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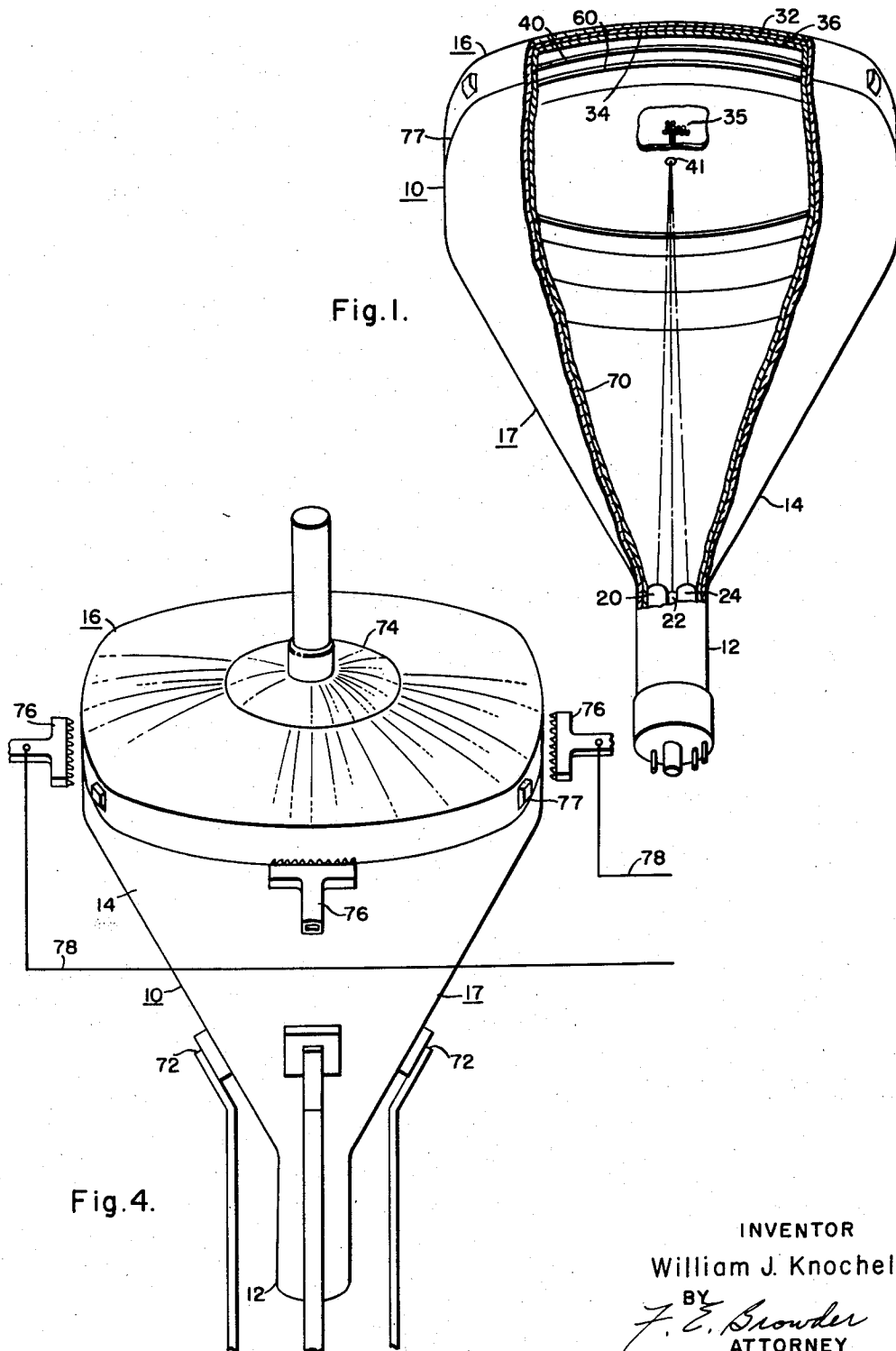
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2,871,087

METHOD OF ASSEMBLING A COLOR TELEVISION TUBE

Filed Feb. 10, 1956

2 Sheets-Sheet 1



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Fig. 2.

