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STORAGE DISPLAY TUBE WITH A SHIELD SEPARATOR BETWEEN THE WRITING GUN AND THE FLOOD GUN

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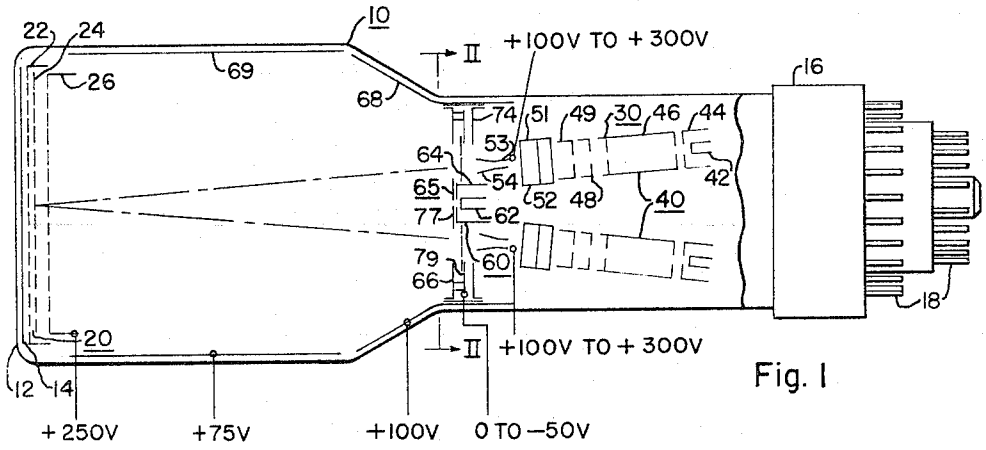


Fig. 1

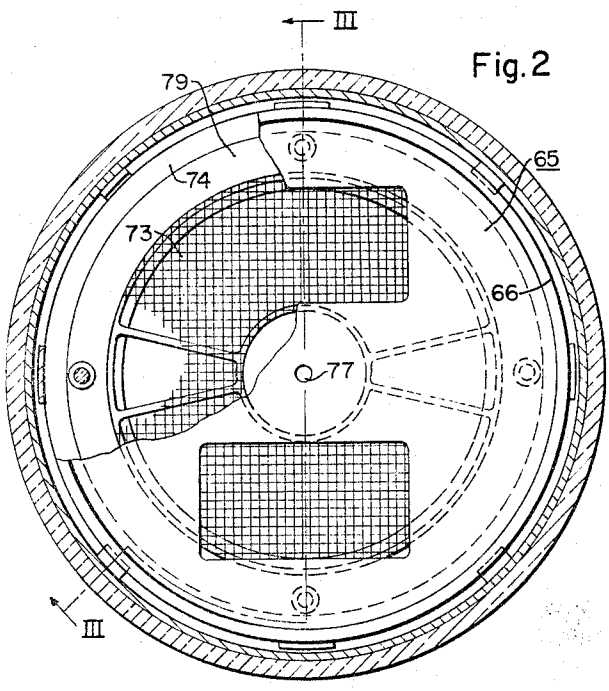
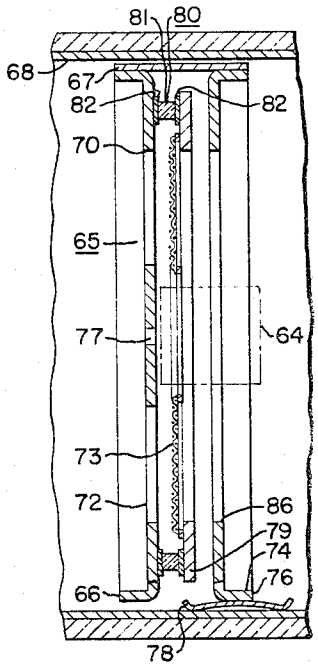


Fig. 2

Fig. 3



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STORAGE DISPLAY TUBE WITH A SHIELD SEPARATOR BETWEEN THE WRITING GUN AND THE FLOOD GUN

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This invention relates to storage tubes and more particularly to improvements in the electron gun assembly within the storage device.

Direct view storage cathode ray tubes for storing information normally in the form of a charge image on a storage mesh and then providing direct viewing of the image on a phosphor screen are well known in the art. The tubes generally contain, in addition to a conventional output phosphor screen and a writing gun similar to those used in a conventional cathode ray display tube, a storage mesh on which information is written by means of a writing gun. The information is then viewed on the phosphor screen by means of directing a large area flooding or viewing electron beam through the apertures in the storage grid mesh. The writing operation is performed in these tubes by a conventional type of electron gun. The gun is provided with electrostatic focusing and deflection. The electron gun is capable of forming a well-defined beam of high current density to provide good resolution at high writing speeds. In general, at least two writing guns are provided within the same envelope and it is customary to provide electrostatic deflection for the writing beams. The writing guns are normally positioned off the longitudinal axis of the tube and at a slight angle thereto. A viewing electron gun which provides a broad beam of electrons is normally located between the two write guns and located substantially on the longitudinal axis of the tube.

