

Description

This invention relates to color cathode ray picture tubes and is addressed specifically to a novel front assembly for color tubes that have a tension foil shadow mask. The invention is useful in color tubes of various types including those used in home entertainment television receivers, and those used in medium-resolution and high-resolution tubes intended for color monitors.

The use of the tension foil mask and flat faceplate provides many advantages and benefits in comparison with the conventional domed shadow masks. Chief among these is a greater power-handling capability which makes possible as much as a three-fold increase in brightness. The conventional curved shadow mask, which is not under tension, tends to "dome" in high-brightness picture areas where the intensity of electron bombardment is greatest. Color impurities result as the mask moves closer to the faceplate. Being under high tension, the tension foil mask does not dome or otherwise move in relation to the faceplate, hence its greater brightness potential while maintaining color purity.

The tension foil shadow mask is a part of the cathode ray tube front assembly, and is located in close adjacency to the faceplate. The front assembly comprises the faceplate with its deposits of light-emitting phosphors, a shadow mask, and support means for the mask. As used herein, the term "shadow mask" means an apertured metallic foil which may have a thickness, by way of example, of about .00025mm (one mil) or less. The mask must be supported in high tension a predetermined distance from the inner surface of the cathode ray tube faceplate; this distance is known as the "Q-distance". The high tension may be in the range of $1.38 \cdot 10^5$ - $2.75 \cdot 10^6$ KPa (20 to 40 kpsi). As is well known in the art, the shadow mask acts as a color-selection electrode, or parallax barrier, which ensures that each of the three beams lands only on its assigned phosphor deposits.

The requirements for the support means for the shadow mask are stringent. As has been noted, the shadow mask must be mounted under high tension. The mask support means must be of high strength so that the mask is held immovable--an inward movement of the mask of as little as .025mm (one-tenth of a mil) is significant in that guard band may be expended. Also, the shadow mask support means must be of such configuration and material composition as to be compatible with the means to which it is attached. As an example, if the support means is attached to glass such as the inner surface of the faceplate, the support means must have about the same thermal coefficient of expansion as that of the glass. The support means must provide a suitable surface for mounting the mask. Also, the support means must be of a composition such that the mask can be welded onto it by electrical resistance welding or by laser welding. The support surface is preferably of such flatness that no voids can exist between the metal of the mask and the support structure to prevent the intimate metal-to-metal contact required for proper welding.

A tension mask registration and supporting system is disclosed in EP-A-143 939. A frame dimensioned to enclose the screen comprises first and second space-apart surfaces. A tensed foil shadow mask has a peripheral portion bonded to a second surface of the frame. The frame is registered with the faceplate by ball-and-groove indexing means. The shadowmask is sandwiched between the frame and a stabilizing or stiffening member. When the system is assembled, the frame is located between the sealing lands of the faceplate and a funnel, with the stiffening member projecting from the frame into the funnel. While the system is feasible and provides an effective means for holding a mask under high tension and rigidly planoparallel with a flat faceplate, weight is added to the cathode ray tube by the presence of the separate stiffening member, and additional process steps are required in manufacture.

There exists in the marketplace today a color tube that utilizes a tensed shadow mask. The mask is understood to be placed under high tension by purely mechanical means. Specifically, a very heavy mask support frame is compressed prior to and during affixation of the mask to it. Upon release of the frame, restorative forces in the frame cause the mask to be placed under high residual tension. During normal tube operation, electron beam bombardment causes the mask to heat up and the mask tension to be reduced. An upper limit is placed on the intensity of the electron beams that may be used to bombard the screen without causing the mask to relax completely and lose its color selection capability. The upper limit has been found to be below that required to produce color pictures of the same brightness as are produced in tubes having non-tensed shadow masks. For descriptions of examples of this type of tube, see U.S. Patent No. 3,683,063.

A color cathode ray tube includes three electron guns arranged in a delta- or an in-line configuration. Each gun projects an electron beam through the apertures of a mask onto assigned target areas located on the inner surface of the faceplate. The target areas comprise a pattern of phosphor deposits typically arranged in triads of dots or lines. Each of the triads consists of a deposit of a red-light-emitting, green-light-emitting, and a blue-light-emitting phosphor. To increase the apparent brightness of the display, and to minimize the incidence of color impurities that can result if a beam falls upon an unassigned phosphor deposit, the target area may include a layer of darkish light-absorbing material termed a "grille" that surrounds and separates each of the dots or

lines, and which serves as a "guard band" in case of beam misregistration.

The phosphor deposits are typically formed by a photoprinting process. The grille, which is also termed the "black surround," is applied first. The target area is then coated with a photosensitive slurry comprising phosphor particles of one of the three phosphors described. The shadow mask, mounted on a rigid frame, is temporarily installed in precise relationship to the faceplate, and the coating is exposed to light actinic to the phosphor deposits projected through the apertures of the mask from a light source located at a position that corresponds to the beam-emission point of the associated electron gun of the end-product tube. The faceplate is then separated from the shadow mask and the coating is "developed." The final result is a pattern of dots or lines capable of emitting, upon beam excitation, red, green or blue light. The photoscreening steps are repeated for each of the remaining colors to deposit triads of phosphor deposits on the target area in coordinate relationship with each aperture of the mask.

In the faceplate screening process, the phosphors for each color are typically embodied in a process screening fluid commonly referred to as a "slurry". The slurry is typically applied to the faceplate by a process known as "radial flow suffusion." The screening fluid is poured onto the faceplate while the faceplate is rotating. As the faceplate turns, the fluid spreads to the edges of the panel and excess fluid is cast off by centrifugal force. If there is any impediment to the free flow of the slurry during the screening process, the radially out-rushing slurry will "wash back," resulting in wave patterns in the coating which will become fixed following the drying of the slurry as by air and applied heat. The effect of this non-uniformity in phosphor density can become cumulative as the faceplate is successively screened. The deleterious effects of the wave patterns are three-fold. First, the thickened coatings are visible to the viewer as dark areas on the screen; second, cross-contamination of the colors can occur; and third, underexposure in the thickened areas during the photoprinting process results in non-adherence of the phosphor and consequent phosphor wash-off and flake-off.

U.S. Patent No. 3,894,321 to Moore, is directed to a method for processing a color cathode ray tube having a thin foil mask sealed in tension directly to the bulb. Included in this disclosure is a description of the sealing of a foil mask between the junction of the skirt of the faceplate and the funnel. The mask is shown as having two or more alignment holes near the corners of the mask which mate with alignment nipples in the faceplate. The nipples pass through the alignment holes to fit into recesses in the funnel. In another Moore embodiment, the front panel is shown as having a continuous ledge around the inner surface of the faceplate. The top surface of the ledge is spaced a Q-distance away from the faceplate for receiving a foil mask such that the mask is sealed within the tube envelope. In yet another embodiment, there are two ledges located at the sides of the faceplate parallel with the vertical axis of the faceplate for receiving a shadow mask. Also shown is an embodiment in which the faceplate is skirtless and essentially flat.

An avionics color cathode ray tube having ceramic components is described in a journal article by Robinder et al of Tektronix, Inc. A shadow mask is mounted in a ceramic ring/faceplate assembly, with the mask suspended by four springs oriented in the z-axis. Ceramic is also used to form a two-piece x-ray-attenuating body. A flat, high-voltage faceplate is utilized, together with a glass neck flare. (From "A High-Brightness Shadow-Mask Color CRT for Cockpit Displays," Robinder et al. Digest of a paper presented at the 1983 symposium, Society for Information Display.)

EP-A-0 121 628 of Tektronix, Inc. discloses a flat screen color cathode ray tube in which a shadow mask is welded to an outer lip portion of the channel-shaped side rails. Prior to receiving the shadow mask the sides of the frame are compressed so that after removal of the frame and mask assembly from the mounting apparatus, the restoring forces produced in the previously compressed sides of the frame prevent buckling of the frame by the mask. The frame and mask assembly is thereafter removably secured within the forward end of the tube by four springs affixed to the mounting frame.

A color picture tube having a conventional curved faceplate and correlatively curved, untensed shadow mask is disclosed in Japanese Patent No. 56-141148 to Mitsuru Matshusita. The purpose according to a quotation from the abstract is "...To rationalize construction and assembly of a tube, by both constituting its envelope from a panel, ceramic shadow mask mounting frame and funnel and integrally forming a surplus electron beam shielding plate to the shadow mask mounting frame."

