

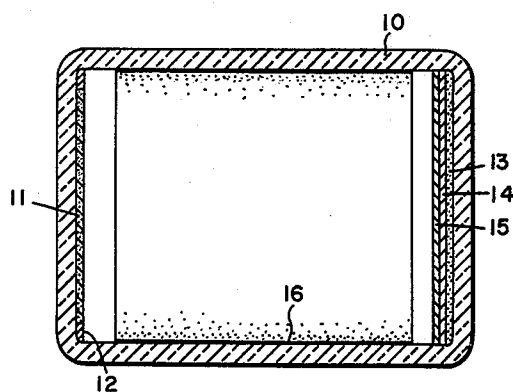
Nov. 15, 1960

W. O. REED

2,960,416

METHOD OF MANUFACTURING SCREENS FOR ELECTRON-DISCHARGE DEVICES

Filed July 29, 1952



INVENTOR:

WILLIAM O. REED

BY

Francis W. Grotty

HIS ATTORNEY.

1

2,960,416

METHOD OF MANUFACTURING SCREENS FOR ELECTRON-DISCHARGE DEVICES

William O. Reed, Chicago, Ill., assignor to The Rauland Corporation, a corporation of Illinois

Filed July 29, 1952, Ser. No. 301,434

6 Claims. (Cl. 117—33.5)

This invention relates to electron-discharge devices and methods useful in the manufacture of such devices. While not restricted thereto, the invention is of particular utility in the manufacture of image-translating devices such as image converters and the like.

In the production of light transducers containing within a common envelope a fluorescent screen and a photoemissive cathode sensitized with an alkali-metal vapor such as caesium or rubidium, considerable difficulties have been encountered, during the activation of the photoemissive cathode, due to the deleterious action of the alkali-metal vapor on commonly used fluorescent screen materials such as zinc sulfide, zinc-cadmium sulfide, zinc silicate (willemite), and calcium tungstate. It has been found that such screen materials blacken in varying degrees and lose their fluorescent properties when exposed to the alkali-metal vapor. Consequently, special and costly precautions have been taken to prevent the caesium or rubidium vapor from reaching the screens; image tubes have been designed with elaborate shielding of the fluorescent screen or with parts, movable in vacuum, which carry the screen from a position protected from the vapor during the processing of the photocathode to a final position after sensitization.

Another expedient which has been employed to protect the fluorescent screen from the deleterious action of the alkali metal vapor has been the use of an electron-permeable metallic coating for the fluorescent screen. While image tubes produced in this manner have reduced the effect of alkali-metal vapors on the luminous efficiency of the fluorescent screen, the action has been one of alleviation rather than complete prevention of screen deterioration.

It is an important object of the present invention to provide a new and improved electron-discharge device, and more particularly an image-translating device, in which the deleterious action of alkali-metal vapors on the fluorescent screen is substantially precluded without employing elaborate and costly movable parts or similar expedients to shield the fluorescent screen from attack by the alkali-metal vapors.

It is a further object of the invention to provide a new and improved method of manufacturing such devices to insure the prevention of contamination of the fluorescent screen by the alkali-metal vapors employed in the activation of the photoemissive cathode.

A new and improved electron-discharge device constructed in accordance with the present invention comprises an evacuated envelope and a fluorescent screen supported within the envelope. A first electron-permeable metallic film is provided in intimate contact with the fluorescent screen, and a second electron-permeable

2

metallic film is placed in direct juxtaposition with the first metallic film.

A new and improved method of manufacturing electron-discharge devices comprises the steps of forming a fluorescent screen, depositing a volatilizable or combustible organic film over the fluorescent screen, applying an electron-permeable metallic film to the exposed surface of the organic film, baking out the organic film to leave the metallic film in intimate contact with the fluorescent screen, and thereafter applying a second electron-permeable metallic film to the exposed surface of the first metal film.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with further objects and advantages thereof, may best be understood, however, by reference to the following description taken in connection with the accompanying drawing in which the single figure is a cross-sectional view of an image-translating device constructed in accordance with the present invention.

