# United States Patent [19]

**Balint et al.**

[11] **3,772,553**

[45] **Nov. 13, 1973**


[54] **SECONDARY EMISSION STRUCTURE**


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[22] Filed: **June 19, 1972**

[21] Appl. No.: **263,834**

**Related U.S. Application Data**

[63] Continuation of Ser. No. 75,809, Sept. 28, 1970, abandoned.

[52] **U.S. Cl.** ..... **313/68 R**

[51] **Int. Cl.** ..... **H01j 31/18**

[58] **Field of Search** ..... 313/68 R US



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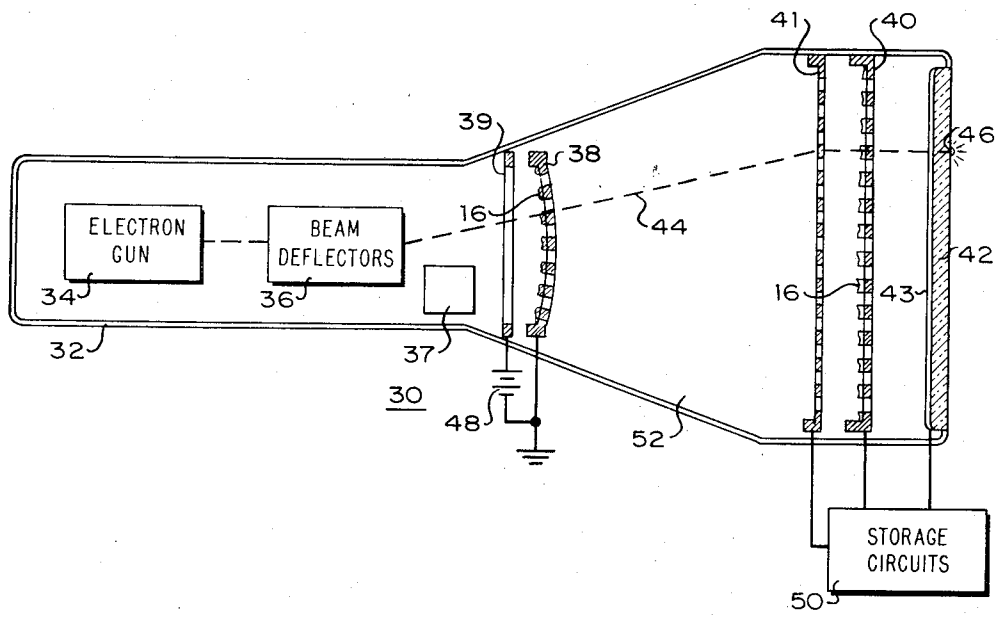
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[57] **ABSTRACT**

A grid is coated with a dielectric material which has good secondary emission characteristics and the coated grid is mounted in a cathode ray tube along with a collector electrode. The secondary emission structure is used as an expansion lens or a storage mesh in a storage type cathode ray tube.