Other prior art: Lerner--U.S. Patent 4,087,717; Dougherty--U.S. Patent 4,045,701; Palac--U.S. Patent 4,100,451; Law--U.S. Patent 2,625,734; Steinberg et al - U.S. Patent 3,727,087; Schwartz - U.S. Patent 4,069,567; Oess - U.S. Patent 3,284,655; Hackett - U.S. Patent 3,303,536; Vincent - U.S. Patent 2,905,845; Fischer-Colbrie - U.S. Patent 2,842,696; Strauss - U.S. Patent 4,547,696; Law - U.S. Patent 2,625,734; a journal article: "The CBS Colortron: A color picture tube of advanced design".

In general the invention aims to provide enhanced performance in high-resolution and home-entertainment-type color cathode ray tubes that utilize a tension foil shadow mask by providing an improved front assembly for the shadow mask in such tubes. The present invention therefore provides a front assembly for a cathode ray tube including a substantially flat faceplate having on its inner surface a centrally disposed

phosphor screen surrounded by a peripheral sealing area adapted to mate with a funnel, and frame means cemented to said inner surface between said sealing area and said screen for supporting and maintaining a foil shadow mask in tension at a predetermined distance from said inner surface of said faceplate, said mask having a central apertured area and a peripheral area which is secured to said frame means, characterized in that said frame means is made of weldable metal to which the mask is welded and wherein said frame means is disposed entirely on the screen side of the mask in the tube.

The invention, together with features and advantages thereof, may best be understood by reference to the following description of preferred embodiments taken in conjunction with the accompanying drawings in which:

Figure 1 is a cut-away view in perspective of a cabinet that houses a cathode ray tube having a novel front assembly according to the invention; the figure shows major components which are the subject of the invention;

Figure 2 is a side view in perspective of the color cathode ray tube of Figure 1 showing another view of components depicted in Figure 1 together with cut-away sections that show features of the novel front assembly according to the invention that includes a separate faceplate-mounted metal frame with a welded-on tension foil shadow mask;

Figure 3 is a view in elevation of a conjoined faceplate and a funnel sectioned at a 120-degree aximuthal interval, and showing in greater detail the separate faceplate-mounted metal frame with a welded-on tension foil shadow mask according to the invention;

Figure 4 is an oblique view in perspective of a section of the front assembly and its construction according to the invention, and indicating slurry flow through another embodiment of the separate faceplate-mounted metal frame according to the invention during the radial flow suffusion screening process;

Figure 4A is a top view of the section shown in Figure 4 depicting the slurry-passing structures in greater detail;

Figures 5A and 5B are views in perspective showing alternate novel slurry-passing structures according to the invention that facilitate the radial flow suffusion screening process;

Figure 6 is a sectional view in perspective showing another embodiment of the separate faceplate-mounted metal frame according to the invention as secured to a faceplate, and with a welded-on shadow mask according to the invention;

Figures 7, 7A and 7B are views in elevation showing in cross-section other embodiments of the metal faceplate frame according to the invention;

Figure 8 is a cross-sectional view in elevation showing in detail an aspect of a further embodiment of the faceplate-mounted metal frame according to the invention;

Figure 9 is a view in elevation of a section of the front assembly and associated tube funnel, similar to Figure 3 and showing a further preferred embodiment of the improved shadow mask support structure according to the invention;

Figure 9A is stick figure representation portraying diagrammatically the forces of tension and compression inherent in the Figure 9 embodiment;

Figures 10 and 11 are detail views in elevation of further embodiments of the improved shadow mask support structure according to the invention;

Figure 12 is a detail view in elevation showing another embodiment of the invention; Figure 12A depicts as variation in the Figure 12 configuration;

Figure 13 is a view similar to Figure 6 showing yet another embodiment of the invention;

Figure 14 is an oblique view in perspective and partly in section of a stabilized shadow mask support structure having at least one foot according to a further modification of the invention with a shadow mask mounted thereon;

Figures 15-18 are sectional views in elevation showing other configurative aspects of this further modification of the invention;

Figure 19 is a view in perspective of a section of a shadow mask support structure showing a further modification of the structure foot configuration of the invention;

Figure 20 is a perspective view of a section of another shadow mask support structure foot configuration according to the invention;

Figures 21-23 are plan views of further aspects of the shadow mask support structure foot configuration according to the invention;

Figure 24 is an oblique view in perspective of a front assembly according to the invention that indicates diagrammatically the flow of process coating materials during the manufacturing process;

Figure 25 is a detail perspective view in section of the mask support component of Figure 24 showing the flow of process coating materials in relation to the component;

Figure 26 is a view similar to Figure 25 depicting the final disposition of process coating materials (not to scale) providing for electrical interconnection of components of the front assembly according to the invention;

Figure 27 is a plan view of the front assembly of a tube similar to that shown in Figure 1 with parts cut away to show the relationship of the embodiment of this further modified mask support structure with the face-plate and the shadow mask of tube; an inset depicts mask apertures greatly enlarged;

Figure 28 is a cutaway view in perspective of a section of the tube front assembly of Figure 27 showing in greater detail the location and orientation of a part of this further modified shadow mask support structure following its installation in a cathode ray tube;

Figure 29 is a perspective view of a corner section of the embodiment of the shadow mask support structure depicted in Figures 27 and 28, with a section of a shadow mask secured thereto;

Figure 30 is a perspective view of a unitary shadow mask support structure according to the invention;

Figure 30A is an enlarged view of a section of Figure 30 showing an additional detail of the shadow mask support structure shown by Figure 30;

Figures 31-34 are are sectioned views in elevation showing other configurative aspects of the preferred embodiment of the invention; and

Figure 35 is a perspective view of a corner section of the embodiment of a shadow mask support shown by Figure 34.

Figure 1 depicts a video monitor 10 that houses a color cathode ray tube 12 having a novel front assembly according to the invention. The monitor-associated tube is notable for the flat imaging area 14 that makes possible the display of images in undistorted form. Imaging area 14 also offers a more efficient use of screen area as the corners are relatively square in comparison with the more rounded corners of the conventional cathode ray tube. The front assembly according to the invention comprises the components described in the following paragraphs.

With reference also to Figures 2, 3 and 4, a front assembly 15 for a high-resolution color cathode ray tube is depicted, the general scope of which is indicated by the bracket. The front assembly 15 includes a glass faceplate 16 noted as being flat, or alternately, "substantially" flat in that it may have finite horizontal and vertical radii. Faceplate 16, depicted in this embodiment of the invention as being planar and flangeless, is represented as having on its inner surface 17 a centrally disposed phosphor target 18, on which is deposited an electrically conductive film 19. The phosphor target area 18 and the conductive film 19 comprises the electron beam target area, commonly termed a "screen" 20 which serves, during manufacture, for receiving a uniform coat of phosphor slurry. The conductive film 19, which is deposited on the phosphor deposits in a final step, typically consists of a very thin, light-reflective, electron-pervious film of aluminum.

Screen 20 is surrounded by a peripheral sealing area 21 adapted to be mated with a funnel 22. Sealing area 21 is represented as having three substantially radially oriented first indexing V-grooved grooves 26A, 26B and 26C therein. The indexing grooves are preferably peripherally located at equal angular intervals about the center of the faceplate 16; that is, at 120-degree intervals. Indexing grooves 26A and 26B, also preferably located 120 degrees apart, are shown by Figure 3. The third indexing element is not shown; however, as noted, it is also located in peripheral sealing area 21 equidistantly from indexing elements 26A and 26B. The V-shaped indexing grooves provide for indexing faceplate 16 in conjunction with a mating envelope member, as will be shown.

Funnel 22 has a funnel sealing area 28 with second indexing elements 30A and 30B therein in like orientation, and depicted in Figure 3 in facing adjacency with the first indexing elements 26A and 26B. Ball means 32A and 32B, which provide complementary rounded indexing means, are conjugate with the indexing elements 26A and 26B and 30A and 30B for registering the faceplate 16 and the funnel 22. The first indexing elements together with the ball means, are also utilized as indexing means during the photoscreening of the phosphor deposits on the faceplate.

