

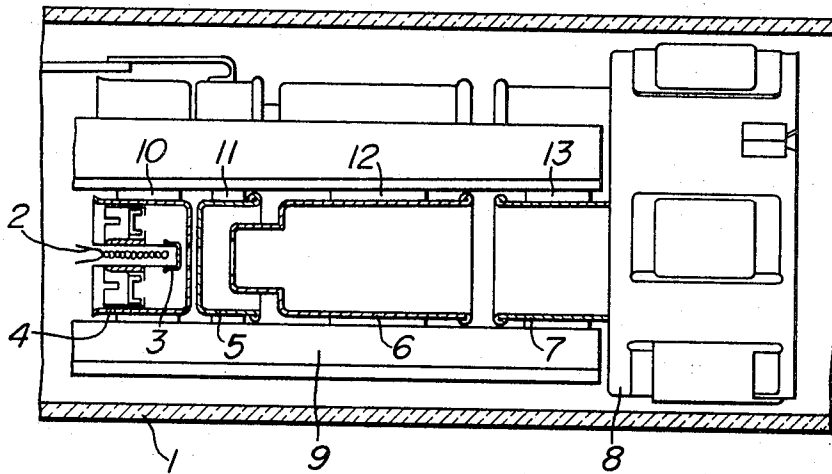
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METHOD OF MAKING A CATHODE-RAY TUBE

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METHOD OF MAKING A CATHODE-RAY TUBE

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6 Claims

ABSTRACT OF THE DISCLOSURE

A method of making a cathode-ray tube having at least one electron gun including the step of treating the mount with an acid etching solution for the removal of an oxidized layer from the surface of the mount. The acid etching solution preferred for the purpose includes a suitable combination of nitric acid, hydrofluoric acid, hydrochloric acid, sulfuric acid, a hydrogen peroxide solution, chromic anhydride and water with or without an inhibitor.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to a novel and improved method of making a cathode-ray tube and also relates to a cathode-ray tube made thereby.

DESCRIPTION OF THE PRIOR ART

Cathode-ray tubes, especially color picture tubes are generally provided with grid No. 3 and grid No. 4 constituting an electron lens for focusing the electron beam, and in such a tube, a high voltage of more than 20,000 volts is fed to grid No. 4, while a voltage in the order of 2,000 to 4,000 volts is fed to grid No. 3. Therefore, a potential difference in the order of 20,000 volts is present between these grids. Under the presence of such a high potential difference between these grids, if the surface of grid No. 3 or grid No. 4 might have been oxidized or contaminated to the slightest degree, flashover would take place between these electrodes and between the neck tube and these electrodes, with the result that an unusual situation would occur in the power source, and in an extreme case, the electron gun itself would be destroyed. Further, cold emission emanates from the electrode surface acted upon by the strong electric field, and the electrons produced by the cold emission may bombard the phosphor screen separately from the electron beam emitted from the cathode to thereby impair the picture quality or these electrons may bombard the neck tube to produce undesirable fluorescence. In addition to the cold emission emitted from the electrode surface, another source of the cold emission may sometimes be provided by oxidized portions of bead supports used for supporting the electrodes which are mounted in bead glasses and acted upon by the strong electric field, because those portions of the bead supports exposed to the glass are unavoidably oxidized during mounting of the bead supports in the bead glass. Still further, in case of a triple electron gun type of color picture tube, its bead glass or neck tube is charged by the induction due to a high voltage applied to grid No. 4 and the pole-piece cage directly connected to grid No. 4 or by being bombarded by high speed stray electrons. This electric charge becomes unstable by being affected by the cold emission electrons or by the secondary electrons emitted from the electrodes and is subject to variation with time. This variation in the electric charge causes a corresponding variation in the potential distribution in the main electron lens constituted by the two electrodes, that is, grid No. 3 and grid No. 4. As a result, it has been

frequently experienced that deviation occurs in beam-paths which cause convergence shift or misregister in color images.

In order to eliminate the arcing and the cold emission phenomenon as pointed out above, it is of primary importance to keep the surface of each electrode in a clean state. However, even with perfect treatment for the cleaning of each part, it is unavoidable that the electrodes as well as the bead supports are slightly oxidized by the heated bead glass during the assembling of the triple gun unit by means of beading. In this connection, it is common practice to employ a non-magnetic material for the material of the electrodes for use in a cathode-ray tube of the kind described above. Stainless steel is most commonly employed for this purpose. It is said that stainless steel is a chemically stable metal, but when microscopically examined, it can be seen that its surface is covered with an oxidized surface film of chromium which is one of the metals contained in the steel composition, and this oxidized surface film which is thickened when heated or left to stand for an extended period of time in air is considered to provide a source of cold emission.

SUMMARY OF THE INVENTION

It is therefore the primary object of the present invention to provide a novel method of making an electron gun for a cathode-ray tube and a method of making a cathode-ray tube having an electron gun which is quite free from the prior defects as pointed out above.