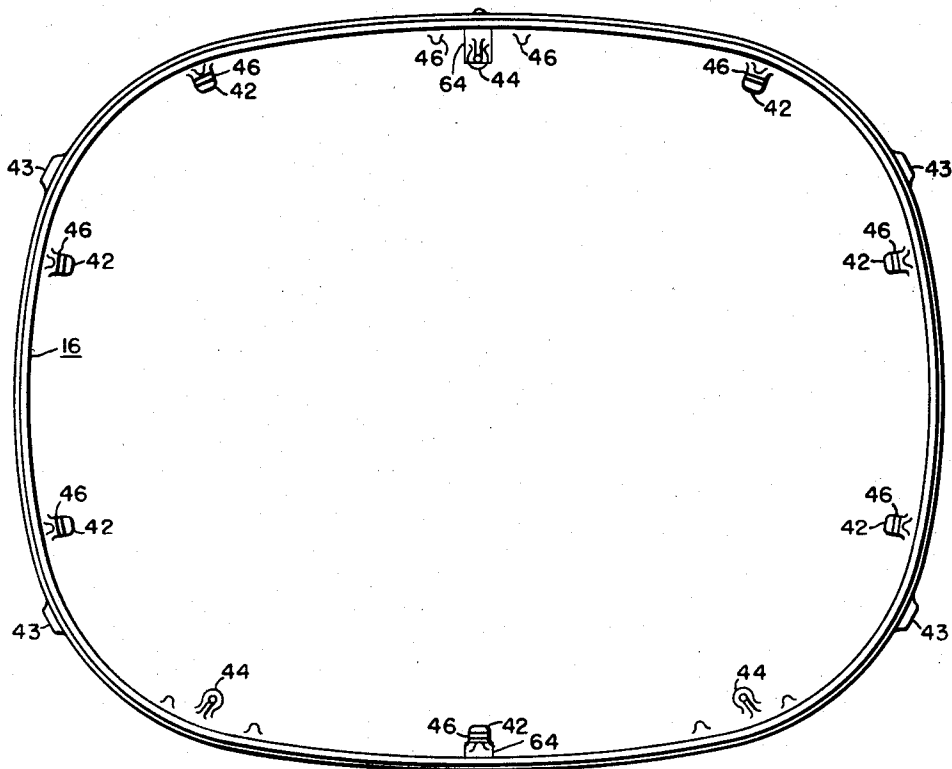
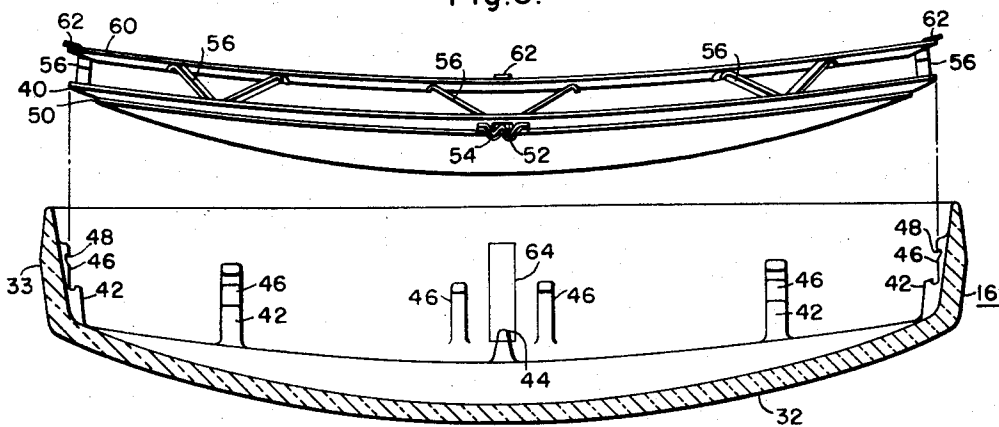


Fig. 3.



