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STORAGE SCREEN FOR DIRECT-VIEWING STORAGE TUBE

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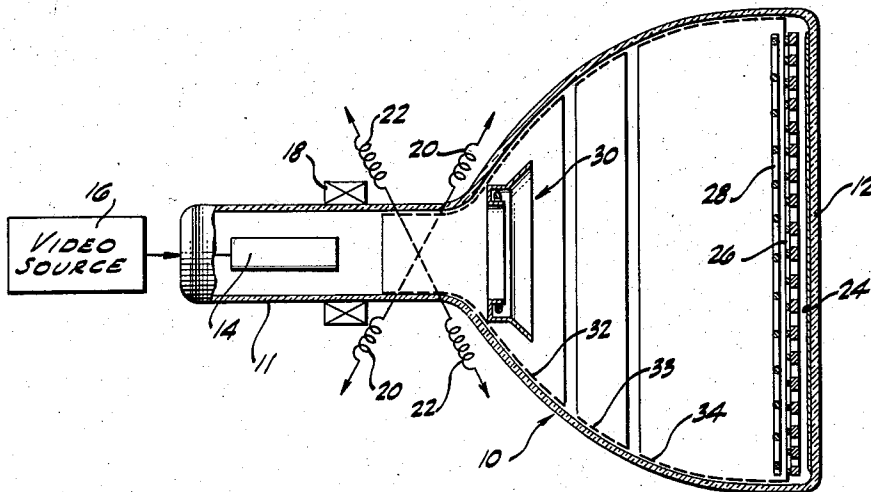


FIG. 2.

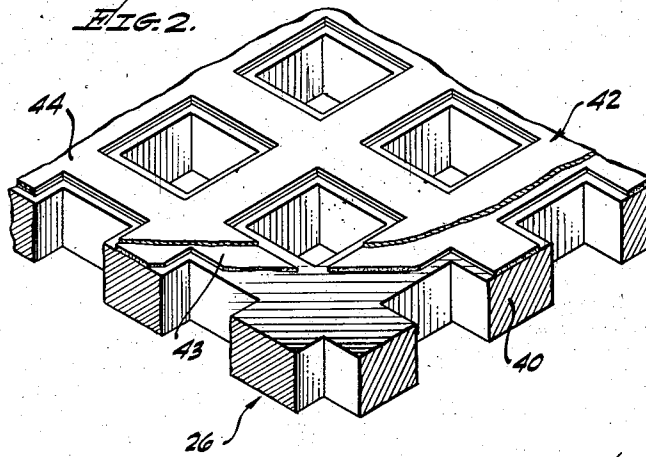


FIG. 1.

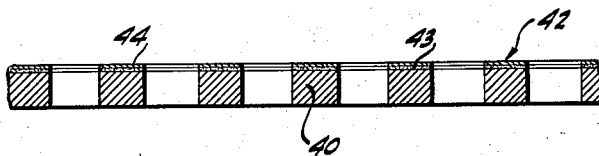


FIG. 3.

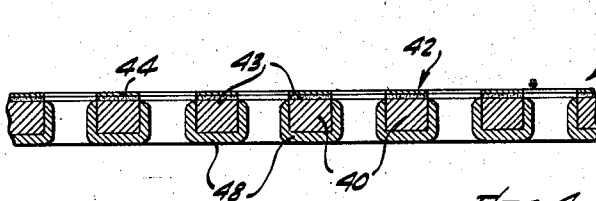


FIG. 4.

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STORAGE SCREEN FOR DIRECT-VIEWING STORAGE TUBE

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Application October 27, 1955, Serial No. 543,185

7 Claims. (Cl. 313—68)

This invention relates to direct-viewing storage tubes and particularly to a storage screen for use in this type of tube that has a storage surface on which substantially higher writing speeds may be effected.

In the operation of a direct-viewing storage tube, an electron beam of elemental cross-sectional area is modulated with an image signal and scanned over a storage screen to produce a corresponding charge replica. The charge replica thus produced is employed to control the flow of flood electrons to a viewing screen to produce a visual presentation of the charge replica. It is thus apparent that the scope of the applications of direct-viewing storage tubes is dependent on the rapidity with which charge replicas can be produced, i.e. on the writing speed capable of being attained. Writing speed is, in turn, a function of the rate at which voltage can be built up on the storage surface. With reference to the storage screen, this depends upon the secondary electron emission ratio of the storage surface and upon the capacitance of the surface to the metallic screen upon which the insulating layer which provides the storage surface, is disposed. Thus in order to have a high writing speed, it is desirable that the storage surface have both a high secondary electron emission ratio and low capacitance to its metallic support screen.

