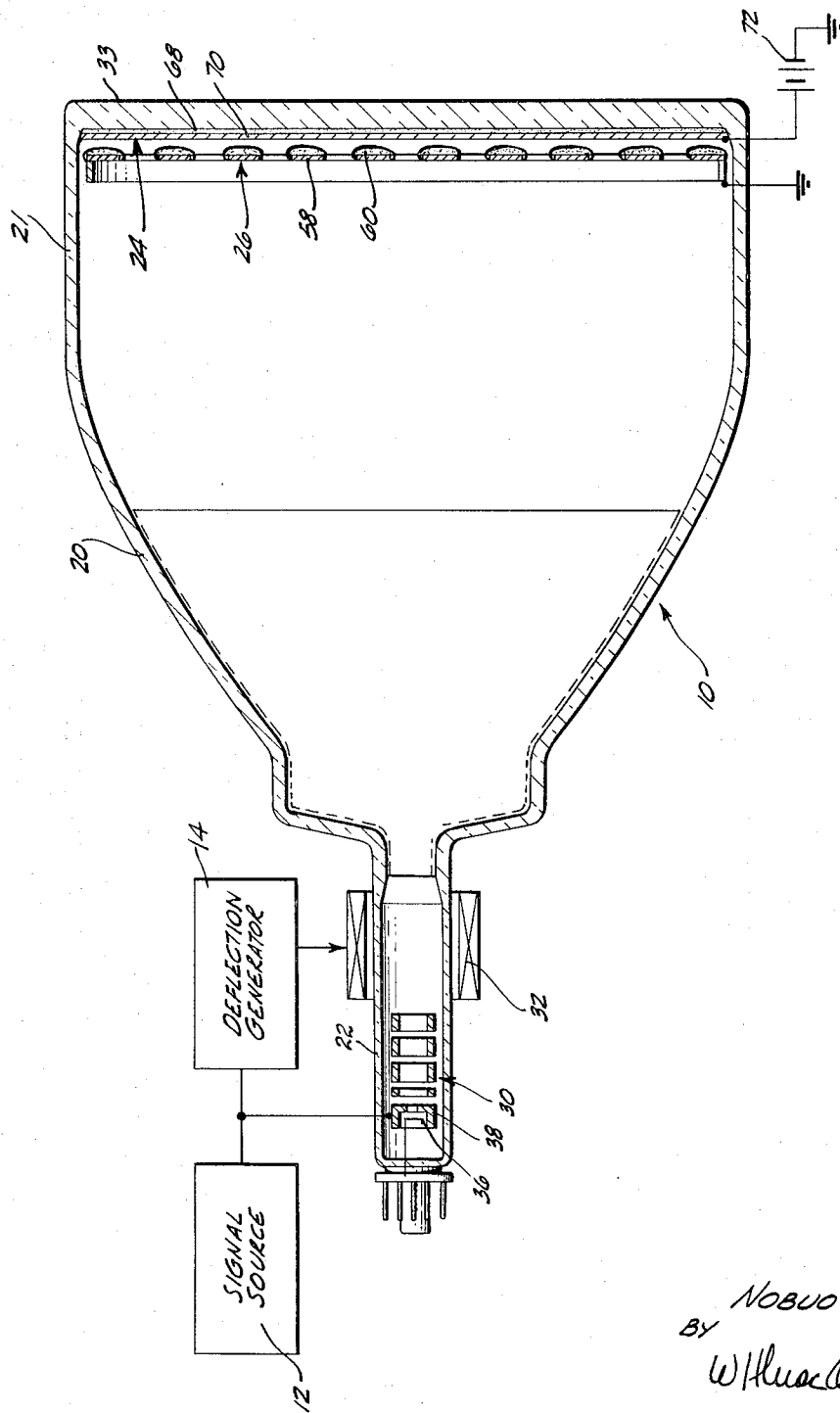


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SINGLE GUN STORAGE TUBE WITH TARGET EMISSION
SUSTAINED BY ELECTRIC FIELD
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**SINGLE GUN STORAGE TUBE WITH TARGET
EMISSION SUSTAINED BY ELECTRIC FIELD****Nobuo J. Koda, Vista, Calif., assignor to Hughes Aircraft
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4 Claims. (Cl. 315—12)**

This invention relates to electronic storage devices and more particularly to a direct-viewing storage tube capable of visually presenting information for extended periods of time.