Another object of the present invention is to provide a cathode-ray tube made by the method according to the invention.

According to one aspect of the invention, there is provided a method of making an electron gun for a cathode-ray tube comprising the steps of firmly securing a plurality of electrodes forming an electron gun of a cathode-ray tube to bead glasses by a plurality of bead supports to obtain a mount, immersing said mount in an acid etching solution for a time sufficient to substantially completely remove an oxidized layer formed on the surface of the electrodes, then rinsing said mount having been treated with said acid etching solution, and fixing heaters and cathodes to said mount.

According to another aspect of the invention, there is provided a method of making a cathode-ray tube comprising the steps of sealing an electron gun made by the above method in a bulb having a phosphor screen, and exhausting the interior of said bulb.

According to a further aspect of the invention, there is provided a cathode-ray tube having at least one electron gun therein, said electron gun comprising a mount formed by firmly securing a plurality of electron gun electrodes to a bead glass by a plurality of bead supports, said mount being then immersed in an acid etching solution for the substantially complete removal of an oxidized layer from its surface, and heaters and cathodes being assembled with said mount.

Other objects, advantages and features of the present invention will become apparent from the following description with reference to the drawing:

BRIEF DESCRIPTION OF THE DRAWING

The sole figure is a longitudinal sectional view of part of a color picture tube made by the method according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention will be described with regard to a method of making a color picture tube as partly shown in the figure, but no description as to those parts which have no direct concern with the present invention will

be given herein. Referring to the figure, the color picture tube includes a neck tube 1, a heater 2, a cathode 3, a grid No. 1 4, a grid No. 2 5, a grid No. 3 6 and a grid No. 4 7 of stainless steel, and a pole-piece cage 8.

According to the invention, the electron gun structure in the cathode-ray tube described above is made in a manner that the grid No. 1 4, grid No. 2 5, grid No. 3 6 and grid No. 4 7 are fixed to bead glasses 9 by respective bead supports 10, 11, 12 and 13 of stainless steel and a mount so assembled is then subjected to an acid treatment. For example, the mount may be immersed for a period of about 1 minute in a strong acid solution which is prepared by mixing a few percent of hydrofluoric acid, by weight based on the undermentioned mixture, with a mixture consisting of 1 part by weight of nitric acid and 6 parts by weight of water and is heated to a temperature in the order of 50° C. By the above immersion, an oxidized surface layer thickly formed on the stainless steel surface of the electrodes and the bead supports can be nearly completely removed. By the above acid treatment, the metallic gloss peculiar to the stainless steel completely disappears with the surface state being turned into a form of orange peel, and a metallic crystallization pattern is now seen on the stainless steel surface. The bead glass 9 has its surface also lightly etched by the hydrofluoric acid and its surface is thereby rendered clean.

The above acid treatment may be made by use of acid solutions other than the mixed acid consisting of nitric acid and hydrofluoric acid referred to above. For example, a mixed acid solution suitable for the acid treatment may be prepared by mixing hydrochloric acid (specific gravity 1.12), a 30% hydrogen peroxide solution and water in a weight ratio of 1.2:1.3:7.5 and adding to the above mixture 0.2% by weight potassium phosphate as an inhibitor, and the mount may be treated for several minutes at a treatment temperature in the range of 30° to 35° C. In another case, a mixed acid solution may be prepared by mixing hydrochloric acid (specific gravity 1.12), a 30% hydrogen peroxide solution, 40% hydrofluoric acid and water in a weight ratio of 1.1:1.5:0.6:6.8, and the mount may be treated for several minutes at a treatment temperature in the range of 28° to 33° C. In still another case, a mixed acid solution may be prepared by mixing hydrochloric acid (specific gravity 1.12), sulfuric acid (specific gravity 1.82), chromic anhydride and water in a weight ratio of 0.3:0.4:0.05:9.3 and annexing to the above mixture 0.1 to 0.2% by weight potassium phosphate as an inhibitor, and the mount may be treated for several minutes at a treatment temperature in the range of 45° to 60° C. There are a variety of combinations of solution components to obtain various kinds of the mixed acid solutions and the mixing ratios as described above, but in any case, sufficient rinsing or neutralization must be made after the treatment, because the reductive acid such as hydrochloric acid or sulfuric acid is operative to cause further etching of the stainless steel, if the rinsing or neutralization after the treatment is insufficient. According to experiments made by the inventors, it was found that the surface of the stainless steel could be most satisfactorily stabilized by the use of a composition containing nitric acid, and therefore we recommend the use of the first-described etching solution consisting of a composition of nitric acid and hydrofluoric acid.

A thin oxidized layer with a thickness in the order of one or two molecular layers might remain on the surface of each electrode even after the acid treatment described above, but such layer will be exhausted soon and would hardly act as a source of cold emission.

