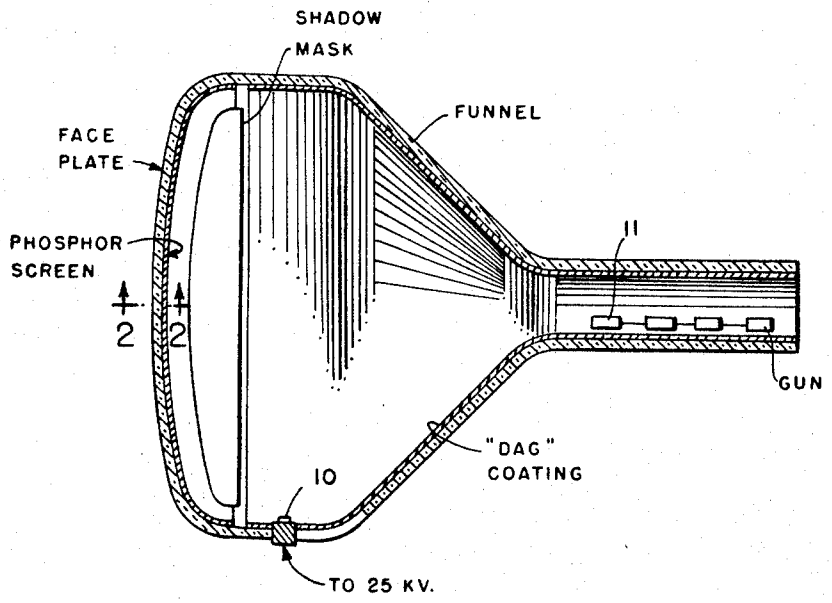
July 9, 1968 J. W. SCHWARTZ 3,392,297

COLOR TRIAD TUBE HAVING HEAT-ABSORPTIVE MATERIAL ON ALUMINUM SCREEN BACKING FOR COOLING SHADOW MASK

Filed Dec. 21, 1966

FIG. 1



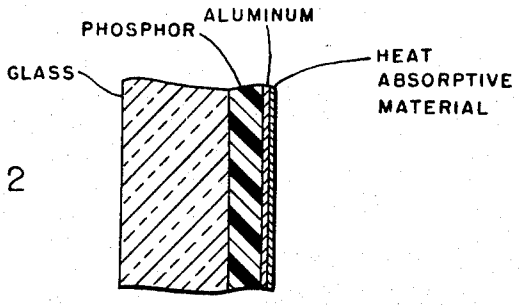


FIG. 2

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United States Patent Office 3,392,297 Patented July 9, 1968

3,392,297

COLOR TRIAD TUBE HAVING HEAT-ABSORPTIVE MATERIAL ON ALUMINUM SCREEN BACKING FOR COOLING SHADOW MASK

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Filed Dec. 21, 1966, Ser. No. 603,607
3 Claims. (Cl. 313—92)

ABSTRACT OF THE DISCLOSURE

Means for increasing the heat transfer between the shadow mask employed in a color television tube and the aluminized phosphor screen on which the image is formed. Preferably, a thin heat absorptive layer is deposited on the screen adjacent the mask to reduce the temperature differential between the two.

SUMMARY

The present invention relates to cathode ray tubes for color television image reproducing system.

In such a system, electron beams modulated with video signals scan a raster in a fixed pattern. Groups of dots of color-producing phosphors are deposited on the screen in a predetermined arrangement such that each beam is associated with one type of color-producing phosphor, and it is modulated with the component video signal corresponding to that color. A shadow mask is located within the tube adjacent the screen, and it is provided with openings in register with the dots. As the electron beams scan the raster, they either impinge on the shadow mask or energize the phosphor dots for reproducing the color image.

The impinging electron beams therefore generate heat in both the mask and the screen. However, more heat is generated in the mask; and since the screen is usually coated with a thin layer of aluminum after deposition of the phosphors, heat radiated from the mask to the screen is reflected back to the mask and absorbed by it. Typically, the mask is constructed of cold-rolled steel, and it will increase as much as 30° C. from the ambient while the glass envelope of the tube will increase only about 10° C. from the ambient temperature.

Hence, even though the thermal expansion coefficients of the glass tube and shadow mask are approximately the same, the large temperature differential between the two causes the mask to expand disproportionately with the screen; and the openings in the mask move out of register with their associated phosphor dots thereby deteriorating the image on the screen.

In a related co-pending, co-owned patent application of James W. Schwartz et al., Ser. No. 559,623, filed June 22, 1966, is described mechanical means for compensating for the disproportionate thermal expansion of the mask and screen.

A principal object of the present invention is to decrease the steady state temperature differential between the shadow mask and screen of a color television tube.

Another object of the present invention is to increase the emissivity of the screen adjacent the shadow mask of a color television tube thereby enhancing the transfer of radiated heat from the mask to the screen.

Other objects and advantages will be obvious to persons skilled in the art from the following detailed description accompanied by the attached drawing in which:

FIG. 1 is a fragmentary sectional view of a color television tube according to the present invention; and

FIG. 2 is a fragmentary closeup view taken along the sight line 2—2 of FIG. 1.