It is well known that most fluorescent screens are readily attacked by hot caesium, rubidium, or other alkali-metal vapors, resulting in poor light emission even at moderately high bombarding velocities. It has been proposed to employ a protective electron-permeable film of aluminum, beryllium, or other suitable metal to serve as a shield for protecting the screen from the alkali-metal vapor. However, this technique has not met with pronounced success.

The present invention is predicated on the discovery that the difficulties encountered in employing a metallic film to protect the fluorescent screen from the caesium vapor are attributable for the most part to defects in the metal film. These defects, in turn, may be traced to the mechanics of the process employed for applying the metal film to the fluorescent screen. As is well known, it is not feasible to evaporate aluminum directly onto a fluorescent screen for the reason that the screen presents a rough surface and the metal deposited thereon forms a mosaic structure which possesses extremely poor conductivity. Consequently, metal-backing layers are almost universally applied to fluorescent screens by employing, as an intermediary in the process, a thin organic film of nitrocellulose lacquer or the like. The organic film provides a smooth surface onto which the aluminum or other suitable metal is then evaporated. After formation of the metallic film on the exposed surface of the organic film, the latter is volatilized or baked out to leave the metallic film in intimate contact with the fluorescent screen. The organic vapors formed during the process of baking out the intermediate film have been found to leave pores in the metallic film, since they have no other means of egress. In addition, the metallizing process is quite critical, and the metallic film is also found in many instances to develop pinholes and other defects. The failure of aluminum films to provide complete protection against caesium contamination is now thought to be attributable to these pores and pinholes in the metallic film through which the hot caesium vapor may gain access to the fluorescent phosphor.

In accordance with the present invention, access of the alkali-metal vapors to the fluorescent screen through the pores and pinholes in the metallic backing layer is substantially precluded by depositing a second metallic

layer or film over the first after the intermediate organic film between the first metal-backing layer and the screen has been baked out. Since the pores in the first metal film are each extremely small in area as compared with the entire film, and since they are randomly distributed, the probability of any pores or pinholes in the second metal film coinciding with those in the first is extremely slight. Consequently, the use of two separately applied metal-backing layers for the fluorescent screen effectively provides substantially complete protection for the screen.

The single figure of the drawing is a cross-sectional view of an embodiment of the invention, in the form of an image-translating device comprising an evacuated envelope 10. A photoemissive cathode 11 is supported within the envelope on one end surface thereof, and a conductive ring 12 is provided for establishing the photocathode at any desired operating potential. At the other end of the envelope there is provided a fluorescent screen 13. A first electron-permeable metallic film 14 is formed in intimate contact with screen 13, and a second electron-permeable metallic film 15 is placed in direct juxtaposition with first metallic film 14. An accelerating electrode 16, which may be in the form of a coating of conductive graphite known as Aquadag or the like on the inner wall of the envelope 10, is provided between photocathode 11 and fluorescent screen 13. Alternatively, any other known type of electrode system may be interposed between photocathode 11 and fluorescent screen 13.

In operation, light images projected on photoemissive cathode 11 result in a space-modulated stream of photoelectrons which is directed towards fluorescent screen 13 by means of accelerating electrode 16. Since metallic films 14 and 15 are sufficiently thin to be electron-permeable, photoelectrons originating at cathode 11 are permitted to gain access to the fluorescent phosphor. Moreover, the presence of the metal-backing layers provides certain operating advantages, such as increased brightness, which are well known in the art.

The use of successively applied metal-backing layers for the fluorescent screen serves an important function in the manufacturing of the image-translating device. Two of the most commonly employed photoemissive surfaces are the antimony-caesium surface and the silver-caesium oxide-caesium surface. Manufacture of these composite photosurfaces requires activation by hot caesium vapors, and should these vapors be permitted to gain access to the fluorescent phosphor, the luminous efficiency of screen 13 would be seriously impaired. However, by employing the successively applied metal films of the present invention, such undesirable caesium contamination is substantially precluded by virtue of the shielding action of the films.

While satisfactory results may be obtained by evaporating a second layer of aluminum or other suitable metal directly onto the first after the intermediate organic film is baked out, it has been found preferable to deposit a second organic film over the first metal-backing layer before evaporating the second metallic film. In this manner, it is insured that any discontinuities or other defects in the first metallic film have little or no effect on the formation of the second. After applying the second metallic film, this organic film is baked out in the same manner as the one applied between the first metal-backing layer and the fluorescent screen.

