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Aoyana

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[54] **CHARACTER GENERATION CATHODE-RAY TUBE USING TANTALUM TARGET**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **313/399,** 313/329

[51] **Int. Cl.** **H01j 31/08,** H01j 31/58

[58] **Field of Search** ..... 313/86 KM, 65 AB, 65 R

[56] **References Cited**

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Primary Examiner—Robert Segal

[57] **ABSTRACT**

Herein disclosed is an improved character generation cathode-ray tube having a target made of tantalum and having a patterned tantalum oxide film formed on one surface thereof.

1 Claim, 13 Drawing Figures

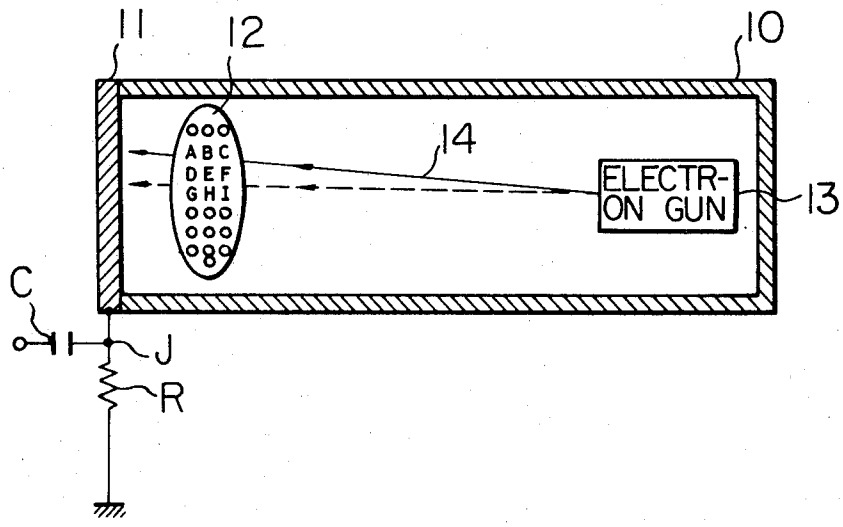


Fig. 1A

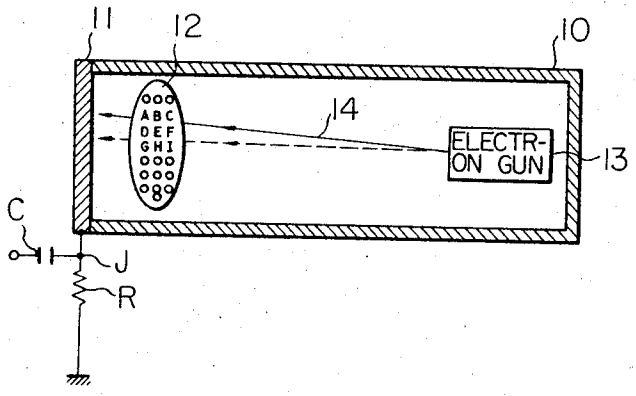


Fig. 1B

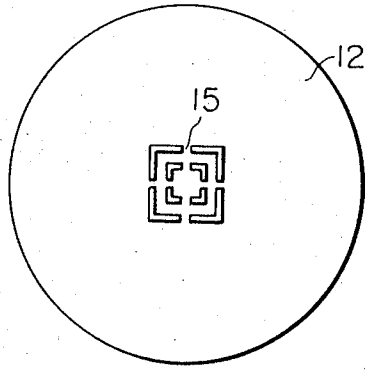


Fig. 2

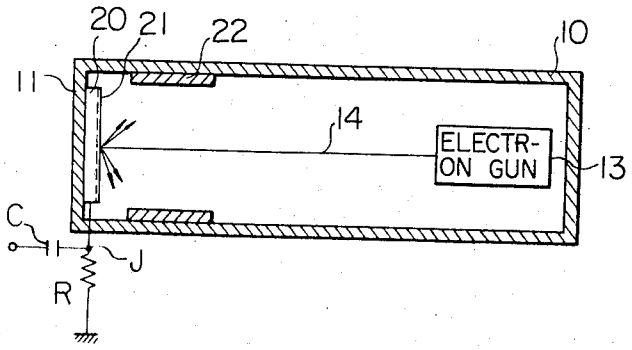


Fig. 3A

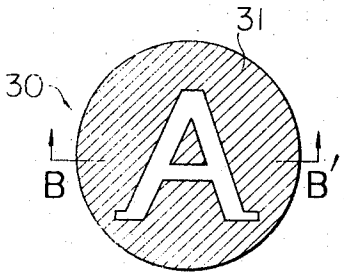


Fig. 3C

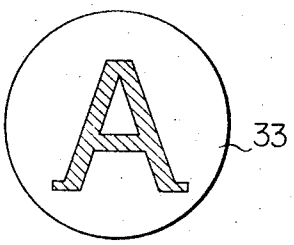


Fig. 3B

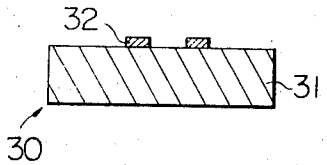


Fig. 4A

Fig. 4B

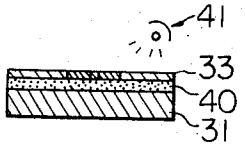


Fig. 4C

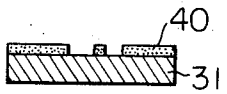


Fig. 4E

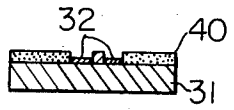


Fig. 4F

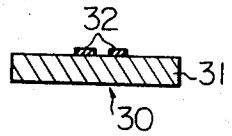


Fig. 4D

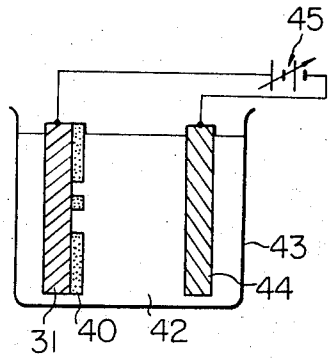
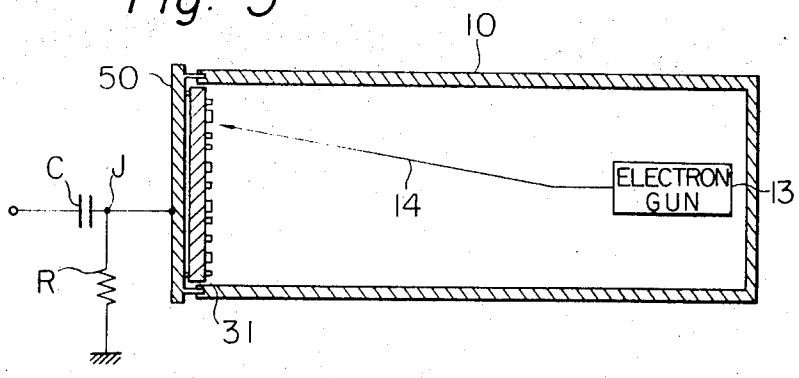


Fig. 5



CHARACTER GENERATION CATHODE-RAY TUBE USING TANTALUM TARGET

The present invention relates to cathode-ray tubes and more particularly to a character generation cathode-ray tube.

Character generation cathode-ray tubes are useful for generating electric symbol or character signals for use in display tube. The character generation cathode-ray tube usually includes a target assembly carrying thereon a set of symbols or characters to be reproduced by a display device. The character generation cathode-ray tube generates an electron beam and deflects the electron beam to scan selected one of the characters thereby to produce an electric character signal. A target assembly of one type for the character