applying video information from a non-storage video information source 62 to the grid 32 of the write-through gun 30, thereby modulating the current density of the electron beam generated by the write-through gun 30. The cathode 31 of the write-through gun 30 is at a negative potential of approximately 2.5 kilovolts with respect to ground and therefore the electrons in the beam from the write-through gun will penetrate the control grid

80 and excite the phosphor 72 on the face panel 70 to display short persistence information independent of the long persistence stored information display. The split screen display provided by the control electrode 80 allows two independent traces to be displayed side-by-side for comparison. While displaying non-storage information the routine techniques of over erasure, low flood gun potential and flood gun duty cycling can be used to extend the viewing duration of the stored information.

A second storage tube mode of operation, one in which long persistence stored information is displayed in both portions of the face panel but at different decay rates, can be implemented by altering the bias voltage supplied to the control electrode 80. The persistence of the information displayed on the upper portion of the face panel is controlled by varying the bias voltage applied to the control electrode 80, typically between 160 and 250 volts, while adjusting the erase duty cycle can be utilized to control the persistence of the information displayed on the lower portion of the face panel.

The brightness of the stored information will be equivalent to that of direct view storage tubes or similar storage surface, flood system and write guns. The resolution, writing speed, erase time, and storage time will be comparable to that of an equivalent storage tube. The resolution of the non-storage information display however will be superior to that of the stored information and will be directly dependent on the spot ability of the write-through gun 30.

The display will have a narrow non-usable area which coincides with the cross member 84 of the control grid support member 82. The size of this area is dependent on the fabrication techniques employed. Since two different types of information are displayed, this minute area functions as a boundary between the displays and by means of proper deflection programming no information will be lost.

While the control grid illustrated in the preferred embodiment is spatially disposed from the storage grid, it may be desirable to deposit the control grid as an integral part of the storage grid.

While the preferred embodiment of this invention illustrated in FIG. 1 incorporates two write guns for simultaneous display of information, it is apparent that a single write gun could be utilized on a sequential basis. Various modifications may be made within the scope of this invention.

I claim:

1. In combination, an information display tube system comprising, a charge storage grid having a plurality of apertures therein, a target disposed on one side of said storage grid, means for forming a first electron beam of a first energy and directing said first electron beam toward said storage grid to write a charge pattern thereon, means for forming a second electron beam to flood said storage grid with electrons of a second energy to pass through the apertures in said storage grid in accordance with modulation provided by said charge pattern thereby bombarding said target with an electron pattern corresponding to said charge pattern, and a transmission control electrode, the area of which is less than the cross-sectional area of said flood electron beam, disposed to effectively control the exposure of a select portion of said target by second energy electron patterns without substantially affecting the transmission of first energy electrons, said select portion of said target corresponding to the area of said transmission control electrode.

2. In combination as claimed in claim 1 wherein said transmission control electrode is disposed between said storage grid and said flood beam forming means to control the bombardment of a select portion of said storage grid by said flood beam second energy electrons.

3. In combination as claimed in claim 1 further including a variable voltage bias supply means electrically connected to said control electrode to adjust the retarding influence of said transmission control electrode on the flow of second electrons to the select portion of said storage grid corresponding to said control electrode area.

4. In combination as claimed in claim 1 wherein said target is an electron sensitive light emitting display screen.

5. In combination as claimed in claim 4 wherein said transmission control electrode effectively isolates a portion of said storage grid from said impinging second energy electrons to establish non-storage display screen capability in the screen area isolated from the second energy electrons, and storage display screen capability in the screen area exposed to said second energy electrons, said control electrode capability permitting the simultaneous display of stored and non-stored information in the form of separate traces.

6. In combination as claimed in claim 4 wherein the transmission control electrode bias voltage can be adjusted to permit transmission of said second energy electrons through said control electrode to establish a charge pattern decay rate in the display screen area influenced by said control electrode that differs from the charge pattern decay rate of the unaffected display screen area, said control electrode capability permitting the simultaneous display of information at different decay rates.

7. In combination as claimed in claim 1 wherein said control electrode is a metallic mesh having a plurality of apertures therein, said mesh spatially disposed from said storage grid.

8. In combination as claimed in claim 1 wherein said control electrode is a metallic mesh having a plurality of apertures therein, said mesh deposited on the surface of said storage grid forming an integral part thereof.

9. In combination as claimed in claim 1 further including a collector grid disposed next to said control electrode and remote from said storage grid.

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