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L. W. EVANS

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CATHODE RAY TUBE SCREEN

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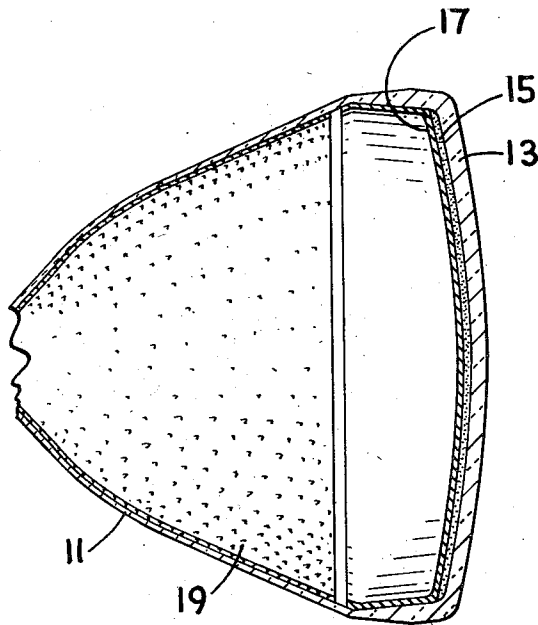


FIG. 1.

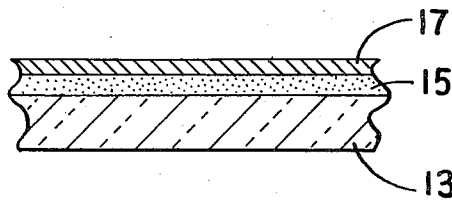


FIG. 2.

INVENTOR
LYLE W. EVANS
BY
Norman J. O'Malley
ATTORNEY

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CATHODE RAY TUBE SCREEN

Lyle W. Evans, Seneca Falls, N. Y., assignor to Sylvania Electric Products, Inc., a corporation of Massachusetts

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2 Claims. (Cl. 313—83)

This invention relates to image reproduction devices and more particularly to the viewing screens and the method of making viewing screens for such devices.

Screens for cathode ray tubes of the type employed in television apparatus are generally formed by a settling technique. In this process, the face plate of the tube envelope is covered with a cushioning fluid, and an electron responsive fluorescent composition is subsequently dispensed into this fluid. The fluorescent material settles through the cushion to form the screen in a manner well understood in the art.

The trend in the manufacture of television apparatus is presently directed toward the use of higher picture tube anode potentials. This increasing operating voltage requirement for the tube imposes correspondingly more critical limitations on the screen material and the screening techniques. One of the critical factors involved in the use of higher picture tube anode potentials is the rate of deterioration of the screen materials under operating conditions. This deterioration results in discolored and low brightness areas on the screen which are evident to the viewer by the appearance of crossburn or spider burn. It has been found that after several hours of continuous picture tube operation at or above 18 kilo-volts, a crossburn of sufficient magnitude to render the tube unacceptable is evident.

In a cathode ray tube employed in television apparatus, it is desirable to operate the screen and internal conductive coating or second anode at the same potential. In order to maintain this condition, the screen should release one electron for each electron received by it from the scanning electron beam. When the screen does not release electrons so as to maintain an equilibrium from the offset of the operation, the screen becomes increasingly more negative than the second anode. The resultant potential difference between the screen and other tube electrodes including the second anode causes the ions which are released from these higher potential electrodes to be attracted to the screen. This phenomena causes an ionic bombardment of the screen, which due to the large mass of the ions, causes the material to burn and discolor.

Several methods have been proposed for reducing screen crossburn. One of these methods uses a secondary emissive material such as calcium magnesium silicate activated with titanium intermixed with the fluorescent screen materials. This secondary emissive composition enhances the ability of the screen to release electrons, and thereby minimizes the voltage differential between the second anode and the screen. However, all of these materials are mechanically mixed solids and, with the present methods of screen settling from a liquid suspension, the results are inconsistent due to the difficulty of controlling the process and the lack of homogeneity of the settled screen composition.

Another method of reducing crossburn is to provide an electron permeable film of aluminum on the back surface

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of the phosphor screen. This aluminum film is substantially transparent to electrons but opaque to ions. When using an aluminization process, the screen must first be provided with a layer of nitrocellulose lacquer deposited by a floatation and decanting process prior to the aluminizing operation. Although such a film tends to reduce crossburn, it is an expensive process to include in the tube manufacturing procedure.

Accordingly, one object of the invention is to reduce the aforementioned disadvantages and to provide an economical method for making cathode ray tube screens while substantially reducing crossburn.

A further object is the provision of an improved cathode ray tube screen structure.

The aforementioned objects are achieved in one aspect of the invention by the provision of a cathode ray tube screen having a very thin layer of secondary emissive material deposited on the fluorescent material coating by a flashing technique.