It has been found in this type of tube that nonuniformity in the deflection of the writing beam gun is a serious problem. This problem has been found to be primarily due to feedback of electrons from the flood or viewing gun section to the writing gun deflection plates.

Accordingly, the general object of this invention is to provide a new and improved storage tube in which the writing gun is substantially isolated from electron feedback from the viewing gun.

It is another object to provide an improved electron gun assembly for a storage tube.

It is another object to provide a new and improved electron gun assembly for use in a storage tube which is simple, rugged and inexpensive to manufacture.

Briefly, this invention accomplishes the above objects by providing an electron gun assembly including a structure or grid positioned in front of the writing gun to provide isolation, with suitable potential, of the deflection electrodes of the writing gun from feedback of electrons from the viewing gun to the deflection electrodes of the write gun.

Further objects and advantages of the invention will become apparent as the following description proceeds and features of novelty which characterize the invention will be pointed out in particularity in the claims annexed to and forming a part of this specification.

For a better understanding of the invention, reference may be had to the accompanying drawings, in which:

FIGURE 1 is a schematic showing, partially in section, of a cathode ray storage tube in accordance with the present invention;

FIGURE 2 is a sectional view taken along the line II—II of FIGURE 1;

FIGURE 3 is a sectional view taken along the line III—III of FIGURE 2.

Referring in detail to FIGURE 1, a direct view storage tube is illustrated and includes an evacuated envelope **10**. Positioned at one end of envelope **10** is a face plate **12** on which is deposited a layer **14** of phosphor material capable of emission of light in response to electron bombardment. Positioned adjacent to the phosphor screen **14**, there is provided a storage grid **20** which consists essentially of an electroformed mesh **22** of an electrically conductive material such as nickel with a coating **24** of a suitable dielectric such as magnesium oxide on the opposite side of the mesh **22** with respect to the phosphor screen **14**. A collector electrode **26** in the form of a mesh is disposed adjacent to the storage grid **20**. The tube base **16** is positioned at the opposite end of the envelope **10** with respect to face plate **12**. Lead-in members **18** for providing support and suitable voltages to the electrodes within the tube are provided through the tube base **16**. Mounted to the tube base **16** by means of the lead-in members **18** is the electron gun assembly **30** which consists of two writing guns **40** and a flood gun **60**. The two writing guns **40** are identical in design and are each capable of forming a well-defined beam having high current density with suitable focusing and acceleration so as to direct a pencil type electron beam onto the storage grid **20**. Each of the electron guns **40** consist of an indirectly heated cathode **42**, a control grid or first grid **44**, a first and second anode **46** and **49** which are the second and fourth grids and which are internally connected and a focusing grid **48** which is the third grid. Also included within the electron gun assembly are horizontal and vertical deflection plates **51**, **52**, **53** and **54** for deflecting the electron beam to scan a raster over the storage mesh **20** in response to suitable deflection voltages applied to the deflection plates. The electron guns **40** are formed into a unitary structure by providing stud members from the electrodes which are embedded in suitable insulating rods as is well-known in the art. The two write guns **40** are positioned off of the axis of the electron tube and directed to provide electron beams which converge substantially at the storage mesh **20**.

Positioned between the two write guns is a viewing gun **60** which consists of a cathode **62**, a control grid **64** and an accelerating grid assembly **65**. The portion of the accelerating grid structure **65** which performs the accelerating action for the viewing gun consists of a plate member **66** transverse to the longitudinal axis of the tube and having an aperture **77** therein. Spacer contact members **78** are provided on the outer periphery of the member **65** to position the electron gun assembly within the neck of the envelope **10** and in addition making electrical contact to a conductive coating **68** on the inner surface of the envelope. The conductive coating **68** is at the same potential as the member **66** and form together the second grid of the flood gun **60**. Another conductive coating **69** is provided on the inner wall of the envelope spaced from the coating **68** and between the coating **68** and the storage mesh **20** and may be referred to as the third grid of the flood gun and is also sometimes referred to as a collimating electrode.