Direct-viewing storage cathode ray tubes are known which operate by creating an electrostatic charge pattern on a storage grid or target and utilizing this charge pattern to control the passage of electrons through the storage target to a conventional phosphor viewing screen. Such a tube, for example, is described in U.S. Patent 2,790,929 to E. E. Herman and G. F. Smith for producing half-tone displays. The direct-viewing storage tube of the present invention may be used to present displays in black or white tones or in half-tones as desired. Previously, such direct-viewing storage tubes comprised a target assembly which included a storage target and a viewing screen. The storage target usually included a metallic support screen or mesh having a dielectric coating on one surface thereof, the target being disposed adjacent a conventional phosphor viewing screen and between this viewing screen and the electron gun means for producing electrons. The storage dielectric coating may be constituted by secondary emissive material as described in the aforementioned patent to Herman et al. Two electron guns are usually provided; one gun (hereinafter called the "writing" gun) causes the formation of an electrostatic charge pattern on the storage target corresponding to the information to be presented; the other gun (hereinafter called the "flood" gun or "viewing" gun) renders this charge pattern visible on the viewing screen. This procedure may be briefly described by assuming that the storage target is initially charged uniformly negative with respect to the flood gun. When the storage target dielectric coating is scanned by the writing beam in accordance with information-representative signals, a less negative potential is produced at the point of impingement by the phenomenon of secondary emission. Thus, by scanning the storage target an overall charge pattern corresponding to the information to be presented is obtained. Thereafter, this charge pattern controls the passage of flood electrons from the flood gun through the storage target to the viewing screen; the flood electrons, properly collimated over the active area of the storage target, can only pass through areas of the storage target which are less negatively charged. Thus, the flood electrons impinge upon the viewing screen in a pattern corresponding to the charge pattern on the storage target and excite areas of the viewing screen to luminesce in accordance with this pattern.

All previous direct-viewing storage tubes have included a viewing screen, a storage target, a "writing" electron gun, and a "flood" electron gun as absolutely minimum essential structures. For completely satisfactory operation the direct-viewing storage tubes of the prior art have also required a collector electrode for collecting secondarily emitted electrons from the storage target as well as a collimating lens system for the flood electron beam.

It is an object of the present invention to provide an improved direct-viewing storage tube.

Another object of the invention is to provide an improved direct-viewing storage tube of simpler construction and with fewer components.

Another object of the invention is to provide an im-

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proved direct-viewing storage tube of simpler construction and operation which does not require a flood electron beam nor a collector electrode.

Yet another object of the invention is to provide an improved direct-viewing storage tube having fewer components within the tube yet capable of providing indefinite storage and bright displays.

These and other objects and advantages of the invention are realized by providing an electron-emitting "storage" target which is triggered by a scanning writing beam into emitting viewing electrons continuously. Once triggered into emission by the writing beam the "viewing" electrons are accelerated toward the viewing screen by means of a high voltage on the viewing screen which is spaced from the electron emitting "storage" target so as to maintain an electric field gradient across the electron emissive layer of the electron emitting "storage" target which faces the viewing screen. While this gradient will not initiate electron emission from the electron emitting "storage" target, it will sustain such emission once it is triggered by the scanning writing beam even after the writing beam signal has terminated. Thus, local areas of the electron emitting "storage" target upon which the writing beam impinges will continuously emit electrons and cause the phosphor viewing screen to luminesce. Erasure, which means cessation of viewing electron emission, may be achieved by reducing the viewing screen potential until electron emission cannot be sustained.

The invention will be described in greater detail by reference to the drawings in which the sole figure is a schematic view of a direct-viewing storage tube according to the invention.

Referring now to the drawings, a direct-viewing storage tube 10 is shown which comprises an evacuated envelope 20 having an enlarged cylindrical portion 21 and a neck portion 22. The end portion 33 of the cylindrical portion 21 is generally flat and transparent. Disposed adjacent the flat end portion 33 is the target assembly according to the present invention comprising a viewing screen or target member 24, and electron emitting screen or target member 26. An electron gun 30, hereinafter called the "writing" gun, is disposed in the neck portion 22 of the envelope 20. Disposed around the outside of the neck portion and adjacent the electron gun 30 is an electromagnetic deflection system 32 for directing the electron beam produced by the writing gun 30 over selected elemental areas on the storage screen 26. The electron beam produced by the writing gun is of elemental cross-sectional area.

More particularly, the writing electron gun 30 includes a cathode 36 and a grid 38 which controls the intensity of the writing electron beam in accordance with signals supplied thereto by a connection from the signal source 12. Illustratively, the cathode 36 may be maintained at a potential of about several thousand volts negative with respect to ground. An adjustable quiescent potential of about 50 volts negative, for example, with respect to the cathode potential may be maintained on the intensity grid 38.

By means of appropriate connections, horizontal and vertical deflection potentials may be applied to the electromagnetic deflection system 32. These deflection potentials may be developed by a deflection generator 14 in synchronism with signals through a connection to the signal source 12.

The viewing screen or viewing target member 24 of the target assembly comprises a phosphor coating 68 disposed on the inner surface of the flat transparent end portion 33 of the envelope 20. An electron transparent conductive coating or film 70 may be then disposed over the phosphor coating 68. The conductive coating 70 may be a thin film of aluminum, for example. The conductive

coating or electrode member 70 may be maintained at a potential of from 1 to 3 kv. by means of a connection to the positive terminal of a battery 72 whose negative terminal is connected to ground.