**3 Claims, 2 Drawing Figures**



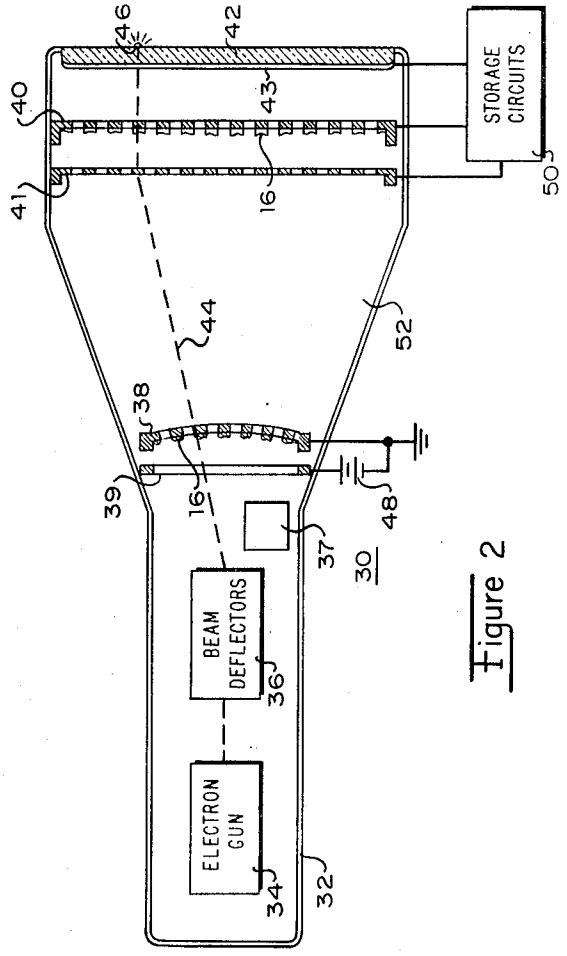



Figure 2

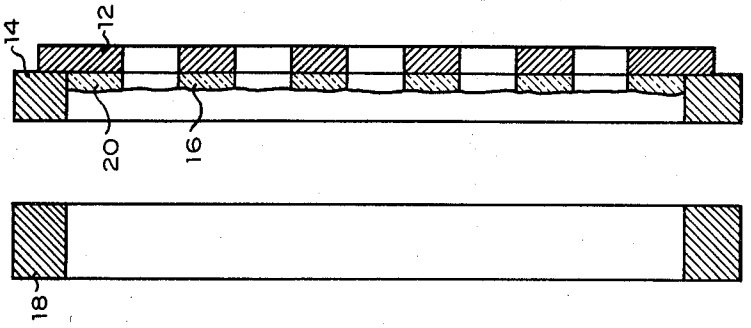



Figure 1

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# SECONDARY EMISSION STRUCTURE

This is a continuation of U.S. Pat. application Ser. No. 75,809, filed Sept. 28, 1970 now abandoned.

## BACKGROUND OF THE INVENTION

The expansion lens in a cathode ray tube (CRT) is usually a metal grid at the electron gun end of the post accelerator region. When the high energy electron beam from the electron gun passes through the expansion lens grid, secondary electrons are often knocked off. These electrons are pulled along with the electron beam and they form a halo or second spot on the CRT display screen near the trace made by the electron beam from the electron gun. In the prior art, the usual solution to this problem was to select a grid material with low secondary emission characteristics. (See *Handbook of Materials & Techniques for Vacuum Devices*, Walter H. Kohl, Reinhold Publishing Company, New York, 1967.)

The storage mesh in a storage or variable persistence type CRT is grid coated on one side with a material optimized for its secondary emission characteristics. Materials commonly used for such a coating include magnesium fluoride, zinc sulfide, and magnesium oxide. A major problem with such coatings is that they dissociate under continued exposure to the high energy electron beam. The result of this dissociation is a bright or "burned" spot on the display screen of the CRT.

## SUMMARY OF THE INVENTION

If the expansion lens grid is coated on the electron gun side with a dielectric coating which emits secondary electrons and a collector electrode is placed between the electron gun and the grid, then the "halo" effect can be eliminated. The electron beam will knock secondary electrons off the coating on the grid, and there will then be a net positive charge at that location. The secondary electrons will be captured either by the collector electrode or the positively charged areas on the expansion lens, and they will not pass through the expansion lens into the post accelerator region. Thus there will be no "halo" because substantially no secondary electrons reach the display screen.

It has been found that the burning of a storage mesh in a storage or variable persistence CRT occurs because the dielectric coating is dissociated by the electron beam if the dielectric coating lattice energy is less than the energy of the electron beam. The lattice energy of the dielectric coating is determined by the refined Kapustinsky method. It has consequently been found that if the lattice energy of the coating is greater than 1,000 kilocalories per mole (kcal/mole), the energy in electron beams used in CRT's is not enough to cause the material to dissociate. Thorium oxide and hafnium dioxide, for example, are dielectrics with lattice energies higher than 1,000 kcal/mole and such materials are suitable for use on expansion lenses and storage meshes.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

A secondary emission structure **10** shown in FIG. **1** comprises a grid **12** supported by a support **14** with a dielectric coating **16** on one surface **20** of grid **12.** A collector electrode **18** is adjacent to and spaced apart from surface **20** of grid **12.** Collector electrode **18** may take different shapes, depending upon the application of secondary emission structure **10.** In FIG. **1** collector electrode **18** is shown as a metal annulus, though it can also be a grid.