Referring now in detail to FIGS. 2 and 3, the transverse plate **66** is a flat disc of a suitable material such as stainless steel having appropriate rectangular openings **70** and **72** to allow for the flow of electrons from the two write guns **40**. In addition, the centrally located aperture **77** provided in plate **66** provides focusing operation for the viewing gun **60**. The portion of the plate **66** surrounding the aperture **77** is positioned adjacent the apertured end of the grid electrode **64** of the viewing gun

60. Positioned to the rear of the plate 66 with respect to the viewing screen 14 is an electrode 79 of annular configuration having an outer diameter less than the outer diameter of the plate 66. The inner diameter of the member 79 is such as to provide clearance with respect to the outer diameter of the grid 64 of the viewing gun 60. The inner portion of the electrode 79 is a mesh 73. It is only necessary that the mesh portion 73 of the electrode 79 be of substantially the same area as the rectangular openings 70 and 72 in the plate 66 so that the outer edge of the mesh portion 73 does not interfere with the electron beams from the writing guns 40. The mesh 73 may be mounted directly to the annular member 79 by using a thin welding strip or a stamped part. Another possible method would be to mount the mesh 73 between two similar stamped parts and in turn weld the complete mesh assembly to the member 79. The member 79 is mounted to the back side of the plate 66 by ceramic separators 80. In the specific embodiment shown, there are four ceramic separators 80 positioned about the periphery of the electrodes. This type of spacer is more fully described in the copending application Serial No. 166,047, filed January 15, 1962, entitled, "Direct Viewing Storage Tubes Having Ceramic Spacers Between Collector Electrode and Storage Grid," by E. Ziemer et al. and assigned to the same assignee as this invention, and which is now U.S. Patent 3,160,773, granted December 8, 1964. The ceramic tab assembly includes ceramic blocks 81, preferably cylindrical in shape, the ends of which are provided with a metallic coating of a few thousandths of an inch of molybdenum manganese. This coating is applied by painting the surface of the ceramic blocks. The ceramic blocks 81 are porous so that the coating penetrates the block to provide a roughened surface which is interlocked with the interstices of the ceramic block. To these coatings on the opposite ends of the ceramic blocks, there is brazed tabs 82 of a suitable material such as a copper silver eutectic alloy. This type of tab constitutes a convenient means of attaching the two electrodes 66 and 79 by brazing or welding. The ceramic tab assemblies 80 may be assembled and then the two electrodes 66 and 79 and the ceramic tabs 80 assembled to provide the structure.

In addition, a plate 74 having an enlarged aperture 86 may be provided to the rear of the mesh member 69 at a distance of approximately .100 inch and provided with a flange 76 about its outer periphery such that the outer periphery is of substantially the same diameter as the plate member 66. The two members 66 and 74 may be physically and electrically connected together by means of three or four metal straps 67 of a suitable material such as stainless steel which are welded to the two electrodes 66 and 74. The straps 67 also provide electrical connection between the electrodes 66 and 74. The bulb spacers 78 may be secured to either one of the two plate members 66 or 74 and provide the function as previously pointed out.

In the operation of the device, the problem of feedback of electrons generated by the flood gun 60 onto the deflection plates 51, 52, 53 and 54 normally arises when an erase pulse is applied to the storage electrode 20. The result is that the low velocity electrons generated by the viewing gun 60 are returned back towards the electron gun assembly 30 and look for the most positive potential electrode. The collecting electrode 26 normally operates at a potential of 250 volts positive with respect to ground. The electrode 69 is at about 75 volts positive while electrodes 66, 68 and 79 are at a positive potential of about 100 volts. The deflection electrodes 51, 52, 53, and 54 are normally at the same potential as the electrodes 66, 68 and 79 which in this case is 100 volts. However, in the application of deflection signals to the deflection plates 51, 52, 53 and 54, one of the deflection plates may rise in potential to about 300 volts positive with respect to ground. This results in this deflection plate being the most positive electrode that the electrons can see and the electrons will be collected by the deflection plate. This in the prior art type of device modifies the deflection voltage applied to the deflection plates and results in non-uniformity of deflection.

By providing the structure as herein described in which the electrode 66 is at a potential of about 100 volts positive with respect to ground and with the mesh electrode 79 insulated from the electrode 66 and connected to the potential of the first grid 64 of the flood gun 60, normally from zero to negative 50 volts with respect to ground, the electrons are unable to see the high positive potential on the deflection plates 51, 52, 53 and 54 and will be collected by the electrode 66 which of course results in no operational disadvantage to the system. It is found that the mesh electrode 79 must be operated at a negative potential with respect to the electrode 66 to perform its function effectively. It is true that even a mesh operating at the same potential as 66 would intercept some of the electrons fed back to the deflection plates, but a much more effective reduction is provided by applying a negative voltage to the mesh electrode 79. It is found that the potential on electrode 79 has no detrimental effect on the writing gun electron beam. In addition, by providing a negative voltage on the mesh electrode 79 with respect to electrode 66, it is obvious that this permits the use of a high transmission mesh of about 90 percent and the writing beam current is not appreciably reduced as it passes through this mesh area. It is found in those tubes in which the mesh was not utilized that the magnitude of the feedback current to the deflection plate was about 20 microamperes. By utilization of the mesh electrodes, it is found that for all practical purposes the feedback current was completely eliminated.