The capacitance of the surface can be decreased by increasing the thickness of the insulating layer. In the present case, however, magnesium fluoride is used to provide the storage surface in that it has a high secondary electron emission ratio. Magnesium fluoride, however, cannot be evaporated on a screen to thicknesses of more than 2 to 3 microns because thicker layers will "craze" or spall off. Other insulators of comparable dielectric constant can be deposited to thicknesses of many microns without this trouble. It is generally known, however, that secondary electron emission properties depend only upon the surface layer to a depth of less than one micron at ordinary bombarding voltages.

Therefore, in accordance with the present invention, a storage screen with a storage surface having a high secondary electron emission ratio and low capacitance is provided by building up the thickness of the insulating layer with a dielectric material which will not craze or spall off, and then covering the surface of this dielectric material with a surface layer of magnesium fluoride which is thin enough to prevent the crazing.

It is therefore an object of this invention to provide an improved storage screen of uniform characteristics.

Another object of this invention is to provide a storage screen with a storage surface having an optimum secondary electron emission ratio and low capacitance to its metallic support screen.

Still another object of this invention is to provide a storage screen with a storage surface on which increased writing speeds may be effected.

The novel features which are believed to be characteristic of the invention, both as to its organization and method of operation, together with further objects and

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advantages thereof, will be better understood from the following description considered in connection with the accompanying drawings in which an embodiment of the invention is illustrated by way of example. It is to be expressly understood, however, that the drawings are for the purpose of illustration and description only, and are not intended as a definition of the limits of the invention.

Fig. 1 is a schematic cross-sectional view of a direct-viewing storage tube incorporating an embodiment of the storage screen of the present invention;

Fig. 2 is a cut-a-way view of the disclosed storage screen in perspective;

Fig. 3 is a cross-sectional view of the disclosed storage screen when only partially completed; and

Fig. 4 is a cross-sectional view of the storage screen of the invention when completed.

Referring to Fig. 1, there is shown a direct-viewing half-tone storage tube of the type which is more fully described in copending application for patent Serial No. 459,403, entitled Half-Tone Direct-Viewing Storage Tube, filed September 30, 1954, by George Smith and Elvin Herman and assigned to the assignee of the present application. For a better understanding of the invention, an embodiment of the storage screen of the invention is described that is particularly adapted for operation in the type of direct-viewing storage tube disclosed in the above copending application for patent. This type of direct-viewing storage tube comprises an evacuated bulbous envelope 10 having a neck portion 11 and a flat end portion 12 at opposite extremities. The neck portion 11 of envelope 10 houses an electron gun 14 which is coupled to a video signal source 16 for producing an electron beam that is modulated in accordance with the video signal. This modulated electron beam is focused by means of a focusing coil 18 and deflected by means of pairs of deflecting coils 20, 22. Commencing from the inner surface of the flat end portion 12 of envelope 10 and proceeding towards the gun 14, a viewing screen 24, a storage screen 26 of the present invention, and a collector grid 28 are disposed in the order named. Last, a flood gun 30 is disposed about the path of the electron beam adjacent the neck portion 11 which, in conjunction with electrodes 32, 33 and 34 disposed concentrically about the inner surface of envelope 10 intermediate gun 14 and the end portion 12, is capable of directing flood electrons uniformly over the entire area of the storage screen 26. In operation, the modulated electron beam is scanned over the storage screen 26 by means of the deflecting coils 20, 22 to produce a charge replica of the video signal on its storage surface. This charge replica then controls the flow of flood electrons from the flood gun 30 to the viewing screen 24 to produce a visual presentation of the charge replica.