The use of successively applied metallic films need not require operating voltages exceeding those used in devices employing a single metal-backing layer, since each of the component layers of the present invention may be made sufficiently thin that the total thickness is no greater than that of a conventional single layer. For example, each of the component metallic films may be 20×10^{-6} inches in thickness, and suitable operation of the device may be achieved with operating voltages of 6 to 12 kilovolts.

While the present invention has been particularly de-

scribed in connection with image-translating devices and methods for producing such devices, the techniques of the invention may also be employed to advantage in other types of electron-discharge device, such as cathode-ray tubes for use in image reproduction and the like.

While a particular embodiment of the present invention has been shown and described, it is apparent that various changes and modifications may be made, and it is therefore contemplated in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

I claim:

1. The method of depositing inorganic material on the surface of a film of metallic conductive material, said film being sufficiently thin to be permeable to the electrons of a cathode ray beam impinging thereon, said method comprising the steps of depositing a film of heat removable, film forming organic material on said conductive film, depositing said inorganic material on said organic film, and heating the structure so formed until said organic film is substantially completely vaporized.

2. The method of depositing particles of inorganic material on the surface of a metallic film, said metallic film being sufficiently thin to be permeable to the electrons of a cathode ray beam impinged thereon and said metallic film being suspended between spaced protrusions from a substrate, said method comprising the steps of depositing a film of heat removable, film forming organic material on said metallic film, depositing said particles of inorganic material on said organic film, and heating the structure so formed until said organic film is substantially completely vaporized.

3. In the manufacture of an electron-discharge device, the method which comprises the following steps in the order named: forming a fluorescent screen; depositing an organic film over said fluorescent screen; applying an electron-permeable metallic film to the exposed surface of said organic film; baking out said organic film to leave said metallic film in intimate contact with said fluorescent screen; and thereafter applying a second electron-permeable metallic film to the exposed surface of said first-mentioned metallic film.

4. In the manufacture of an electron-discharge device, the method which comprises the following steps in the order named: forming a fluorescent screen; depositing an organic film over said fluorescent screen; applying an electron-permeable metallic film to the exposed surface of said organic film; baking out said organic film to leave said metallic film in intimate contact with said fluorescent screen; depositing an organic film over the exposed surface of said metallic film; applying a second electron-permeable metallic film to the exposed surface of said last-mentioned organic film; and baking out said last-mentioned organic film to leave said second metallic film in direct juxtaposition with said first-mentioned metallic film.

5. In the manufacture of an electron-discharge device comprising an evacuated envelope, the method which comprises the following steps in the order named: forming a fluorescent screen within said envelope; depositing an organic film over said fluorescent screen; applying an electron-permeable metallic film to the exposed surface of said organic film; baking out said organic film to leave said metallic film in intimate contact with said fluorescent screen; applying a second electron-permeable metallic film to the exposed surface of said first-mentioned metallic film; and forming a photoemissive cathode within said envelope, the activation of said photoemissive cathode being performed subsequent to the application of said second metallic film.

6. In the manufacture of an electron-discharge device comprising an evacuated envelope, the method which comprises the following steps in the order named: forming a fluorescent screen within said envelope; depositing an organic film over said fluorescent screen; applying an

5

electron-permeable metallic film to the exposed surface of said organic film; baking out said organic film to leave said metallic film in intimate contact with said fluorescent screen; depositing an organic film over said metallic film; applying a second electron-permeable metallic film to the exposed surface of said last-mentioned organic film; baking out said last-mentioned organic film to leave said second metallic film in direct juxtaposition with said first metallic film; and forming a photoemissive cathode within said envelope, the activation of said photoemissive

5

10

6

cathode being performed subsequent to the application of said second metallic film.

References Cited in the file of this patent

UNITED STATES PATENTS

2,233,786	Law	Mar. 4, 1941
2,303,563	Law	Dec. 1, 1942
2,374,310	Schaefer	Apr. 24, 1945
2,555,545	Hunter et al.	June 5, 1951
2,567,714	Kaplan	Sept. 11, 1951