The resulting structure while providing the essential electrical characteristics important in preventing the electron feedback to the deflection plates of the writing guns also provides a rugged assembly. The resulting construction of the assembly is simple to fabricate and reproduce.

While there have been shown and described what are at present considered to be the preferred embodiments of the invention, modifications thereto will readily occur to those skilled in the art. It is not desired, therefore, that the invention be limited to the specific arrangement shown and described and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

We claim as our invention:

1. A storage tube comprising an envelope and including a storage target therein, an electron gun assembly disposed at the opposite end of said envelope with respect to said storage target, said electron gun assembly comprising at least a write gun and a flood gun, said write gun including a plurality of deflection electrodes, a member transverse to the longitudinal axis of said tube and positioned between said electron guns and said storage target and mechanically assembled to said electron gun assembly, said transverse member including a first opening through which the electrons from said write gun are directed toward said storage target and a second opening smaller than said first opening centrally located in said transverse member through which the flood electron beam electrons leave said electron gun assembly and are directed onto said storage target, a mesh electrode provided between said second aperture in said transverse member and the deflection plates of said write gun to prevent electrons from said flood gun being collected on said deflection plates.

2. A storage display device comprising an envelope and including therein a storage target, an electrode assembly including at least a writing electron gun and a viewing electron gun positioned at the opposite end of the envelope with respect to said storage target, said writing electron gun including a plurality of deflection plates, said electrode assembly secured to the base of said envelope at one end and positioned within said envelope

by means of spacer members provided at the other end of said electrode systems and on the periphery of a transverse member of said electrode system, said transverse member including a first aperture through which the writing electron beam is directed onto said storage target, said transverse member also including a second aperture through which said viewing electron beam is directed onto said target, a conductive mesh electrode within said electrode assembly positioned between the deflection electrodes of said writing electron gun and said storage target to prevent collection of electrons from said viewing electron gun on the deflection plates of said writing electron gun.

3. A storage display tube comprising an envelope, a phosphor display screen provided at one end of said envelope, a storage mesh positioned adjacent to said phosphor display screen, an electron gun assembly provided at the opposite end of said envelope with respect to said display screen and including at least a writing electron gun having vertical and horizontal deflection plates and a flood gun, a transverse mesh provided within said electron gun assembly between said deflection plates of said writing electron gun and said display screen, said transverse mesh operating at a negative potential with respect to said deflection plates of said writing electron gun to prevent collection of electrons from said flooding gun on said deflection plates.

4. A storage display tube comprising an envelope, a phosphor display screen provided at one end of said envelope, a storage mesh positioned adjacent to said phosphor display screen, an electron gun assembly provided at the opposite end of said envelope with respect to said storage mesh and including at least a writing electron gun having vertical and horizontal deflection plates, a transverse diaphragm provided at the end of said electron gun assembly and between the deflection plates of said writing electron gun and said display screen, said transverse diaphragm having a large aperture to provide passage of electrons from said writing gun to said storage mesh, a viewing electron gun centrally disposed within

said electron gun assembly with a small aperture provided in said transverse diaphragm for focusing the electrons emitted from said viewing gun, said transverse diaphragm operating at a positive potential with respect to the cathode of said viewing gun, a mesh electrode positioned between said transverse member and the deflection plates of said writing electron gun and insulated therefrom and operating at a negative potential with respect to the deflection plates of said writing electron gun and said transverse diaphragm.

5. A direct viewing storage tube comprising an envelope, a storage screen, a phosphor display screen and an electron gun assembly including a plurality of electron guns disposed at the opposite end of said envelope with respect to said display screen, said electron gun assembly comprising at least a high velocity electron gun and a low velocity electron gun, said high velocity gun including deflection electrodes, a transverse member positioned between said electron guns and said display screen and mechanically assembled to said electron gun assembly, said transverse diaphragm including a large opening through which high velocity electrons from said high velocity gun are directed onto said screen and a small opening through which the low velocity electron from said low velocity gun leave such assembly and are directed onto said storage screen, a mesh electrode provided between said large aperture of said transverse diaphragm and the deflection electrodes of said high velocity gun and operating at a negative potential with respect to the potential applied to said transverse diaphragm to prevent low velocity electrons from being collected on said deflection electrodes.

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