The electron emitting target member 26 comprises an electroformed nickel screen 58, having, for example, about 250 meshes per inch and a thickness of the order of about 0.001". The outer periphery of the screen is welded to a support ring 74. On the surface of the screen which faces the viewing screen 24 is provided a coating 60 of electron emissive material such as magnesium oxide, for example. This emissive layer 60 may overhang or extend over the interstices of the nickel screen 58. The thickness of this electron emissive layer 60 is preferably about 35 microns. The magnesium oxide layer may be formed according to the following procedure. Approximately equal proportions by weight of magnesium carbonate and magnesium peroxide are mixed and then ground as in a ball mill until the average particle size is approximately one micron. During ball milling the mixture may be suspended in amyl acetate, for example. Thereafter the mixture is sprayed on to the nickel screen until a porous fluffy coating having a thickness of approximately 35 microns is obtained. To help in the spraying a binder such as nitro-cellulose may be used according to well known procedures in the powder spraying art. It may also be desirable to oxidize the nickel screen prior to spraying in order to avoid flaking and peeling of the dielectric coating applied. Suitable oxidization may be achieved by heating the screen to a dull red heat in air until the bright nickel finish disappears and becomes dull gray.

After the porous fluffy coating has been applied to the nickel screen, the assembly is mounted in a vacuum system and after outgassing, dry air is admitted to a pressure of about 1/4 atmosphere. The coated assembly is then heated to a temperature of about 800° for five minutes. It may be preferable to perform this last step in the cathode ray tube envelope itself in which case after the baking procedure has been accomplished, the target assembly is allowed to cool and the cathode ray tube is pumped down to a good vacuum and then sealed off.

The electron emitting screen 26 is disposed adjacent the viewing screen 24 and is coextensive therewith and may be positioned at approximately 0.1" away from the viewing screen, for example. The conductive mesh or electrode member 58 may be connected to ground as shown. Due to the potential of from 1 to 3 kv. on the viewing plate about 0.1" away, an electric field gradient of approximately 100 to 200 volts is provided across the magnesium oxide coating 60 and will sustain electron emission from the emissive layer 60 after this emissive layer has been triggered into electron emission. Such triggering is provided according to the present invention by scanning the electron emitting target 26 with the writing beam from electron gun 30.

In operation, upon the application of appropriate signals to the writing electron gun 30 and its associated deflection system 32, the electron beam formed by the electron gun 30 is intensity modulated and caused to strike the conductive screen 58 with such energy that the adjacent areas of the emissive layer 60 thereof are triggered into electron emission. These areas will continue to emit electrons for as long as desired. Due to the high potential of the viewing screen, the emitted electrons are accelerated thereto and eventually impinge upon the phosphor layer resulting in the luminescence of areas thereof in accordance with the emitting areas of the electron emitting target 26. By this means, a high resolution, bright display is obtained with indefinite storage time. Erasure may be accomplished by reducing the viewing screen potential until electron emission from the electron emitting target cannot be sustained and fails.

What is claimed is:

1. An electronic storage display device comprising: an

evacuated container; a target member in said container having an electrically conductive surface and an opposite surface thereto on which is disposed a layer of electron emissive material; a viewing target disposed in said container coextensive with said target member and adapted to luminesce in response to the impingement thereon of electrons emitted from said layer of electron emissive material, said viewing target being disposed adjacent the surface of said target member on which said layer of electron emissive material is disposed; means for forming an electron beam and for scanning said conductive surface of said target member to trigger the emission of electrons only from areas of said layer of electron emissive material opposite areas of said conductive surface impinged by said scanning electron beam; and means for establishing an electric field across said layer of electron emissive material to sustain said triggered electron emission therefrom.

2. An electronic storage display device comprising: an evacuated container; a target member in said container including a first electrode member on the opposite surface of which is disposed a layer of electron emissive material; a viewing target disposed in said container coextensive with said target member and including a phosphor layer adapted to luminesce in response to the impingement thereon of electrons emitted from said layer of electron emissive material; said viewing target being adjacent and facing the surface of said target member on which said layer of electron emissive material is disposed; a second electrode member disposed in said container between said target member and said viewing target; means for forming an electron beam and for scanning said first electrode member of said target member to trigger the emission of electrons only from areas of said layer of electron emissive material opposite areas of said first electrode member impinged by said electron beam; and means including said first and second electrode members for establishing an electric field across said layer of electron emissive material to sustain said triggered electron emission therefrom.

3. The invention according to claim 2 wherein said electron emissive material consists essentially of magnesium oxide.

4. An electron storage display device comprising: an evacuated container; a target member disposed in said container comprising an electrically conductive foraminous member on one surface of which is disposed a layer of electron emission material; a viewing target disposed in said container coextensive with said target structure and including a phosphor layer adapted to luminesce in response to the impingement thereon of electrons emitted from said electron emissive layer, said viewing target facing the surface of said target member on which said electron emissive material is disposed; an electron transparent electrode member disposed in said container on said phosphor layer; means for forming an electron beam and for scanning said foraminous member on the surface thereof opposite to said surface on which said layer of electron emissive material is disposed to trigger the emission of electrons only from areas of said electron emissive layer opposite areas of said foraminous member impinged by said electron beam; and means including said foraminous member and said electron transparent electrode member for establishing an electric field across said electron emissive layer to sustain said triggered electron emission therefrom.

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