Front assembly 15 according to the invention includes a separate faceplate-mounted frame means in the form of metal frame 34 secured to the inner surface of faceplate 16 between the screen 20 and the peripheral sealing area 21 of faceplate 16, and enclosing the phosphor target 18. The separate faceplate-mounted metal frame 34 according to the invention provides for supporting a welded-on tension foil shadow mask 35 a predetermined "Q" distance from the inner surface of faceplate 16. The mask, indicated as being planar, is depicted as being stretched or tensioned in all directions in the plane of the mask. The welding, indicated by the associated weldment symbols 33, may be spot-welding. The predetermined distance may comprise the "Q-distance" 41, as indicated by the associated arrow in Figure 3. The metal faceplate frame 34 according to the invention may for example be attached to the inner surface of the faceplate by a devitrifying glass frit well-known in the art, or by a cold-setting cement such as a Sauereisen-type cement.

A neck 36 extending from funnel 22 is represented as housing an electron gun 38 which is indicated as

emitting three electron beams 40, 42 and 44 that selectively activate phosphor target 18, noted as comprising colored-light emitting phosphor deposits overlaid with a conductive film 19. Beams 40, 42 and 44 serve to selectively activate the pattern of phosphor deposits after passing through the parallax barrier formed by shadow mask 35.

Funnel 22 is indicated as having an internal electrically conductive funnel coating 37 adapted to receive a high electrical potential. The potential is depicted as being applied through an anode button 45 attached to a conductor 47 which conducts a high electrical potential to the anode button 45 through the wall of the funnel 22. The source of the potential is a high-voltage power supply (not shown). The potential may be for example in the range of 18 to 26 kilovolts in the illustrated monitor application. Means for providing an electrical connection between the electrically conductive metal faceplate frame 34 and the funnel coating 37 may comprise spring means 46 (depicted in Figure 2).

A magnetically permeable internal magnetic shield 48 is shown as being attached to faceplate-mounted metal frame 34. Shield 48 extends into funnel 22 a predetermined distance 49 which is calculated so that there is no interference with the excursion of the electron beams 40, 42 and 44, yet maximum shielding is provided.

A yoke 50 is shown as encircling tube 12 in the region of the junction between funnel 22 and neck 36. Yoke 50 provides for the electromagnetic scanning of beams 40, 42 and 44 across the screen 20. The center axis 52 of tube 12 is indicated by the broken line.

The separate faceplate-mounted metal frame according to the invention may be continuous (unbroken); however, for ease of slurry screening in certain types of screening equipment, it may according to the invention have slurry-passing structures contiguous to the inner surface of the faceplate 16 for passing radially outwardly any surplusage of slurry during the photodeposition process. Configurative aspects of such slurry-passing structures are shown in greater detail in Figures 4 and 4A, and in Figures 5A and 5B. In Figure 4, a section of metal faceplate frame 34 is shown in detail as having slurry-passing structures 53 which are contiguous to the inner surface 17 of the faceplate 16. As shown by Figure 4, and in the top view Figure 4A, the slurry passing structures 53 are depicted as comprising columns affixed to the inner surface 17 of faceplate 16, and having openings 58 therebetween. The columns will be seen to have, in the illustrated preferred embodiment, a cross-section effective to promote radial flow of the slurry 54 with minimum washback.

Other aspects of slurry-passing structure configurations according to the invention are portrayed in Figures 5A and 5B. In Figure 5A, slurry-passing apertures 59 are depicted as being a series of ovals contiguous to but not opening onto the inner surface 17 of the underlying faceplate 16; the associated arrows indicate the flow of the slurry. In Figure 5B, the slurry-passing apertures 61 are depicted as comprising a series of tunnels contiguous with the inner surface 17 of faceplate 16; the associated arrows indicate the flow of slurry. Other feasible slurry-passing aperture configurations will readily recommend themselves to those skilled in the art, with all such innovations being within the spirit and scope of the invention.

The separate faceplate-mounted metal frame that supports a welded-on tension foil shadow mask according to the invention may comprise a continuous ring of metal, as indicated by faceplate frame 34 in Figure 2. The faceplate-mounted metal frame according to the invention can as well be discontinuous ("broken") or segmented, as indicated by the metal faceplate frame 64 depicted in Figure 6. It is observed that frame 64 is "discontinuous" only in the sense that it is segmented; the sequence of the segments however is continuous along the sides of the mask. Frame 64 is shown as being attached by cement 66 to a faceplate 62; means of attachment may comprise, for example, a devitrifying glass frit or a cold-setting cement such as a Sauerelsen-type cement. Metal faceplate frame 64, noted as being discontinuous, will be seen as having gaps 68 which can act as slurry-passing apertures. A further advantage in providing a discontinuous faceplate-mounted metal frame lies in the fact that a problem may be experienced in securing a separate faceplate-mounted metal frame (the faceplate frame according to the invention) to a glass faceplate unless the two have near-exact thermal coefficients of expansion. Even a slight difference in the coefficients may result in cracking or chipping of the glass substrate unless the faceplate-mounted metal frame is segmented according to the invention; such a discontinuous or segmented faceplate-mounted metal frame is depicted in Figure 6 wherein the problem is obviated by providing the segmented metal faceplate frame 64. Discontinuous faceplate-mounted metal frame 64 is represented as having a tension foil shadow mask 70 welded to each of the segments, as indicated by the associated weldment symbols 72.

The configuration of the faceplate frame, shown diagrammatically in Figure 3 as comprising a rectangle composed of metal (reference No. 34), may according to the invention, have other forms, embodiments of which are shown in cross-section by Figures 7, 7A, 7B and 8; these forms may also have slurry-passing apertures. As depicted by Figure 7, a faceplate frame 74 according to the invention may have the configuration of an inverted "V". The frame 74 is depicted as being secured to the inner surface 76 of faceplate 78 by fillets 80 of cement, which may comprise a devitrifying glass frit. As previously described, the faceplate-mounted metal frame 74 supports a tension foil shadow mask 82 a predetermined Q-distance 85 from the inner surface

76 of faceplate 78. The mask 82 is indicated by the weld symbol as being welded on faceplate-mounted metal frame 74.

The faceplate-mounted metal frame according to the invention may also take the form shown by Figure 7A wherein frame 84 is indicated in cross-section as being a rod of solid metal, with securement to the inner surface of the faceplate indicated as being by means of fillets of cement. In the embodiment shown by Figure 7B, a faceplate-mounted metal frame 86 is shown in cross-section as being in the form of a pyramid, with the sides of the pyramid tapering toward the shadow mask 88.

Another configurative aspect of the faceplate-mounted metal frame 34 depicted in Figure 3, represented as being a rectangle, is indicated by Figure 8, wherein a rectangular faceplate-mounted metal frame 90 according to the invention is depicted as having a shadow-mask-receiving surface 92 shown as being at an angle ϕ with respect to the plane of the mask 94.

The preferred method of installing the mask is to stretch a pre-apertured shadow mask blank across the metal faceplate frame according to the invention by suitable tensioning means (not shown). The tensioned mask extends across the faceplate-mounted metal frame and is secured to the frame by welding. The welding process may be electrical resistance welding or laser welding. In a 14-inch tube for example, more than 1000 such welds at intervals of about 1.0mm (0.040 inch) are required around the circumference of the frame to ensure positive securement of the mask. Also, and had been noted, it is preferred that the mask-support frame interface be flat to ensure positive all-around welded contact between the mask and the supporting structure. The flat surface may be created by lapping; that is, rubbing the surface of the face-plate-mounted metal frame (when mounted on the face-plate) against a flat surface having an abrasive thereon.

With regard to the ball means which form an intercessory part of the indexing elements when paired, the balls are preferably formed from a composition that has a thermal coefficient of expansion compatible with the glass of the tube envelope; such compatibility is required as the balls are ultimately sealed between the sealing areas of the faceplate and the funnel at a relatively high temperature. The balls must have a diameter that provides the precise Q-spacing between the shadow mask and target area. The balls preferably have a sphericity tolerance of $\pm 0.00125\text{mm}$ (± 0.000050 inch). The balls are preferably formed of a ceramic such as forsterite, and finish-ground by means well-known in the art. The grooves are formed by an ultrasonic tool having the desired cavity shape, and which is vibrated ultrasonically in the presence of an abrasive slurry.

With regard to the composition of the separate metal faceplate frame, alloy No. 27 supplied by Carpenter Technology, Inc. of Reading Pennsylvania, is preferred. The coefficient of thermal expansion of this alloy is considered to be compatible with the glass of the faceplate.