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METHOD OF ASSEMBLING A COLOR TELEVISION TUBE

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This invention relates to color television and more particularly to the structure and method of manufacture of color television presentation tubes. This invention concerns generally a color television tube as described in an article entitled "A Three-Gun Shadow Mask Color Kinescope" by H. B. Law in the October 1951 issue of The Proceedings of the IRE. In general, the tube which may be referred to as a shadow mask type tube is comprised of three electron guns for generating three separate electron beams and on which separate video modulation may be impressed representative of the three primary colors. The red video information, green video information and blue video information are impressed on separate electron guns. A phosphor screen is positioned near the viewing face of the tube. The phosphor screen consists of a plurality of regular arrays of red, green and blue emitting phosphor dots of symmetrical arrangement. Between the electron guns and the phosphor screen there is placed a thin perforated metal sheet for the purpose of partially masking the electron beams. By positioning the electron guns such that the electron beams generated approach the phosphor screen at an angle with respect to each other, it is possible for the electron beam modulated with a given color to strike only the corresponding color emitting phosphor dot on the screen.

Although the color television tube described in the above-mentioned article has proven to be satisfactory in operation, it has been found that the manufacturing cost of such a tube is prohibitive. The major problem therefore confronting the color television industry is either to reduce the cost of the above-mentioned color tube or to go to a different type presentation system.

A reduction in the cost of manufacturing of the above-mentioned tube and also an improvement in performance was obtained and such a structure is described in an article entitled "The CBS Colortron: A Color Picture Tube of Advanced Design" by N. F. Fyler, W. E. Rowe and C. W. Cain in the January 1954 issue of The Proceedings of the IRE. This article describes briefly a version of this tube having a substantially rectangular face with bowed sides and rounded corners. This version has such substantial advantages in permitting compact receiver cabinet design that only the rectangular version will be described. In both of the above-mentioned tubes it was necessary to resort to a metallic flange arrangement to seal the face panel of the tube to the bulb funnel portion of the envelope. This type structure not only resulted in an increase in cost of parts, but also there was a considerable amount of shrinkage in manufacturing. The metal flange of this tube operated at high voltage (25-27 kv.) with respect to ground and expensive insulation had to be provided in the television receiver.

It is accordingly an object of my invention to provide an improved color television tube.

It is another object to provide a substantially all glass envelope for a rectangular color television tube of the shadow mask type.

It is another object to provide an improved design for

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a rectangular color television tube of the shadow mask type which is of simple construction and more easily processed.

It is another object to provide an improved rectangular color television tube of the shadow mask type in which the face panel including the phosphor screen and associated mask structure form a complete assembly for ease in mounting to the funnel portion of the envelope.

It is another object to provide a rectangular color television tube of the shadow mask type in which the envelope is comprised of glass and requires no metal to glass seals.

It is another object to reduce the cost of rectangular color television tubes of the shadow mask type.

It is another object to provide a rectangular color television tube of the shadow mask type which eliminates need for a high voltage insulated tube mount in the receiver.

These and other objects are effected by my invention as will be apparent from the following description taken in accordance with the accompanying drawings, throughout which like reference characters indicate like parts and in which:

Figure 1 is a perspective view, partly in section, of a rectangular color television tube embodying my invention;

Fig. 2 is a view illustrating the interior of the face panel of the tube shown in Fig. 1;

Fig. 3 is an exploded view, partly in section, illustrating the mounting of the shadow mask and beam shield within the face panel; and

Fig. 4 is a diagrammatic view illustrating the method of sealing the face panel to the funnel portion of the envelope.