DESCRIPTION

In the illustration given, the cathode ray tube is seen to define a funnel portion enlarging to become united with a faceplate portion. The interior surface of the faceplate is furnished with a conventional phosphor screen. Further inwardly of the faceplate and following the contour thereof is mounted the shadow mask which, in a 23-inch size color television tube, for example, has upward of 300,000 of the small openings described above. The openings are normally in register with phosphor triads (dots of red, green and blue) which scintillate responsive to the impingement of the electron beams modulated by the video signal. The beams are generated in the throat of the funnel. The tube interior is biased at about 25,000 volts by a connection as at **10** and this is coupled to the high voltage grid (the G–4 grid) designated **11** by means of a "dag" coating providing a conductive coating on the interior of the funnel and throat of the tube.

The tube thus described is commercially available and is conventional. In the use of such a tube, as mentioned, the shadow mask expands because it intercepts the electron beams thereby translating the small openings laterally relative to their associated phosphor dots causing a misregistration between the two. Thus a video beam may be precluded from falling squarely on a given phosphor dot—according to the intent and design of the tube.

To substantially minimize this undesirable phenomenon, I provide the phosphor screen with an interior coating or layer of heat absorptive material as can be best appreciated from a consideration of FIG. 2. Preferably, the heat absorptive material may be lithium nitride, but equivalent substances may easily be found. For example, suitable materials include tungsten oxide, boron carbide, and nickel oxide, as these are all black (heat absorptive), inert (so as to not poison the cathode) and evaporate readily.

The practice of the invention may be better understood by a consideration of the following example.

Example

For this example, a rectangular color television tube was employed. Into the faceplate of such a tube, a polyvinyl alcohol solution was introduced, followed by a slurry, slosh-and-swirl technique performed by rotating the faceplate only. For this purpose, the faceplate is separate from the funnel portion. The polyvinyl alcohol solution consisted of 80 parts of 3% polyvinyl alcohol in demineralized water, 10 parts of ethylene glycol, 5 parts of ammonium dichromate, and 5 parts of dioxane. Following the swirling technique, the majority of the polyvinyl alcohol solution was poured off and spun off, leaving less than about 10% of the solution adhering to the inner face of the faceplate.

Following this, the adherent material was partially dried thereby providing a tacky surface which was exposed to ultraviolet radiation through the shadow mask, utilizing a point source of actinic light positioned at the source position of the electron beam modulated by the green video signal. Thereafter, the film was coated with a P 22 green phosphor. The green phosphor dots were then developed by washing with a fine spray of demineralized water, after which fixing was achieved through the application of a boric anhydride solution spray.

The foregoing steps were repeated, from the deposition of the polyvinyl alcohol layer through the developing, fixing and rinsing, for the blue dots, and thereafter for the red dots. Following the developing, fixing and rinsing of the last layer of dots, i.e., the red dots, an additional water spray was directed against the faceplate so as to provide a thin water film on the phosphor dots. This was followed by centrifuging the faceplate after which an acrylic plastic spray lacquer (with toluene and ketones

as solvents) was sprayed on under the same conditions. The lacquer film was air-dried for a few minutes, and thereafter a layer of aluminum was provided in a vacuum evaporator.

To provide the lithium nitride coating, the material in its gray crystalline form is evaporated subsequent to the deposition of the aluminum. This is advantageously performed using a small quantity of lithium nitride in a porcelain crucible heated by RF current in a suitable vacuum as is conventional. Typically the thickness of the phosphor dots is 10^{-3} inches, whereas the thickness of the aluminum and heat absorptive films is less than 10^{-5} inches. FIG. 2 is, therefore, exaggerated for purposes of illustration.

After the provision of the heat absorptive material layer or coating as seen in FIG. 2, the faceplate is integrated with the funnel.

Alternatively, I have found that the heat absorptive material layer can be provided in the form of an aluminum compound formed subsequent to the previously described aluminizing operation. The vacuum evaporation of aluminum is ordinarily carried out in a vacuum in the order of 10^{-4} mm. Hg. Following that, if the vacuum is reduced to the order of about 10^{-3} mm. Hg, all other parameters remaining constant, the aluminum continues to be deposited but the additional deposition develops a darkened surface which completely covers the layer of the reflective aluminum. This darkened surface has all the necessary properties of the heat absorptive layer required in the present invention, and may therefore be suitably used.

With a color kinescope thus constructed, the emissivity of the screen is appreciably increased thereby permitting it to absorb heat radiated from the mask as contrasted with prior color kinescopes furnished only with the reflective aluminum film which reflected the radiant heat back to the mask.

Thus, in the steady state, two compensating results are achieved to reduce the temperature differential of the screen and mask. First, the temperature of the mask is decreased by providing for additional heat transfer from it; and secondly, the temperature of the screen is raised by the radiant heat it receives from the mask.

While in the foregoing specification a detailed description of an embodiment of the invention has been set down for the purpose of explanation, many variations may be made by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. In a color television kinescope having a screen furnished with phosphor triads, an aluminized backing, and a shadow mask mounted in said kinescope adjacent said screen, said mask defining apertures in registration with said triads, the improvement comprising a film on said aluminized backing of a material having substantial heat absorptivity relative to said aluminized backing whereby the difference in temperature between said shadow mask and said screen is reduced when said kinescope is operative thereby maintaining said mask apertures in registration with said phosphor triads.

2. The kinescope of claim 1 characterized by said heat absorptive film being a material selected from the group consisting of nickel oxide, tungsten oxide, boron carbide and lithium nitride.

3. The kinescope of claim 1 characterized by said heat absorptive film being furnished after said aluminum backing has been applied to said screen by reducing the vacuum while continuing to deposit said aluminum.

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ROBERT SEGAL, *Primary Examiner.*