Means other than the internal ball-and-groove elements shown and described may be used for indexing the faceplate, the mask-tensing structure, and the funnel. For example, the indexing means may be attached externally.

Figure 9 depicts another embodiment of the invention including a front assembly 115 similar to the front assembly 15 of Figure 3 but employing a different tension foil shadow-mask structure 134.

As shown in Figure 9, the shadow mask support structure 134 according to the invention is indicated as being secured to the inner surface 17 of faceplate 16 by means of a cement 154 which may comprise by way of example a devitrifying glass frit such as that supplied by Owens-Illinois under the designation CV-130. Alternately, the cement 154 may comprise a cold-setting cement of the type supplied by Sauereisen Cements Company of Pittsburgh, Pennsylvania.

This embodiment of the support structure 134, noted as being made of sheet metal, is depicted as having a peak 156 with a first surface 158 for receiving foil shadow mask 35 in tension; the preferred composition of the support structure is metal such as Carpenter Alloy No. 27 manufactured by Carpenter Technology, Inc. of Reading, Pennsylvania. (As used herein, the term "peak" means the promontory of a shadow mask supporting structure for receiving a foil shadow mask.) First surface 158 preferably has a flat surface 159 for receiving and securing the foil shadow mask 35 in tension. The thickness of the alloy No. 27 may be in the range of 0.25 to 0.50mm (10 to 20 mils), byway of example.

In general, the method of installing the mask onto the tension mask supporting structure 134 is similar to that described above in connection with Figures 1-8. Also, it is considered necessary that the peak 156 have the flat surface 159 for ensuring positive all-around welded contact between the mask 35 and the supporting structure 134. The flat surface may be created by lapping; that is, by rubbing the surface of the supporting structure (when mounted on the faceplate) against a flat surface having an abrasive thereon. The breadth of the flat surface 159 can be in the range of 0.125 to 2.5mm (5 to 100 mils) according to the invention for securing a foil mask in tension. After the mask has been tensed and secured to the supporting frame 134, excess mask material is trimmed off as indicated by trim line 161.

Referring to Figure 9A, it will be recognized that the essence of the supporting structure 134 of the Figure 9 embodiment is a compression member 163 which defines the mask-to-screen distance, and a tension mem-

ber 165 which resists the high restorative forces developed in the tension foil shadow mask by theaforedescrib-
ed tensioning; the direction of these forces is represented by the arrow 162. The compressive and tensive
aspects are indicated by the respective arrows 163A and 165A.

Another preferred embodiment of the invention is depicted in Figure 10, in which a faceplate 166 is shown
as having a foil shadow mask support structure 168 composed of sheet metal secured to the inner surface
170 of faceplate 166. Support structure 168 is depicted in this aspect of the invention as having a cross-
sectional configuration approximating an inverted "V". The peak 172 of support structure 168 provides a first
surface 174 for receiving a foil shadow mask 176 in tension. A second surface 178 is represented as extending
radially outwardly and sloping downwardly from peak 172. The second surface 178 will be noted as being closer
to the faceplate inner surface 168 than first surface 174 such that peak 172 precisely defines a predetermined
mask-to-screen Q-distance 180. Mask 176 is depicted as being secured to the peak 172 of support structure
168, as indicated by the weld symbol. Support structure 168, noted as being sheet metal in this embodiment
of the invention, can be fabricated by roll-forming or extrusion, by way of examples.

A further aspect of the invention is also depicted in Figure 10 wherein the shadow mask supporting struc-
ture 168 is indicated as being hollow. Supporting structure 168 is depicted as having, according to the inven-
tion, a hardened cement 186 within. Cement 186 is effective upon hardening to attach shadow mask supporting
structure 68 to the inner surface 170 of faceplate 166. The beneficial effect of the cement is to strengthen, in
accordance with the invention, supporting structure 168 against deflection resulting from the high tension of
the sahadow mask 176, and to firmly secure the supporting structure 68 to the inner surface 170 of faceplate
166. The enclosing of the cement within the supporting structure has another benefit in that the securement
means for the supporting structure does not intrude upon the areas of the peripheral sealing area 171 of the
faceplate nor its inner surface 170. It is essential in the installation of the cement 86 that there be no voids in
the cement as process screening 186 fluids could otherwise be retained therein to emerge later as contami-
nants in the production process.

Another embodiment of the shadow mask support is shown by Figure 11, which depicts a shadow mask
support structure 187 depicted as having in cross-section the shape of a hollow tube. The structure 184 is
secured to the inner surface 186 of a faceplate 188 on opposed sides of the screen 189. Support structure
184 is depicted as having a peak 190 for receiving and securing a shadow mask 192 in tension. Peak 190 may
have a flat surface 194 like the flat surface 159 described in connection with the embodiment of the invention
shown by Figures 9 and 9A. Support structure 184 is indicated as being secured to the inner surface 186 of
faceplate 188 by fillets 196A and 196B of cement, which may be by way of example, a devitrifying frit.

While particular embodiments of the invention have been shown and described, it will be readily apparent
to those skilled in the art that changes and modifications, as well as other embodiments of the shadow mask
support structure, may be made without departing from the invention in its broader aspects. For example, the
shadow mask support structure according to the invention may comprise the embodiments shown by Figures
12, 12A and 13. A shadow mask support structure 200 is depicted in Figure 12 as being secured to the inner
surface 202 of a faceplate 204 for supporting a shadow mask 206 on mask-receiving surface 208. Support
structure 200 is shown as being attached to inner surface 202 by fillets of cement 210 which may comprise
a devitrifying glass frit or a cold-setting cement, as heretofore described. The hollow interior 209 of mask sup-
port structure 200 could as well be completely filled with cement, as represented by mask-support structure
168 depicted in Figure 10.

Another configurative aspect of the Figure 12 embodiment of the invention is shown by Figure 12A wherein
the mask-receiving surface 208A of support structure 200A is depicted as being at an angle ϕ with respect to
the plane of the mask. A further embodiment is shown by Figure 2 wherein a mask-support structure 210 is
depicted as having a tooth-like configuration.

The various configurations of the shadow mask support structures according to the invention can be
formed by various means. For example, the structures can be fabricated by roll-forming, which is a continuous
high-production process for shaping metal strips by means of progressive forming rolls-- a method notable for
accuracy in formation and production economies. Another feasible manufacturing technique is cold-extruding,
also known as impact extruding or cold forging, which provides close tolerances and excellent surface finishes.
Casting and powder metallurgy are still other feasible fabrication techniques.

It is apparent that the shadow mask structure must be capable of holding the shadow mask under highly
tensed conditions in precise registration with the faceplate while being subject to high electron beam bombard-
ment. This condition requires a shadow mask support structure that is stabilized and is braced for maximum
resistance to lateral displacement due to the high mask tension forces exerted on the structure. It is accordingly
a further feature of the invention to provide special means on the mask supported structure to assure a sta-
bilized and braced support structure. The further modifications of the invention shown in Figures 14-26 are
directed to this feature.

Mask support structure 334 shown in Figure 14 is one example of this modified support structure exhibiting greater stability and resistance to the high mask tension forces as noted above. Structure 334 is depicted as having a surface 354 comprising a peak for receiving and securing foil shadow mask 335 under high inward tension; that is, tension toward the center of the faceplate. Mask support structure 334 according to modified aspect of the invention is characterized by having at least one foot. This embodiment is depicted as having two feet 356 and 358, resting on inner surface 17 of faceplate 16. The purpose of each foot is to brace and stabilize shadow mask support structure 334 against upset from the high tension of mask 335. Both foot 356 and foot 358 will be noted as turning inwardly. (In this application, the direction in which the foot or feet is said to turn is with respect to the support structure itself.) Foot 388 is also depicted as having a substantial heel 359.

An embodiment of the invention wherein a support structure has but one foot is shown by Figure 15. Support structure 360 is depicted as having a first surface 362 comprising a peak for receiving and securing a foil shadow mask 364 under high inward tension. Support structure 360 is represented as having a second surface 366 extending radially outwardly. First surface 362 precisely defines a predetermined mask-to-screen Q-distance 372. Support structure 360 is characterized by the termination of the second surface 366 having a foot 374 resting on and secured to inner surface 368 and turning outwardly for bracing and stabilizing structure 334 against inward upset from the high tension of mask 364.