Referring in detail to Figs. 1, 2 and 3, a rectangular color television tube is illustrated comprised of an envelope 10 having a neck portion 12, a flared portion 14 and a face panel portion 16. Positioned within the neck portion 12 of the envelope 10 are three suitable electron guns 20, 22 and 24 for generating and directing three separate electron beams of different trajectory. Positioned on the exterior of the neck portion 12 are suitable electromagnetic deflection coils (not shown) for moving the electron beams in both a vertical and a horizontal direction to scan a suitable raster.

Deposited on the interior surface of viewing window or face plate 32 of the face panel 16 is a phosphor screen 34 comprised of a plurality of phosphor dots 35 with an electron permeable conductive coating 36 such as aluminum deposited on the exposed surface of the phosphor screen 34. Positioned adjacent to the phosphor screen 34 is the apertured masking electrode 40 of a suitable conductive material. The electron beams from the guns 20, 22 and 24 pass through the aperture 41 in the shadow mask 40 and impinge on the desired phosphor dot. Only one aperture 41 and a few phosphor dots 35 are shown in Fig. 1 for purposes of illustration.

The specific details and structural features of the tube can best be described in conjunction with the description of the manufacturing process. The flared portion 14 of the glass envelope 10 is made by spinning or by any other suitable method to obtain a glass member of substantially uniform thickness. The neck portion 12 may be sealed on by suitable methods and the assembled unit may be referred to as a funnel.

The face panel 16 of the envelope 10 is obtained by pressing or molding glass in order to obtain the desired thicknesses throughout its area to provide sufficient strength in the assembled tube. The face panel 16 consists of a face plate 32 and a skirt portion 33 provided thereon. The face panel 16 is provided with support lands 42 on the interior thereof molded integral with the face plate 32 and the skirt 33 and disposed at an angle formed be-

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tween the face plate 32 and the skirt 33. The support land portions 42 provide means for supporting the mask 40 within the face panel 16 and also spacing the mask 40 from the screen 34. In the specific embodiment shown, seven support lands are provided. In addition to the support land portions 42, there are three projections 44 provided near the angle formed at the skirt portion 33 and face plate 32 for preventing lateral movement of the mask 40.

There is also provided on the inner surface of the skirt 33 a plurality of spaced projections 46 molded in the skirt 33 and having notches 48 molded therein for locking or retaining the mask 40 within the face panel 16. In the specific embodiment shown, most of the projections 46 are integral with the lands 42.

The support lands 42, locating projections 44 and lock-in projections 46 may be formed while the face panel 16 is in a molten condition or may be ground out in a later operation. Indexing members 43 may also be provided on the exterior of the skirt portion 33 of the face panel 16 to aid correct positioning during assembly operations. The face panel 16 of the envelope 10 is now in final condition and is ready for assembling of the mask 40 and screen 34 within the face panel 16.

The next step in the manufacturing procedure is the preparation of a suitable mask member 40. This mask 40 may be of a material such as copper-nickel alloy (95-5), steel or iron sheet of a thickness of about .007 inch and of an area similar to that of the face plate 32 of the face panel 16 is obtained having a plurality of apertures 41 therein. The apertures 41 may be placed therein by any suitable process such as etching. The etched mask blanks 40 are then stamped to a spherical or curved shape to conform approximately with the spherical or curved shape of the face plate 32. The mask blanks 40 are also provided with a channel shaped rim 50 about its periphery for additional strength and may be pierced with three openings 52 positioned about the periphery. The mask 40 is then degreased and nickel or iron plated and positioning members 54 in the form of a W are welded at the position of the optional openings 52 in the periphery of the mask 40. Mask springs 56 are also provided about the periphery of the mask 40 and are essentially in the shape of a V. After the W positioning members 54 and the springs 56 are welded in place, the mask 40 is again degreased and blackened to increase its thermal emissivity by chemical treatment if iron or iron plated or by spraying on both sides with a dilute solution of graphite if nickel plated. The mask is then dried and baked at approximately 450° C. in air on a fixture to pre-set the shape of the mask 40. A beam shield ring or annular member 60 is then stamped on a suitable die, is shaped to conform to the spherical shape of the mask 40 and may be of a material such as iron chromium flashed to prevent oxidation or corrosion of the beam shield 60. Beam shield springs or clamps 62 are welded to the ring 60 which may be in turn inserted into the notches 48 provided on the hold down members 46 within the face panel 16 so as to secure the mask 40 within the face panel 16.