After the acid treatment as described above, the mount is rinsed and is assembled together with the heater 2 and the cathode 3. The assembly thus obtained is immediately sealingly mounted in a bulb (not shown) and the bulb is then exhausted. The cathode-ray tube thus made is free from the arcing, cold emission phenomenon,

convergence shift characteristic and other undesirable phenomena encountered with the prior cathode-ray tubes described previously, and has remarkably excellent operating characteristics. It is to be added that a liquid used for the rinsing of the mount has desirably such a nature that it would not re-oxidize the electrode surface, and in this respect, pure water is most preferred.

The prominent effects obtainable by the acid treatment as described above will be described in more detail. The first effect resides in that the stainless steel surface is smoothed out by the etching of convex parts of surface unevenness and is rendered less liable to be oxidized by virtue of the reduced overall surface area. The second effect is derivable from the fact that the surface of the stainless steel after the above treatment is merely covered with an extremely thin oxidized layer with a thickness in the order of one to two molecular layers. Therefore, even if the cold emission might emanate from such oxidized layer, the source of the cold emission would be exhausted in a quite short time and can not continue the emanation of the cold emission. It is needless to say that the mount having been subjected to the acid treatment as described above should be kept in an oxidization-free state, and after having been mounted in a bulb to form a cathode-ray tube, the bulb should be exhausted as soon as possible to keep the interior of the bulb in a high vacuum state to thereby further enhance the effect of inhibition from oxidization. Of course, electrolytic polishing may be employed in lieu of the acid treatment to effect the cleaning of the surface of the stainless steel, but according to our experiment, the effect attained by the electrolytic polishing was not so marked compared with the effect attained by the acid treatment.

The example of a color picture tube has been referred to in the foregoing description, but it will be understood that the present invention is also applicable to other cathode-ray tubes, for example, black and white picture tubes. Although several preferred forms of the etching solution for the acid treatment of the mount have been given in the foregoing description, the etching solution usable in the present invention is in no way limited to the specific etching solutions referred to in the above. It will also be understood that the duration of the acid treatment may be suitably adjusted without departing from the spirit and scope of the present invention. Further although the foregoing description has referred to a mount of the type having Nos. 1 to 4 electrodes therein, it will be understood that the present invention is likewise effectively applicable to a mount of the type having Nos. 1 to 5 electrodes therein, and leads for these electrodes may be treated together with the electrodes in the step of the acid treatment.

What is claimed is:

1. A method of making an electron gun for a cathode-ray tube comprising the steps of individually cleaning a plurality of grid electrodes to remove foreign matter therefrom, firmly securing said plurality of grid electrodes forming said electron gun of said cathode-ray tube to bead glass by a plurality of bead supports to form a mount, immersing said mount in an acid etching solution for a time sufficient to substantially remove oxidized layers existing on the surface of said mount, then rinsing said mount which has been treated with said acid etching solution, and thereafter fixing heaters and cathodes to said mount.

2. A method of making an electron gun for a cathode-ray tube according to claim 1, in which said acid etching solution is prepared by adding several percent by weight hydrofluoric acid to a mixture of nitric acid and water mixed in a weight ratio of about 1:6 and is heated to a temperature of about 50° C., and said mount is immersed in said etching solution for about 1 minute.

3. A method of making an electron gun for a cathode-ray tube according to claim 1, in which said acid etching solution is prepared by adding 0.2% by weight potas-

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sium phosphate as an inhibitor to a mixture of hydrochloric acid having a specific gravity of 1.12, a 30% hydrogen peroxide solution and water mixed in a weight ratio of 1.2:1.3:7.5 and is heated to a temperature of 30° to 35° C., and said mount is immersed in said etching solution for several minutes.

4. A method of making an electron gun for a cathode-ray tube according to claim 1, in which said acid etching solution is a mixture of hydrochloric acid having a specific gravity of 1.12, a 30% hydrogen peroxide solution, 40% hydrofluoric acid and water mixed in a weight ratio of 1.1:1.5:0.6:6.8 and is heated to a temperature of 28° to 33° C., and said mount is immersed in said etching solution for several minutes.

5. A method of making an electron gun for a cathode-ray tube according to claim 1, in which said acid etching solution is prepared by adding 0.1 to 0.2% by weight potassium phosphate as an inhibitor to a mixture of hydrochloric acid having a specific gravity of 1.12, sulfuric acid having a specific gravity of 1.82, chromic anhydride and water mixed in a weight ratio of 0.3:0.4:0.05:9.31 and is heated to a temperature of 45° to 60° C., and said

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mount is immersed in said acid etching solution for several minutes.

6. A method of making a cathode-ray tube comprising the steps of sealingly mounting an electron gun made by the method according to claim 1 in a bulb having a phosphor screen, exhausting the interior of said bulb, and applying a mount seal.

References Cited

UNITED STATES PATENTS

2,400,635	5/1946	Eitel et al.	316—26
2,871,086	1/1959	Korner et al.	316—4
3,296,141	1/1967	Lieb et al.	252—79.3
3,419,440	12/1968	Rinaldo et al.	148—6.15

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