Another aspect of this modification is depicted in Figure 16 wherein there is depicted a support structure 378 composed of sheet metal and having two legs 380 and 382 with respective feet 384 and 386 turning inwardly and resting on the inner surface 388 of the faceplate 390 for bracing and stabilizing support structure 378 against inward upset by the high tension of the associated shadow mask 392.

A further aspect of this modification of the invention is depicted in Figure 17 wherein there is represented a shadow mask support structure 394 having two feet 396 and 398 both of which turn outwardly for supporting a shadow mask 400 in high tension. Alternately, as shown by Figure 18, a shadow mask support structure 404 according to the invention has two feet 406 and 408, with foot 406 represented as turning inwardly, and foot 408 as turning outwardly.

The shadow mask support structure according to the invention depicted by Figure 14 is represented as being secured to the inner surface 17 of the faceplate 16 by fillets of cement 410, which may comprise, by way of example, a devitrifying frit. The further embodiments of the invention shown by Figures 15-18 may also be so secured.

Another aspect of this modification is depicted in Figure 19 wherein there is shown a shadow mask support structure 412 similar to the support structure 366 shown by Figure 15 in that the support structure has a single foot 414. Shadow mask support structure 412 is secured by cement to the inner surface 416 of a faceplate 418. Foot 414 is represented as having a plurality of open-ended openings 420 therein. Openings 420 facilitate according to the invention the passage of cement 422 through the foot 414, by presenting cement-contactible edges for enhancing the securement of structure 412 to the inner surface 416 of faceplate 418. The open-ended openings 520 in this embodiment of the invention are shown as comprising a series of opposing notches indicated as being rectangular. The edges of the notches could as well be rounded.

Another embodiment of the invention is shown by Figure 20 wherein a shadow mask support structure 424 is characterized by having two facing feet 426 and 428 resting on the inner surface 430 of a faceplate 432. Foot 426 and foot 428 are indicated as having a plurality of respective open-ended openings 426A and 428A therein in the form of notches for facilitating the passage of cement through the feet, and presenting cement-contactible edges for enhancing the securement of structure 424 to the inner surface 130 of faceplate 432. (The flow of the cement as indicated by cement 422 in Figure 19 is applicable as well to the structure of Figure 20, and to the feet of the support structures described infra and depicted in Figures 21-23.

The open-ended openings 426A and 428A in the respective feet 426 and 428 are depicted in Figure 20 as being in the form of a series of opposing notches. As depicted in Figure 21, the open-ended openings in the feet 426 and 428 of support structure 424 according to the invention could as well comprise notches, or openings 430 and 437, staggered with respect to each other, as depicted. Alternately, as represented by Figure 22, the openings in the foot 439 of a support structure could as well comprise closed-end openings comprising a series of apertures 440. The configuration shown by Figure 22 is unique in that some of the apertures, i.e., apertures 442, comprise "open-ended" openings. This aspect of the invention is considered beneficial in that the open-ended openings 442 act as "claws" to grip the cement used to secure the foot according to the invention to the inner surface of the faceplate.

Another configuration of the preferred embodiment is shown by Figure 23 wherein open-ended openings of the foot 444 of a support structure are shown as comprising narrow slits 446.

The benefits of the openings in the feet of a shadow mask support structure are two-fold: first, the presence of the open-ended or closed-end openings according to the invention facilitate conformance of the feet

to the inner surface of the faceplate to which they are attached; that is, if the inner surface is not truly planar, the feet can flex to adapt to the untrue contour. Secondly, the securement of the shadow mask support structure to the inner surface of the faceplate is greatly enhanced because of the presentation of cement-contactible edges to the cement used to secure the structure to the inner surface of the faceplate.

5 The various configurations of the shadow mask support structures shown in Figures 14-23 according to the invention can be fabricated by the roll-forming process as noted above. With regard to the roll-forming process, the notches or apertures in the feet can be die-cut or otherwise punched into the flat blanks prior to the forming operation.

10 The mask support structures are depicted as being hollow and are preferably formed from sheet metal. The structures could in some cases be composed of solid metal. With regard to the composition of the mask support structure 334 and the other support structures depicted, alloy No. 27 supplied by Carpenter Technology, Inc. of Reading, Pennsylvania is preferred because its coefficient of thermal expansion is compatible with the glass of the faceplate. The cement for fastening the feet of the support structures is preferably a devitrifying glass frit well-known in the art. Alternately, as has been noted, a cold-setting cement can be employed, such as one of the cements supplied by Sauereisen Cements Co. of Pittsburgh, Pennsylvania.

15 As noted above the process coating materials such as the grille coating and the phosphors for each color are typically applied in the form of a slurry which is conventionally applied by pouring the slurry onto the faceplate as it is rotated. The fluid spreads to the edges of the panel under the influence of centrifugal force, and excess fluid is cast off from the faceplate perimeter. If there is any obstacle to the free flow of the slurry during the spin-application process, the out-rushing slurry will "wash back" from the obstacle, resulting in thickened wave patterns in the coating which become fixed upon drying. The effect of the wave patterns is a non-uniformity in phosphor density thickness that can become cumulative as the process coating materials are successively applied. The presence of such wave patterns is objectionable for the reasons noted above.

20 A further aspect of the invention involves the use of a shadow mask support structure of the invention to assist in avoiding the problem caused by undesired thickened wave patterns in the faceplate coating.

25 A further modified front assembly for a color cathode ray tube according to the invention is therefore provided as shown in Figure 24. The front assembly 454 includes a faceplate 456 having on its inner surface a centrally disposed screen area 458 comprising an uncoated glass surface which receives process coating materials during the spin-application process. The application of the coating materials is indicated diagrammatically by the cup and the fluid pouring from it onto the center of screen area 458. The rotation of the front assembly for the spin-application process is indicated by the arrows 459, and the outward flow of the fluidized process materials due to centrifugal force is indicated by the center cluster of arrows 461. The rate of rotation may be e.g., in the range of 300 to 600 revolutions per minute. A shadow mask support structure 460 is represented as being secured to the inner surface of the faceplate on opposed sides of screen area 458.

30 The mask support structure 460 is shown in greater detail in Figure 25. Structure 460 is depicted as having a first surface 462 for receiving and securing a foil shadow mask in tension. In accordance with an aspect of this invention, structure 460 has a second surface 464 inclined from first surface 462 to the screen area 458. The inclination of second surface 464 in accordance with this further aspect of the invention is effective to conduct from screen area 457 any excess of the process coating materials applied during the spin-application process. This conduction is indicated by the arrows 466. As a result, discontinuities in phosphor application, and non-adherence of phosphor resulting in phosphor washoff and flake-off, are avoided, according to the invention.

35 Mask support structure 460 is depicted in this preferred embodiment of the invention as being hollow and is preferably composed of sheet metal. Structure 460 is shown as being secured to screen area 458 by fillets of cement 468 which may comprise, by way of example, a devitrifying frit. The second surface 464 inclined from first area 462 to screen area 458 is at an obtuse angle according to the invention in the range of 91 degrees to 135 degrees with respect to the plane of the screen area 458, and preferably about 120 degrees, as indicated by angle 70.

40 Another aspect of the front assembly according to the invention is shown by Figure 26 wherein the final disposition of the process materials is indicated diagrammatically. Centrally disposed screen area 458 is shown as having a deposit of grille dag 472, noted as being electrically conductive, separating triads of electron-beam-excitable phosphor deposits 474, the colorations of which are indicated by the symbols R, G and B (red, green and blue). The shadow mask support structure is of electrically conductive composition, and is shown in this embodiment of the invention as being solid metal and noted as bearing reference number 460A. Support structure 460A is represented schematically as receiving a high-voltage charge through the aforesaid spring means 446, noted as being in contact with the inner conductive coating 443 of funnel 422 of tube 412. Support structure 460A is indicated as having a deposit of electrically conductive grille dag thereon extending from and electrically connected with grille dag 472 in screen area 458. In the Figure 25 embodiment of the front assembly

according to the invention, the deposit of grille dag 472A is shown as deposited on second surface 464 which is inclined from first surface 462 to screen area 458. The beneficial result according to this aspect of the invention is that the aluminum film covering screen area 458 is, by its contact with grille dag 472A, charged to the same potential as the electrically charged shadow mask support structure without the need for any ancillary coatings or electrical connection means. The complete electrical circuit in sequence from the high voltage power supply to the screen comprises the following: conductor 449, anode button 445, internal conductive funnel coating 443, spring means 446, internal magnetic shield 448, shadow mask support structure 434, grille dag 472, and aluminum coating 420. As a result, the entire interior of the tube, with the exception of the gun area, is at a common-high electrical potential.