generation cathode-ray tube includes an electro-conductive faceplate and a metallic plate positioned at the inner side of the faceplate and having therein perforations arranged to represent characters. This type of target assembly can not carry a sufficient number of characters due to physical limitation or fabrication technique limitation. Another type of target assembly includes a secondary emissive substrate and non-secondary emissive strips arranged on the substrate in the form of characters. This latter type of target assembly also has a problem that the number of the characters is limited since the non-secondary emissive strips should have a width enough for a sufficiently large signal current.

It is therefore an important object of the invention to provide an improved character generation cathode-ray tube having a target assembly, which can carry thereon a sufficiently large number of characters.

It is another object to provide a character generation cathode-ray tube having a target assembly including a tantalum plate having thereon patterned tantalum oxide layers.

All of the objects, features and advantages of the invention and the manner of attaining them will become more apparent and the invention itself will be better understood by reference to the following description of an embodiment taken in conjunction with the accompanying drawings, in which:

FIG. 1A is a sectional view showing a conventional character generation cathode-ray tube.

FIG. 1B is a diagram showing a simplified target incorporated in a target assembly of the character generation cathode-ray tube of FIG. 1A.

FIG. 2 is a sectional view showing another conventional character generation cathode-ray tube.

FIG. 3A is a plan view illustrating a target according to the invention.

FIG. 3B is a cross-sectional view taken along the line B—B′ shown in FIG. 3A.

FIG. 3C is a diagram showing a negative film to be used for fabricating the target shown in FIGS. 3A and 3B.

FIGS. 4A to 4F are diagrams showing steps of a method of making the target of FIGS. 3A and 3B.