Alternatively, the beam shield 60 and the springs 56 and 62 may be eliminated and the mask secured by springs engaging the notches 48 in the hold down members 46 and bearing directly on the mask. The beam shield function may then be performed by a flexible light metal strip, for example aluminum foil, which is shaped to approximate the contour of the mask rim and touches the panel wall. This shield may be held in place by the springs which secure the mask.

The next step in the processing of the tube is to deposit the phosphor screen 34 on the inside face plate 32 area of the face panel 16 by suitable methods such as normal settling techniques or by use of a slurry method in which the phosphor is made into a suitable suspension so that the phosphor can flow over the inside surface by

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spinning, etc. The necessary dot pattern is formed by utilization of what is known as the photo-resist technique. In this process one of the primary phosphor colors is deposited on the interior surface of the face plate. The phosphor is then coated with an emulsion of a photo-resist material such as polyvinyl alcohol sensitized with ammonium dichromate. The previously prepared shadow mask 40 is then positioned within the face panel 16 and the combined unit is exposed to a light source. The light source is positioned with respect to the mask 40 and screen 34 to correspond to the position of the electron gun that would excite the color of phosphor deposited. Allowance must also be made to correct for the earth's magnetic field. The masking electrode 40 is then removed and the face plate 32 is washed, to remove the unexposed phosphor, and then dried and a phosphor dot pattern of the first primary color remains on the face plate 32 while the remaining portions are washed away. Additional brushing or abrasive cleaning may be necessary to remove unexposed phosphor. This process is continued until the three primary color phosphors are deposited on the face plate panel 16 and the light source position is adjusted for each color. Although I have described details of the photo-resist technique as applied to a settled screen, it is also possible to use a slurry technique, in which the photo-resist is applied with the phosphor, or to apply the phosphor by spraying through a suitable stencil. After the three phosphors have been deposited on the face plate 32, the face plate 32 may be sprayed with potassium silicate material in order to bind the phosphor onto the face panel. The indexing members 43 permit correct registration within the light source device.

It is desirable especially in color television tubes to apply a conductive electron permeable film over the phosphor screen 32. This process includes the application of a lacquer film over the phosphor screen 32 in order to insure that the conductive coating, such as aluminum which is evaporated on the lacquer, will have substantially smooth continuous surface. One suitable method is to rewet the screen 34 with a solution of polyvinyl alcohol and water to fill the interstices between the phosphor dots before application of the filming lacquer. A lacquer film is then applied by suitable techniques. One method is flowing a film on in a manner described in copending application Serial Number 402,207 filed January 5, 1954 entitled "Cathode Ray Tube Screen Filming by a Flow Method" by E. Atti and assigned to the same assignee now Patent No. 2,770,557 issued November 13, 1956.

Two or three silver patches 64, approximately one-half inch wide are then painted on the inside of the panel skirt on the long sides. Starting on a support land 42, and on an opposite locating projection 44, and extending continuously up the panel wall to a distance approximately one and one-eighth inches from the edge. This insures electrical contact between the aperture mask, aluminized screen and the high voltage contact button on the funnel. After the aluminum coating has been evaporated onto the face panel 16, the panel 16 may be baked at a temperature of 385-410° C. for a period of 30 minutes in order to remove the lacquer film between the phosphor screen 34 and the aluminum coating 36. The aluminum coating 36 extends to a distance of about one and one-eighth inches from the edge of the panel.