With regard to the composition of the mask support structure 434, alloy No. 27 supplied by Carpenter Technology, Inc. of Reading, Pennsylvania is preferred because its coefficient of thermal expansion is compatible with the glass of the faceplate.

It is desirable that first surface 462 have a flat thereon for ensuring positive all-around contact between the shadow mask and the support structure for weld integrity and the maintenance of the proper Q-distance. The flat can be formed by lapping; that is, grinding the surface of the supporting structure (when it is secured to the faceplate) against a flat surface having an abrasive thereon. The extent of the flat according to the invention is in the range of 0.075 to 3.0mm (3 to 120 mils). The lapping has another benefit in that all grille dag and contaminants which would otherwise interfere with proper welding are removed from the first surface.

As has been noted, shadow mask support means should be of high strength so the mask is held immovable; an inward movement of the mask of as little as 0.0025mm (one-tenth of a mil) is significant in expending guard band. Also, it is desirable that the shadow mask support means be of such configuration and material composition as to be compatible with the means to which it is attached. As an example, if the support means is attached to glass, such as the glass of the inner surface of the faceplate, the support means should have substantially the same thermal coefficient of expansion as the glass, and by its composition, be bondable to glass. Also, the support means should be of such composition and structure that the mask can be secured to it by production-worthy techniques such as electrical resistance welding or laser welding. Further, it is essential that the support means provide a suitable surface for mounting and securing the mask. The material of which it is composed should be adaptable to machining or other forms of shaping so that it can be contoured into near-perfect flatness so that no voids between the metal of the mask and the support structure can exist to prevent the positive, all-over contact required for proper mask securement.

With reference to Figs. 27-29, there is depicted in greater detail a further preferred embodiment of the invention comprising a separate shadow mask support structure 548 that is preferably composed of a ceramic material. Support structure 548 is depicted as having a separate cap 580 thereon, indicated as comprising a discrete metal strip, for securing shadow mask 550. Cap 580 preferably comprises a weldable material for securing shadow mask 550 by weldments, as indicated by the weldment symbols. The metal strip may be fastened to the surface 582 of the ceramic material by means of a suitable cement, the nature of which will be described infra.

The cap 580 according to the invention may as well comprise a deposit of weldable metal which may, for example be applied by electrolytically plating the metal onto the ceramic material, or, applying the metal to the ceramic material by technologies such as flame spraying or plasma arc spraying. Fritted pastes and resins can also be used as welding bases; it is essential however that the weldable surface, whatever its composition, be thick enough to accept welding without loss of weld integrity.

The shadow mask support structure 548 according to this embodiment of the invention is indicated in Figure 27 as comprising four discrete rails 548A-D; two of the rails, rails 548A and 548B, are depicted in a corner view Figure 29. The rails will be seen as being secured to the inner surface 526 of faceplate 524 on opposed sides of the screen 528 between sealing area 534 and screen 528 for receiving and supporting a foil shadow mask 550 in tension a predetermined distance from the screen. The assembly includes means for interconnecting rails 548A-D to form a generally rectangular unitary shadow mask support structure (the four-rail structure is shown by Figure 27). The preferred means according to the invention for interconnecting the four rails comprises a continuous or discontinuous weldable metal strip secured to the top of each of the rails for securing the shadow mask 450 by weldments, as indicated by the weldment symbols. The metal strip may be fastened to the surface 482 of the ceramic material by means of a suitable cement, the nature of which will be described in a following paragraph. This embodiment of the invention is represented in Figure 29 wherein metal strip 580 is shown as interconnecting two of the rails, rail 548A and rail 548B, at the intersection 586 of the rails.

Another embodiment of the invention is shown by Figure 30 wherein a shadow mask support structure comprises a unitary frame 588 composed of a ceramic. As with the embodiment of the invention shown by Figs. 27-29, unitary frame 588 is secured to the inner surface of the faceplate and encloses the screen for receiving and supporting a foil shadow mask in tension a predetermined distance from the screen. Unitary

frame may also have a separate cap of weldable metal in the form of a continuous or discontinuous metal strip thereon similar to cap 580 shown by Figure 29, for securing a shadow mask thereto by weldments. Cap 580 is shown as being continuous; a section of a discontinuous metal strip 589 is shown by Figure 30A in which the discontinuous sections are depicted as being discrete islands of metal deposited on unitary frame 588.

Also, the metal strip may be discontinuous in the sense that extensions of the strip may not be needed in corner areas as the tensing of the mask is accomplished primarily by pulling equally on all four sides rather than in the corners.

Other configurative aspects of the metal cap according to the invention are shown by Figures 31-33. Figure 31 depicts the metal cap 580 shown by Figure 29 secured to the rail 548B, indicated graphically as being composed of a ceramic material. Cap 580 is represented as being secured to the rail by means of beads 590 of a cement. Rail 548B is also indicated as being secured to the inner surface 526 faceplate 524 by beads of cement 583. The support structures shown by Figures 32-35 are indicated graphically as being similarly secured to the associated faceplate by beads of cement. As the ceramic is a highly effective electrical insulator, an electrical path must be provided from the cap 580 to the screen 528. As shown by Figure 29, and in greater detail in Figure 31, the path is provided by coating the ceramic with an electrically conductive "dag" 592, and the screen 528. Although not shown in the respective figures, this deposition of dag is noted as being applied as well to the other configurations of the shadow mask support means according to the invention.

As shown by Figure 32, the metal rail may comprise a "crown" 594 that overlaps the sides of the mask support structure, and is secured by a cement 595. As depicted in Figure 33, the crown 596 is preferably mortised into the mask support structure. This mortised-crown configuration is preferred as no voids or corners are left for the lodgement of contaminants such as remnants of screening fluids which could interfere with the operation of the finished tube. The crown can be secured to the mask support structure by a suitable cement.

With reference again to Figure 29, the electrical path from the high voltage power supply to the screen 528 and its coating of aluminum 530 is similar to that described above in connection with Figures 1 and includes contact spring 578, similar to spring means 46 in Figure 1 which makes contact with the internal conductive coating 560. The electrical path from contact spring 578 to the shadow mask 550 is shown by Figure 29, wherein contact spring 578 is shown as being welded onto the already secured shadow mask 550, as indicated by the respective weldment symbols. Electrical contact is also made with the underlying metal of cap 580 by way of the weldment. The electrical path from the shadow mask to the screen 528 is supplied by the coating of electrically conductive dag 592 depicted by Figures 29 and 31.

Another configurative aspect of the preferred embodiment of the invention is shown by Figures 34 and 35 wherein a separate metal hoop 598 is depicted as being secured to a separate hoop support means 600, which is in turn secured to the inner surface 601 of a faceplate 602. As a result, the hoop 598 derives at least a substantial part of its rigidity from faceplate 602. The separate hoop support means 600 according to the invention, also called a "buffer strip," is preferably composed of a ceramic material. (In the context of this disclosure, "hoop" means a continuous band or loop of metal formed into a rectangle to conform to the aspect ratio of the tube faceplate.) The ceramic material according to the invention is characterized by having a thermal coefficient of expansion substantially equal to the coefficient of the glass of the faceplate 602. The ceramic could as well have a coefficient intermediate to the coefficients of the glass and the metal hoop effective to absorb the stresses produced due to the differing expansion and contraction coefficients of the glass and the metal hoop. The metal hoop 598 may be secured to the ceramic material, and the ceramic material to the faceplate, by a suitable cement, indicated by the fillets of cement 604 and 606, respectively. It is noted that in all cases, in addition to comprising the fillets of cement, the cement is also applied between the attached parts; e.g., between the hoop 98 and the ceramic material, and between the ceramic material and the glass of the faceplate, for additional securement.

By way of example, the thermal coefficients of the components described may comprise--

parts per 10 million
per degree Celsius

5	separate metal hoop 598:	100
	separate ceramic hoop support means 600:	105
10	glass of faceplate 602:	106

Note: Coefficients cited pertain to a temperature range of 25 degrees centigrade (ambient) to 430 degrees centigrade (the temperature at which glass frit devitrifies in the fritting cycle.)