FIG. 5 is a sectional view of a character generation cathode-ray tube employing the target of FIGS. 3A and 3B.

Referring now to the drawings and more specifically to FIG. 1A, there is shown a conventional character generation cathode-ray tube which comprises an evacuated envelope **10**, a target assembly of an electro-conductive faceplate **11** and a metalic plate **12** positioned in the vicinity of the faceplate **11** and having therein patterned perforations representing characters diagrammatically shown in the figure, an electron gun **13** positioned at an inner portion of the envelope **10** opposite to the faceplate **11**, and a deflection element (not shown) for deflecting an electron beam **14** emitted from the electron gun **13** so as to scan selected one of the characters of the metalic plate **12**. The electron beam **14** passed through the perforations forming a set of character hits the electro-conductive faceplate **11**. Electrons of the electron beam **14** in the faceplate **11** flow through a resistor R to the ground thereby to cause a voltage to appear at a joint J. The voltage at the joint J is picked up through a coupling capacitor C by a suitable signal processing device which produces a character or video signal.

In FIG. 1B, the metalic plate **12** is diagrammatically illustrated in simplified form, which carries a single character ▣, although it ordinarily carries about one hundred characters. It is, in this instance, a problem that a plurality of bridge portions **15** should be retained, which causes unwanted noise in the character signal.

In FIG. **2**, another conventional character generation cathode-ray tube is illustrated, comprising an evacuated envelope **10** having a faceplate **11**, a target assembly of a secondary emissive substrate **20** placed on the inner surface of the faceplate **11** and a non-secondary emissive strips **21** formed on the substrate **20** in character form, an electron gun **13** positioned at an inner portion of the envelope **10** opposite to the faceplate, a secondary electron collector **22** placed in the vicinity of the target assembly, and a deflection element for deflecting an electron beam **14** emitted from the electron gun **13** to permit the electron beam to scan selected one of the characters formed by the strips **21**. The substrate **20** is connected through a resistor R to the ground and through a joint J to a coupling capacitor C. When, in operation, the electron beam **14** scans the selected one of the characters, the secondary electrons emanated from the substrate **20** is collected by the collector **22** and, on the other hand, a voltage signal appears at the joint J. The voltage signal is picked up through the coupling capacitor C by a suitable signal processing device which produce a character or video signal to be reproduced by a display tube. This character generation cathode-ray tube is disadvantageous in that the number of characters of the target assembly is enevitably limited since the non-secondary emissive strips should have such a large width as to cause a sufficiently large signal current.

In order to overcome the above-stated problems encountered in the conventional character generation cathode-ray tubes, a novel target for an improved character generation cathode-ray tube has been provided by the present invention, which is shown in FIGS. 3A and 3B. The target, generally designated by **30** comprises a tantalum substrate **31**, and a tantalum oxide film **32** disposed in character form on one surface of the substrate **31**. The film **32** represents in negative or positive form a set of characters in a density for example, of a letter per an area of 200 × 200 microns, although it is, in this case, is shown to represents a single letter A. The conventional target, on the other hand, carries a set of characters in a density, for example, a single character per an area 1 × 1 milli-meter. The sub-

strate 31 may be formed on a glass plate through either spattering or evaporation technique.

The target of FIGS. 3A and 3B can be fabricated by a method using a transparent film 33 shown in FIG. 3C containing opaque portions representing characters into which the tantalum oxide film is formed. It is now apparent that since the tantalum oxide film 32 forming a set of characters is disposed on the tantalum substrate 31, such bridges as those of FIG. 1A are unnecessary so that a desired character signal can be obtained and a complicted character can be clearly represented by the tantalum oxide film 32. Furthermore, it should be understood that since the tantalum oxide film 32 can be formed through a chemical technique, the film 32 can represent characters in a density several hundreds to thousands times as much as that of a conventional one. In addition, the target 30 is advantageous in its much higher chemical stability than a target made of a semiconductive material such a silicon and in that the target 30 hardly emanates unwanted gas even if it is hit by the electron beam.

A preferred method of making the target will be described hereinbelow in conjunction with FIGS. 4A to 4F.