The next step is to assemble the masking electrode 40 into the face panel 16, which completes the assembly of the face panel assembly. The masking electrode 40 is positioned within the face panel 16 resting on the support land portions 42 provided within the face panel, and is clamped in this position by means of the beam shield 60 bearing on the mask springs 56 and the flexible clamps 62 seated within the grooves or notches 48 in the lock-in projections 46 of the panel wall. The locating

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projections 44 prevent lateral movement of the mask 40.

The funnel member which is comprised of the flared portion 12 and the neck portion 14 is immersed in ammonium bifluoride solution then water and then dried. A portion of internal conductive coating 70 is applied around the anode button (not shown) and around the funnel and neck area as in the standard black and white aluminized tubes. The funnels are then baked at approximately 410° C. to remove organics and water and to set the silicate binder in the conductive coating.

The next step in the operation is the sealing of the face panel 16 to the funnel portion of the envelope 10. The face plate and funnel are preheated in a furnace and then mounted in a lathe. It is desirable to heat the funnel to a temperature of about 150° C. and the face plate 16 to a higher temperature of about 250° C.

The face plate panel 16 and funnel assembly are next positioned in a horizontal lathe for sealing. The funnel is held in the head stock end of a lathe by clamping members 72 on the funnel. A fixture on the lathe holds the face plate panel 16 in proper position and is held in the tail stock of the lathe by using a vacuum chuck 74. This is shown in Fig. 4.

After mounting on the lathe, the face plate panel 16 and funnel 17 are rotated with a suitable heating means such as gas flame burners 76 directed in the immediate area of the matching portions of the face panel 16 and funnel 17. The supports holding the burners 76 are connected to a cam arrangement (not shown) designed to follow the contour of the particular shape of tube sealed. The gas flame heat is insufficient to soften the glass, but it does uniformly heat the adjoining edges of the face panel 16 and the funnel 17 to a temperature so that its resistance is lowered. After this preliminary localized heating, alternating current supplied through conductors 78 to one of the pairs of diametrically opposed burners 76 is fed through the gas flames and due to the decreased resistance of the heated glass, current will be conducted within the heated portions. This electric current flowing through the glass raises the temperature of the glass higher until the adjoining edges of the funnel 17 and the face panel 16 are plastic and a suitable glass seal is thereby provided between the face panel portion 16 and the funnel portion 17. The method of sealing two glass members together is more thoroughly described in U. S. Patent 2,306,054 entitled "Glass Heating and Working" by E. M. Guyer.

In order to provide a unipotential drift space between the deflection yoke region and the screen in cathode ray tubes such as the type described here, it is necessary to provide the conductive coating 70 on the interior surface of the flared portion 14 of the funnel 17 and extending back into the neck portion 12. It is also desirable that the conductive coating 70 on the flared portion 14 of the funnel 17 extend to the face panel 16 and make electrical contact with the conductive coating 36 on the phosphor screen 34. One of the reasons why the glass seal has not been utilized prior to this between the face panel 16 and the funnel 17 is that any type seal utilized results in oxidizing or removing of any coating applied to this region prior to the sealing operation. This difficulty has been overcome by inserting a capsule of aluminum provided with suitable shielding means into the envelope 10 after sealing and a complete conductive coating may be evaporated over the entire surface of the funnel 17 and also extending over the seal region 77 so as to easily make contact with the conductive coating 36 on the face panel 16 which was deposited in the earlier described operation. The shielding means is used to prevent evaporation of aluminum onto the mask to avoid lowering its thermal emissivity.

The electron guns 20, 22 and 24 with exhaust tubulation may now be inserted into the neck portion 12 of the envelope 10 and the glass button of the electron gun assembly sealed to the neck 12 in any suitable manner.

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The tube is then connected to an exhaust system and placed within a bake oven and exhausted on an exhaust-bake schedule which includes maintaining the bulb temperature at 390-410° C. for a period of about 30 minutes. The tube is then allowed to cool while the cathodes in the guns are activated and the exhaust tubulation is tipped off. Further reduction of the residual gas in the tube 10 may be obtained by flashing of a suitable getter material by well known means.