The metal comprising the hoop 598, and for which the coefficient figure is provided, is preferably Alloy No. 27 manufactured by Carpenter Technology, Inc. of Reading, Pennsylvania. In this example, the ceramic hoop support means 600 will be noted as having according to the invention a thermal coefficient of expansion very close to that of the glass of the faceplate. Alternately, and in accordance with the invention, the hoop support means 600 could as well have a thermal expansion coefficient intermediate to the coefficients of the glass and the metal hoop 598; e.g., a coefficient of 107×10^{-7} per degree Celsius.

Having a separate ceramic hoop support means according to the invention makes it possible to use less expensive metal for the rail in place of a more costly alloy. For example, a steel less expensive than a fully compatible alloy could as well be used, as the ceramic buffer is able to compensate for a greater disparity in coefficients of thermal expansion of the metal and the glass of the faceplate. An example of such a metal is type 430 stainless steel; it has a thermal coefficient of expansion of 111×10^{-7} per degree Celsius in the range of 25 to 430 degrees C.

Further with regard to Figure 35, a shadow mask 608 is shown as being secured to the separate metal hoop 598 by weldments, as indicated by the weldment symbols. The hoop 598 of this embodiment of the invention is noted as being of such strength as to be able by itself to resist the restorative forces of the tensed foil shadow mask. However, additional resistance to the high inward tension is provided by the ceramic hoop support means 600, which in turn takes its strength primarily from its integral securement to the glass of the faceplate.

The ceramic material may comprise, by way of example, a product known as "forsterite," designated generically as magnesium silicate. Ceramic is a refractory material that can be formed into the rails according to the invention by the dry-pressing process, or preferably, by extrusion. It is essential that the precision and linearity of its dry-pressed or extruded configuration be maintained after firing, and that warping be at a minimum. Also, the composition of the ceramic must be compatible chemically with that of the glass of the faceplate, and with the weldable metal cap or strip. Further, the ceramic must be of such composition that the internal environment of the tube will not be contaminated by the shedding of particulate matter, or by outgassing.

The composition of the ceramic or oxide composition comprises:

INGREDIENTWEIGHT PERCENT

5	Aluminum oxide	9.49
	Silicon dioxide	30.69
	Magnesium oxide	43.38
10	Potassium oxide	2.38
	Calcium oxide	1.89
	Zinc oxide	12.17

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The extrusion batch contains the ceramic composition, the organic binder/plasticizer system, and 15 to 35% water, depending on the extrusion conditions desired.

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Because of an exothermic reaction from the hydrolization of the magnesium oxide, the ingredients are pre-blended dry and then mixed with a suitable amount of water to hydrolize the magnesium. To mill the ingredients, they are combined with sufficient water to form a slurry.

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The ingredients are intimately and thoroughly mixed using ball-milling or other suitable technique to ultimately provide a very high green (pre-fired) density. The careful mixing ensures a homogeneous condition on a micro-scale. When the extrusion process is used for forming the shadow mask supports, one or more plasticizers may be added to the dry ingredients to promote a smooth extrusion with minimum pressure. For example, 3 weight per cent (of the ceramic composition) of the plasticizing agent Methocel A4M can be added to the list of ingredients described in the foregoing. In addition, 1 weight-percent of glycerine and 2 weight-percent of polyvinyl alcohol are added in the water solution to promote material flow and pre-fired strength in the mask support structure.

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Methocel A4M is a cellulose ether available from Dow Chemical Co. of Midland, Michigan; polyvinyl alcohol is available from Air Products and Chemical Co., Inc. of Calvert, Kentucky; and the glycerine and other chemicals can be had from Fisher Scientific Co. of Pittsburgh, Pennsylvania. Although specific suppliers and their designations are cited, equivalent materials of equivalent quality supplied by others may as well be used.)

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When dry pressing is used for forming the mask support structure, only 2-1/2 percent polyvinyl alcohol and 1/2 percent glycerine are required. Firing temperature is typically about 2550 degrees C with a holding time of about two hours at temperature. To meet changing production requirements, ceramic compositions having a range of coefficients of thermal expansion from 105 to 107×10^{-7} per degree C may be compounded and kept available in the production area.

40

The cement described heretofore as being used for cementing the shadow mask support structures to the faceplate (e.g., beads of cement 583 in Figure 31), and the metal strips and caps to the structures (e.g., beads of cement 590 in the same figure), preferably comprises a devitrifying glass frit such as that supplied by Owens-Illinois, Toledo, Ohio, under the designation CV-685. Alternately, the cement may comprise a cold-setting cement of the type supplied by Sauereisen Cements Company of Pittsburgh, Pennsylvania. The use of a devitrifying glass frit provides for the integral bonding of the ceramic of the mask support structure to the glass of the 5 faceplate, as both are ceramics by classification, and hence capable of the intimate bonding defined as "welding"; that is, by intimately consolidating the components of the two ceramics. By its integral attachment to the glass, the ceramic mask-supporting structure according to the invention derives support from the glass, making the structure capable of withstanding the restorative forces inherent in the high tension of the foil shadow mask. The means of securement of the shadow mask metal to the metal can be by electrical spot welding or preferably, laser welding.

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With respect to dimensions (cited by way of example), the width of the weldable metal that receives and secures the shadow mask (e.g., cap 580 in Figure 31) may be, according to the invention, a width in the range of 1.25mm (0.050 inch) to a width substantially greater than the width of the support structure; the metal crown 594 depicted in Figure 32 is an embodiment of such a width dimension. The thickness of the metal must be adequate for welding without loss of welding integrity; e.g., about 1.25mm (0.05 inch). The dimensions of the ceramic rails for use in a tube of 51 cm (20-inch) diagonal measure may be 8.9mm (0.350 inch) high 6.25mm (0.250 inch) wide, also by way of example. The cross-sectional configuration may be square, or there may be a slight inward taper near the mask-mounting surface. Opposed pairs of the four rails may have a length of

about 31 cm (12 inches) and 40 cm (15.9 inches), respectively. The Q-distance is about 10mm (0.399 inch) in the 51 cm (20-inch) diagonal tube; this height includes the thickness of the metal cap.

Typical dimensions in inches of the shadow mask support structures for a 36 cm (14-inch) diagonal measure tube are: Q-height 7.0mm (0.275 inch) and width 5.7mm (0.225 inch). The opposed pairs of the four rails have a length of about 21 cm and 28 cm. (about 8.2 and 10.9 inches).

The preferred method of installing the mask is to tension a pre-apertured shadow mask blank across the tensioned mask support structure by tensioning means as described above in connection with Figure 1-8. Also, it is considered necessary that the weldable metal cap or strip have a flat surface to ensure positive, all-around intimate contact between the mask and the cap or strip. The flat surface may be created by means of a surface grinder, or by lapping; that is, by rubbing the surface of the supporting structure (when mounted on the faceplate) against a flat surface having an abrasive thereon.