An enlarged cut-a-way portion of the storage screen 26 of the present invention adapted for operation in the above direct-viewing storage tube is illustrated in Fig. 2. The screen 26 illustrated in the drawing is of the same type shown and described in a copending application for patent, Serial No. 519,384, entitled, Storage Screen for Direct-Viewing Storage Tube, filed July 1, 1955, now U.S. Patent No. 2,858,463, by Nobuo John Koda and Sidney T. Smith and assigned to the same assignee as is the present application. The screen 26 comprises an electroformed nickel layer 40 having a light transparency of the order of 30% and from 100 to 400 meshes per inch, depending on the size of the tube and the resolution desired. An insulating layer 42 is disposed along the central portion of the meshes on one side of the nickel screen 40. The insulating layer 42 has a thickness of the order of from 5 to 10 microns and is composed of an intermediate layer 43 of dielectric material in contact with the screen 40 and a surface layer 44 of magnesium

fluoride. The particular dielectric material employed for the intermediate layer 43 may be of two types. First, it may be of a material which has thermal expansion properties which match that of the nickel screen 40 such as, for example, glass, SiO_2 , fused quartz, etc. Secondly, it may be a substance that is sufficiently soft such as, for example, ZnS, so as to yield to thermal stresses between the nickel screen 40 and the surface layer 44 of magnesium fluoride rather than break. In either event the dielectric constant of layer 43 should be kept to a minimum so as to have minimum capacitance from the storage surface to the screen 40 for the particular thickness employed. The layer 44 of magnesium fluoride is disposed on top of the intermediate layer 43 so as to achieve optimum secondary electron emission characteristics. A thickness of from one to three microns is desirable in order to provide these characteristics and is still sufficiently thin so as to prevent the aforementioned crazing or spalling.

In the operation of the above-mentioned direct-viewing storage tube, it is necessary that the meshes of the nickel screen 40 be only partially covered by the insulating layer 42. In addition, it is desirable that the storage screen have uniform characteristics over its entire area. A storage screen of this type may be realized by having the insulating layer 42 symmetrically disposed about each interstice of the metallic screen 40. One manner in which a storage screen of this type may be fabricated is to commence with a metallic screen 40 which has meshes equal in width to those of the insulating layer 42, as illustrated in Fig. 3. The intermediate layer 43 may then be provided by evaporating approximately 1.1 grams of zinc sulfide on one side of the meshes of the metallic screen 40 from a distance of approximately 8 inches. The surface layer 44 is then provided by evaporating 1.2 grams of magnesium fluoride on top of the intermediate layer 43 from an equal distance. The screen 26 is then electroplated with a layer 48 of metal to increase the width of the meshes, as shown in Fig. 4.

Although a specific embodiment of the storage screen of the present invention has been shown and described, it is evident that numerous other modifications fall within the spirit and scope of this invention.

What is claimed is:

1. In an electronic storage tube, a target element comprising a conductive member for providing a support surface, an intermediate layer of insulative material of uniform thickness disposed over at least a portion of said support surface, and a surface layer of magnesium fluoride of uniform thickness disposed only over said intermediate layer.

2. In an electronic storage tube, the target element as defined in claim 1 wherein the thickness of said surface layer of magnesium fluoride is greater than one and less than three microns.

3. In an electronic storage tube, the target element as defined in claim 1 wherein said intermediate layer of insulative material is composed of a soft substance that will yield to thermal stresses between said conductive member and said surface layer of magnesium fluoride.

4. In an electronic storage tube, the target element as defined in claim 1 wherein the thermal expansion characteristics of said intermediate layer of insulative material substantially match the thermal expansion characteristics of said conductive member.

5. In a direct-viewing electronic storage tube, a storage screen assembly comprising a metallic screen, an intermediate layer of insulative material disposed over the meshes of said metallic screen on one side thereof, said intermediate layer being of a uniform thickness of from two to ten microns, and a surface layer of magnesium fluoride disposed only over said intermediate layer, said surface layer having a uniform thickness of from one to three microns.

6. In a direct-viewing electronic storage tube, the storage screen assembly as defined in claim 5 wherein said insulative material is zinc sulfide.

7. In a direct-viewing electronic storage tube including means for producing an electron beam of elemental cross-sectional area, a storage screen assembly comprising an electroformed nickel screen having from 100 to 400 meshes per inch, said electron beam being adapted to be scanned over said storage screen assembly, an intermediate layer of zinc sulfide disposed over at least a portion of the meshes of said nickel screen on one side thereof, said intermediate layer being of a uniform thickness and covering substantially equal portions of the meshes of said nickel screen within each elemental area thereof equivalent to the spot size of the electron beam thereon, and a surface layer of magnesium fluoride disposed only over said intermediate layer, said surface layer having a uniform thickness of from one to three microns.

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