A cathode ray tube **30** shown in FIG. **2** comprises a glass envelope **32,** an electron gun **34,** beam deflectors **36,** a flood gun **37,** an expansion lens **38,** a storage mesh **40,** and a display screen **42.** An electron beam **44** is shown emanating from electron gun **34,** passing through beam deflectors **36,** and expansion lens **38** and impinging on storage mesh **40** and display screen **42,** forming a trace **46** on display screen **42.** A collector ring **39** is disposed on the electron gun side of expansion lens **38** and is maintained at a positive potential of approximately **50** volts with respect to expansion lens **38** by battery **48.** A collector mesh **41** is disposed on the electron gun side of storage mesh **40.** Display screen **42** has a transparent conductive coating **43,** and coating **43,** storage mesh **40** and collector mesh **41** are connected to storage circuits **50** which control the potentials on elements **40, 41,** and **43.**

When electron beam **44** passes through expansion lens **38,** secondary electrons may be knocked off dielectric coating **16.** Since dielectric coating **16** is only on the electron gun side of expansion lens **38,** the secondary electrons will scatter toward collector ring **39** and most secondary electrons will be captured by collector ring **39.** The portion of dielectric coating **16** struck by electron beam **44** will be charged positive and will recapture substantially all secondary electrons not captured by collector ring **39.** Since substantially no secondary electrons are carried along with electron beam **44,** no "halo" effect will appear on display screen **42** near trace **46.**

When electron beam **44** passes through storage mesh **40,** it will knock off some secondary electrons which will be collected by collector mesh **41.** A net positive charge will remain on storage mesh **40** where the secondary electrons were knocked off. This charge pattern constitutes a stored trace. Flood gun **37** emits a flood of low energy electrons toward storage mesh **40** and the electrons will pass through the mesh only at those points which have a net positive charge; the remainder of the storage mesh has a net negative charge which will repel the flood electrons. The flood electrons which pass through storage mesh **40** make a trace on display screen **42** which duplicates the stored trace on storage mesh **40.** If electron beam **44** remains directed at one spot on storage mesh **40** for more than 5 or 10 minutes, enough of the beam energy will usually be transferred to dielectric coating **16** to cause some of the dielectric material to dissociate, if the lattice energy of the material is lower than the energy of electron beam **44.** With presently used materials such as magnesium fluoride, magnesium oxide and zinc sulfide, the lattice energy is less than commonly used electron beam energies. Dissociation of the dielectric material causes "burned" spots on storage mesh **40** which will no longer store a negative charge. These spots allow flood electrons to pass through, causing bright spots on display screen **42.** If materials such as hafnium dioxide or thorium oxide are used as dielectric coating **16,** there will be no "burn" effect since the lattice energies of these materials are 2,740 kcal/mole and 2,510 kcal/mole respectively, and CRT electron beam energies are well below that level. Such dielectric materials with lattice energies above 1,000 kcal/mole are appropriate for use on expansion lens **38** as well as storage mesh **40,**

since the dielectric coating **16** on expansion lens **38** should not dissociate when exposed to the electron beam.

In practice, a CRT may have an expansion lens and a storage mesh, or it may only have one; and CRT **30** in FIG. **2** includes both only for illustrative purposes.

We claim:

**1.** In a cathode ray tube including an electron gun disposed at one end of the tube for emitting an electron beam, a display screen disposed at an opposite end of the tube for receiving the electron beam, electron deflectors for deflecting the electron beam disposed adjacent the electron gun, and a post accelerator region between the electron deflectors and the display screen, an expansion lens disposed adjacent the electron deflectors at the incident end of the post accelerator region comprising:

a grid having a surface facing the electron gun;

a dielectric coating on said surface for enhancing secondary electron emission from said surface in response to the electron beam impinging thereon, said impingement forming charged areas on the dielectric coating; and

a collector electrode disposed adjacent to and insulated from said surface for collecting secondary electrons,

whereby secondary electrons from said surface are kept from being carried along with the electron beam by being collected by the collector electrode and by the charged areas on the dielectric coating.

**2.** A cathode ray tube as in claim **1** wherein the dielectric coating has a unit lattice energy greater than the equivalent unit energy of the electron beam.

**3.** A cathode ray tube as in claim **2** wherein the dielectric coating has a lattice energy greater than 1,000 kcal/mole.

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