For a better understanding of the invention, reference is made to the following description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a cross section of a portion of a cathode ray tube; and

Fig. 2 is a cross section of a portion of the cathode ray tube screen shown in Fig. 1.

Referring to the drawings, a cathode ray tube blank 11 is provided with a viewing panel 13, which has deposited thereon a layer of fluorescent material 15. A coating 17 of a secondary emissive material is positioned adjacent the fluorescent screen. Formed on internal wall of cathode ray tube 11 is a conductive film 19 which serves as the second anode electrode for the tube. The secondary emissive coating 17 is shown to extend along a portion of the side walls of tube blank 11.

In accordance with one aspect of the invention, the cathode ray tube blank 11, which has previously been cleaned and dried, is placed upon a moving conveyor so that it is continually moved through a plurality of work stations. At the first work station, a cushioning or settling fluid comprising deionized water and an electrolyte such as barium acetate, is dispensed into the tube blank. A solution containing potassium silicate, deionized water, and the fluorescent material is subsequently flowed into the settling fluid. The fluorescent material conventionally comprises a mixture of phosphors such as zinc sulfide activated with silver and zinc cadmium sulfide activated with silver. The potassium silicate is used in the process to aid in furnishing a silica bond between the screen composition and the glass face plate 13 of the tube blank. After the dispensing operations have been completed, the phosphor materials are allowed to settle through the cushioning fluid and onto the inner surface of the tube face plate. The moving conveyor next carries the blank to a siphoning positioning where most of the settling fluid is removed, and then to a decanting position where the remaining cushioning fluid is slowly poured off. A drying operation completes formation of the fluorescent screen layer 15.

The tube blank 11 is next placed upon an adaptor which is formed as an integral part of a vacuum pumping device so that one or more heating electrodes extend into the flared portion of the tube from the adaptor. Very small pellets of magnesium are placed on these heating elements, and the picture tube blank is evacuated to a low pressure of approximately .5 micron. The electrodes are then electrically energized to cause them to heat and vaporize the magnesium. Condensation of the vapor on the back of the screen and the flared portion of the tube forms a very thin and uniform coating of magnesium on these surfaces. The blank 11 is allowed to

return to atmospheric pressure and the excess magnesium is then removed if desired from the flared portion of the tube which will be covered by coating 19. The screen thus formed is subsequently baked in a high temperature oxidizing atmosphere to oxidize the magnesium and convert it to the secondary emissive substance, magnesium oxide, which is referred to in the drawings as coating 17. It has been found that an extension of the magnesium oxide coating along the side walls of the tube to a position near coating 19 enhances the function of the oxide to emit electrons and thereby maintain the screen potential by providing a larger emissive area. Excellent results have also been obtained by providing all of the face plate and flared portion of the bulb area with a coating of the oxidized magnesium.

The tube blank provided with the screen described above is subsequently moved to a work position where the internal conductive coating material 19 is applied to the flared portion of the cathode ray tube blank. This conductive coating serves as the second anode electrode for the tube.

To complete the cathode ray tube manufacturing process, the gun structure (not shown) is next mounted in the tube neck, and after evacuation, the tube is hermetically sealed.

It has been found that only a very small amount of magnesium is needed to provide a uniform coating of sufficient thickness on the back of the screen when using the flashing technique described above. Excellent results have been obtained by flashing a pellet of magnesium weighing about 25 milligrams. An accurate method of defining the processing specifications providing for the magnesium oxide coating is in terms of the coating thickness. It has been found that if the flashed magnesium layer is less than .003 micron in thickness, there will be insufficient magnesium oxide to adequately produce the secondary emission necessary to maintain the screen potential reasonably close to the anode potential, and consequently avoid crossburn. Conversely, if the magnesium layer is above .025 micron, the magnesium layer will not oxidize entirely, thereby causing a visually observable dark center. In this instance, the appearance of the

screen is not uniform and the brightness is considerably decreased.

Cathode ray tubes having screens constructed in accordance with the described embodiment of the invention have good brightness characteristics and the susceptibility of the screen to crossburn is greatly reduced. This condition is brought about by the ability of magnesium, when vaporized, to coat the glass intermediate the screen phosphor particles. This feature, not readily produceable in previous methods, is important since the glass has poor secondary emissive properties.

Although one embodiment of the invention has been shown and described, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the scope of the invention as defined by the appended claims.

What is claimed is:

1. An electron discharge device comprising a glass envelope with side walls and an end wall, a layer of fluorescent material deposited on said end wall, a film of electron emissive material disposed upon said layer and extended to lie upon said glass envelope side walls, and an anode formed by a conductive coating disposed on said side walls spaced from said film to receive electrons emitted from said film.

2. An electron discharge device comprising a glass envelope with side walls and an end wall, a layer of fluorescent material deposited on said end wall, a film of electron emissive material having a thickness of from .003 micron to .025 micron disposed upon said layer and extended to lie upon said glass envelope side walls, and an anode formed by a conductive coating disposed on said side walls spaced from said film to receive electrons emitted from said film.

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