By the above-described assembly and processing schedule, the cost of the color television tube has been substantially reduced and the resulting shrinkage has been decreased considerably.

While I have shown my invention in only one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications without departing from the spirit and scope thereof.

I claim as my invention:

1. The method of assembling a color television tube, said tube characterized in having a glass envelope having a funnel portion and a face panel comprising the steps of depositing a phosphor screen on the interior portion of said face panel, evaporating an aluminum coating on the interior surface of said face panel, mounting a masking electrode within said face panel, securing said masking electrode within said face panel by means of clamping members secured to said face panel, sealing said glass face panel and said glass funnel together by electrically heating said face panel and said funnel, and evaporating a conductive coating within the interior of said envelope so as to cover the interior portion of said funnel and the sealing region between said funnel and said face panel to form a continuous conductive coating between said face panel and said funnel.

2. The method of assembling a color television tube, said tube characterized in having an envelope of glass material and being comprised of a funnel portion and a face panel, said funnel portion being comprised of a neck portion and a flared portion and said face panel being comprised of a face plate viewing portion and a skirt portion, comprising the steps of depositing a three color single layer phosphor screen in three separate operations on the interior portion of said face plate viewing portion, flow filming an organic film on said phosphor screen, evaporating an aluminum coating on the interior surface of said face panel, heating said phosphor screen to remove said organic film, mounting a masking electrode within said face panel, securing said masking electrode within said face panel by means of clamping members secured to the interior surface of said skirt portion, sealing said face panel and said funnel together by passing an electric current through the adjoining edges of said funnel and said skirt portion of said face panel, annealing the seal region of said envelope, evaporating a conductive coating over the interior surface of said envelope so as to provide electrical conductivity between said neck portion of said envelope and said screen, sealing electron beam generating means within said neck portion, evacuating said envelope to remove the residual gas from within said envelope and sealing said envelope off to provide a predetermined pressure within said envelope.

3. The method of assembling a color television tube, said tube characterized in having an envelope of glass material and being comprised of a funnel portion and a face panel, said funnel portion being comprised of a neck portion and a flared portion and said face panel being comprised of a face plate viewing portion and a skirt portion, comprising the steps of depositing a plurality of elemental areas of a first phosphor material capable of emission of a first color on the interior surface of said face plate viewing portion, depositing a plurality of elemental areas of a second phosphor material capable of emission of light in a second color, depositing a plurality of elemental areas of a third phosphor material

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capable of emission of light of a third color on the interior surface of said face plate viewing portion to provide a screen of symmetrical arrangement of three color phosphor areas, drying said phosphor screen, re-wetting said phosphor screen with water, flow filming an organic film on said phosphor screen, evaporating an aluminum coating on the interior surface of said face panel, heating said phosphor screen to remove said organic film, mounting a masking electrode within said face panel, securing said masking electrode within said face panel by means of clamping members secured to the interior surface of said skirt portion, sealing said face panel and said funnel together by passing an electric current through the adjoining edges of said funnel and said skirt portion of said face panel, annealing the seal region of said envelope, evaporating a conductive coating over the interior surface of said envelope so as to provide electrical conductivity between said neck portion of said envelope and said screen, sealing electron beam generating means within said neck portion, evacuating said envelope to remove the residual gas from within said envelope and sealing said envelope off to provide a predetermined pressure within said envelope.

4. A method of assembling a color television tube, said tube characterized in having a glass envelope having a

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funnel portion and a face panel, comprising the steps depositing a phosphor screen on the interior portion of said face panel, evaporating an aluminum coating on the interior surface of said face panel, mounting a masking electrode within said face panel, securing said masking electrode within said face panel by means of clamping members secured to said face panel, sealing said glass face panel and said glass funnel together by fusing the adjoining edges of said face panel and said funnel and evaporating a conductive coating within the interior of said members to cover the interior portion of said funnel and the sealing region between said funnel and said face panel to form a continuous conductive coating between said face panel and said funnel.

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