A tantalum plate 31 is first prepared as shown in FIG. 4A. Thereupon, a photocurable and dielectric material 40 is coated on one surface of the plate 31 and a transparent film 33 containing an opaque pattern as shown in FIG. 3C is placed on the layer 40 as shown in FIG. 4B. A light source 41 is provided so as to irradiate light rays onto the film 33 thereby to cause the photocurable layer 40 to cure in a form corresponding to the transparent pattern or portion of the film 33. The remaining portion of the layer 41 other than the cured portion is removed by a suitable solvent whereby the cured portion remains on the plate 31 as shown in FIG. 4C. The plate 31 carrying thereon the cured layer 41 is dipped into a electrolytic solution 42 contained in a container 43. A metallic plate 44 is also dipped into the solution, serving as a cathode electrode. A D.C. power source 45 which is preferably a variable voltage source has a positive terminal connected to the plate 31 and a negative terminal connected to the metallic plate 44 as shown in FIG. 4D. It should be understood that the photociurable material is so selected that the cured layer 41 has high dielectricity. Since the oxidizing current flowing through the electrolytic solvent 42 tends to decrease in concurrence with the advancement of the anode oxidization, the voltage of the D.C. power source 45 is regulated to maintain substantially constant the magnitude of oxidizing current. Thus, the surface of the tantalum plate 31 which contacts with the solution 42 through the perforations of the layer 41 is oxidized so that a tantalum oxide film 32 is formed on the plate 31 as shown in FIG. 4E. The cured layer 41 is then removed by irradiating a prasma jet onto the layer 41, resulting in a target 30 of the invention as shown in FIG. 4F.

It is now to be noted that the thickness of the tantalum oxide layer 32 is readily controlled by observing the color of the layer 32 since the color of the layer 32 changes from violet to green in dependence on the thickness thereof. Furthermore, the tantalum oxide has high dielectricity and chemical stability. The solution 42 is, for example, an aqueous solution containing citric acid of 2 percent by weight. The solution may be another solution as far as oxygen ions are generated by a current flow through the solution. It is further to be noted that the oxidizing current should be maintained at a suitable magnitude so as to obtain a desirable crystal structure of the tantalum oxide.

FIG. 5 illustrates a character generation cathode-ray tube of the invention which employs the thus made target 31. The target 31 is supported by and electrically connected to a metallic face panel 50 through, for example, spot-welding, so that, the target 31 and the face panel 50 forms a target assembly. The face panel 50 is hermetically combined with an end of an envelope 10 so as to form a hermetically sealed chamber. The chamber is evacuated and an electron gun 13 is positioned in the chamber. A deflection element (not shown) is provided on the peripheral wall of the envelope 10 so as to vertically and horizontally deflect an electron beam emitted from the electron gun 13 to permit the electron beam to scan selected one of characters represented by the tantalum oxide film on the target 31 in raster form. Since the tantalum oxide film is dielectric and, on the other hand, the tantalum plate is conductive, the electron beam is periodically interrupted thereby causing to develop an electric signal in the target 31 and the face panel 50. The face panel 50 is grounded through a resistor R and connected through a joint J to a coupling capacitor C so that the electric signal developed in the face panel 50 can be picked up through the coupling capacitor C by a suitable signal processing device which then converts the signal into a suitable signal. The metallic face panel 50 may be made of tantalum and the face panel 50 and the plate 31 are integral with each other. When, for example, a voltage of −1.5 KV is exerted on the cathode of the electron gun 13 and the resistor has a resistance of 20 kΩ and the capacitor C had a capacitance of 100 pF, the output signal through the coupling capacitor C had a voltage of about 0.1 mV.

It should be now appreciated that since the target of the invention is made of tantalum and accordingly can endure the bombardment of an electron of high intensity, it is possible to impress a high accelerating voltage to the electron gun with the result that the electron beam is preferably focused into an extremely thin pencil beam. It was revealed that the invention target is operative up to such a high accelerating voltage as 5KV. On the other hand, the conventional silicon target is usually inoperative under such high accelerating voltage as above. Furthermore, the target can be readily fastened to a desired portion of a character generation cathode-ray tube through, for example, spot-welding without using a specific means.

It was revealed that even if the target of the invention is repeatedly scanned by the electron beam, such a large amount of electrons as to prevent the electron beam from bombarding onto the target did not store in the tantalum oxide film of the target.

It should be apparent from the above detailed description that an improved target assembly and a character generation cathode-ray tube have been provided.

It will be understood that the invention is not to be limited to the exact construction shown and described and that various changes and modifications may be made without departing from the spirit and scope of the invention, as defined in the appended claims.

What is claimed is:

1. A character generating cathode-ray tube having an evacuated envelope, a face plate coupled to the enve-

lope at one end thereof, an electron gun at the other end of the envelope, a target assembly mounted on the face plate to be scanned by the electron beam emitted from the electron gun, and in electrical contact with the face plate, said target assembly having a tantalum substrate, and a tantalum oxide layer with high dielectricity formed on a surface thereof facing said electron gun and being disposed in the form of minute characters to be generated, wherein each of characters of the oxide layer formed on said substrate is disposed in an area of about 200 × 200 microns, and the color of said tantalum layer is green.

* * * * *