Claims

1. A front assembly (15) for a cathode ray tube (12) including a substantially flat faceplate (16) having on its inner surface a centrally disposed phosphor screen (20) surrounded by a peripheral sealing area (21) adapted to mate with a funnel (22), and frame means (34) cemented to said inner surface between said sealing area (21) and said screen (20) for supporting and maintaining a foil shadow mask (35) in tension at a predetermined distance (41) from said inner surface of said faceplate (16), said mask (35) having a central apertured area and a peripheral area which is secured to said frame means (34), characterized in that said frame means (34) is made of weldable metal to which the mask (35) is welded and wherein said frame means (34) is disposed entirely on the screen side of the mask (35) in the tube (12).
2. An assembly according to claim 1, characterized in that the sealing area (21) of the faceplate (16) has three substantially radially oriented V-shaped grooves (26A & 26B) therein for indexing said faceplate (16) in conjunction with complementary rounded indexing means (32A, 32B) associated with the funnel (22).
3. An assembly according to claim 1 or 2, characterized in that the frame means comprises a discontinuous or segmented metal frame (64) secured to said inner surface (17) of the faceplate (16).
4. An assembly according to claim 1 or 2, characterized in that said frame (84) has a solid round cross-section or said frame means (74) has a triangular cross-section.
5. An assembly according to claim 1 or 2, characterized in that said frame (90,86) is substantially rectangular or trapezoidal in cross-section.
6. An assembly according to any of the preceding claims, characterized in that the faceplate (16) of the color cathode ray tube (12) is adapted to receive during manufacture a uniform coating of phosphor slurry by the radial flow suffusion process, said frame means (34) having a plurality of slurry-passing structures (53) contiguous to the inner surface (17) of the faceplate (16) for passing any surplusage of slurry during the slurry-deposition process.
7. An assembly according to claim 6, characterized in that said slurry-passing structures comprise columns (53) affixed to said inner surface (17) and having openings (58) therebetween, said columns (53) having a cross-section effective to promote radial flow of said slurry with minimum washback.
8. An assembly according to any of claims 1 to 3, characterized in that said frame means (134) has a peak (156) with a flat surface (159) thereon having a breadth of from .13 to 2.5 mm (5 to 100 mils) for receiving and securing the foil shadow mask (35) in tension, and a second surface extending radially outwardly and closer to the faceplate inner surface than said peak (156) such that said peak (156) precisely defines a predetermined mask-to-screen Q-distance.
9. An assembly according to claim 8, characterized in that the frame means (168) is hollow with a cross-sectional configuration approximating an inverted "V", the peak (172) of which provides a surface (174) for receiving and securing the foil shadow mask (176) in tension, and a second surface (178) extending radially outwardly and sloping downwardly from said peak (172), said second surface (178) being closer to the faceplate inner surface (168) than said first surface (174) such that said peak (172) precisely defines a predetermined mask-to-screen Q-distance.

about 31 cm (12 inches) and 40 cm (15.9 inches), respectively. The Q-distance is about 10mm (0.399 inch) in the 51 cm (20-inch) diagonal tube; this height includes the thickness of the metal cap.

Typical dimensions in inches of the shadow mask support structures for a 36 cm (14-inch) diagonal measure tube are: Q-height 7.0mm (0.275 inch) and width 5.7mm (0.225 inch). The opposed pairs of the four rails have a length of about 21 cm and 28 cm. (about 8.2 and 10.9 inches).

The preferred method of installing the mask is to tension a pre-apertured shadow mask blank across the tensioned mask support structure by tensioning means as described above in connection with Figure 1-8. Also, it is considered necessary that the weldable metal cap or strip have a flat surface to ensure positive, all-around intimate contact between the mask and the cap or strip. The flat surface may be created by means of a surface grinder, or by lapping; that is, by rubbing the surface of the supporting structure (when mounted on the faceplate) against a flat surface having an abrasive thereon.

Claims

1. A front assembly (15) for a cathode ray tube (12) including a substantially flat faceplate (16) having on its inner surface a centrally disposed phosphor screen (20) surrounded by a peripheral sealing area (21) adapted to mate with a funnel (22), and frame means (34) cemented to said inner surface between said sealing area (21) and said screen (20) for supporting and maintaining a foil shadow mask (35) in tension at a predetermined distance (41) from said inner surface of said faceplate (16), said mask (35) having a central apertured area and a peripheral area which is secured to said frame means (34), characterized in that said frame means (34) is made of weldable metal to which the mask (35) is welded and wherein said frame means (34) is disposed entirely on the screen side of the mask (35) in the tube (12).
2. An assembly according to claim 1, characterized in that the sealing area (21) of the faceplate (16) has three substantially radially oriented V-shaped grooves (26A & 26B) therein for indexing said faceplate (16) in conjunction with complementary rounded indexing means (32A, 32B) associated with the funnel (22).
3. An assembly according to claim 1 or 2, characterized in that the frame means comprises a discontinuous or segmented metal frame (64) secured to said inner surface (17) of the faceplate (16).
4. An assembly according to claim 1 or 2, characterized in that said frame (84) has a solid round cross-section or said frame means (74) has a triangular cross-section.
5. An assembly according to claim 1 or 2, characterized in that said frame (90,86) is substantially rectangular or trapezoidal in cross-section.
6. An assembly according to any of the preceding claims, characterized in that the faceplate (16) of the color cathode ray tube (12) is adapted to receive during manufacture a uniform coating of phosphor slurry by the radial flow suffusion process, said frame means (34) having a plurality of slurry-passing structures (53) contiguous to the inner surface (17) of the faceplate (16) for passing any surplusage of slurry during the slurry-deposition process.
7. An assembly according to claim 6, characterized in that said slurry-passing structures comprise columns (53) affixed to said inner surface (17) and having openings (58) therebetween, said columns (53) having a cross-section effective to promote radial flow of said slurry with minimum washback.
8. An assembly according to any of claims 1 to 3, characterized in that said frame means (134) has a peak (156) with a flat surface (159) thereon having a breadth of from .13 to 2.5 mm (5 to 100 mills) for receiving and securing the foil shadow mask (35) in tension, and a second surface extending radially outwardly and closer to the faceplate inner surface than said peak (156) such that said peak (156) precisely defines a predetermined mask-to-screen Q-distance.
9. An assembly according to claim 8, characterized in that the frame means (168) is hollow with a cross-sectional configuration approximating an inverted "V", the peak (172) of which provides a surface (174) for receiving and securing the foil shadow mask (176) in tension, and a second surface (178) extending radially outwardly and sloping downwardly from said peak (172), said second surface (178) being closer to the faceplate inner surface (168) than said first surface (174) such that said peak (172) precisely defines a predetermined mask-to-screen Q-distance.



10. An assembly according to claim 9, characterized in that said frame means (168) has a hardened cement (186) disposed within its interior, said cement (186) being effective to attach said frame means (168) to said faceplate (166) and to strengthen said frame means (168) against deflection resulting from said high tension of said mask (176).
- 5 11. An assembly according to claim 8, characterized in that said frame means in cross-section has the shape of a hollow metal tube (184) secured to said inner surface (186) on opposed sides of said screen (189).
- 10 12. An assembly according to any of the preceding claims, characterized in that the frame means (334) has at least one foot (356, 358) resting on the inner surface (17) of the faceplate (16) for bracing and stabilizing said frame means (334) against upset from said high tension of said shadow mask (335).
13. An assembly according to claim 12, characterized in that said foot (356, 358) is turned inwardly or outwardly and said foot (358) preferably has a substantial heel (359).
- 15 14. An assembly according to claim 12 or 13, characterized in that said frame means (334) has two feet (356, 358) for bracing and stabilizing said frame means (334) against inward upset by said high tension of said mask (335).
- 20 15. An assembly according to claim 14, characterized in that one of said feet (406) turns inwardly and the other (408) turns outwardly.
16. An assembly according to claim 14, characterized in that both of said feet (356, 358; 384, 386; 396, 398) turn inwardly or outwardly.
- 25 17. An assembly according to any of claims 12 to 16, characterized in that the or each foot (426, 428) is provided with a plurality of open-ended openings (436, 437) or closed-ended openings (440) or notches (446) therein, said openings (440) or notches (446) facilitating passage of cement for securing said support structure (424) to said faceplate (418) through the foot (426, 428) and presenting cement-contactible edges for enhancing the securement of said structure (424) to said inner surface (416).
- 30 18. An assembly according to any of the preceding claims, wherein the screen area (458) on the inner surface of the faceplate (456) is adapted to receive process coating materials during the spin-application process in the manufacture of the cathode ray tube (10), characterized in that said frame means (460) is secured to said inner surface on opposed sides of said screen area (458), said frame means (460) having a first surface (462) for receiving and securing a foil shadow mask, and a second surface (464) inclined from said first surface (462) to said screen area (458) effective to conduct from said screen area (458) any excess of coating material applied during the spin-application process, thereby avoiding discontinuities in phosphor application visible to the viewer, and non-adherence of phosphor resulting in phosphor wash-off and flake-off.
- 35 19. An assembly according to claim 18, characterized in that the inclination of said second surface (464) is in the range of 91 degrees to 135 degrees, preferably about 120 degrees, with respect to the plane of the screen area (458).
- 40 20. An assembly according to claim 18 or 19, characterized in that the centrally disposed screen-area (458) of the faceplate (456) is provided with a deposit of electrically conductive dag (472) thereon separating triads of electron-beam-excitable phosphor deposits, said shadow mask support structure (460) being electrically charged and having a deposit of said electrically conductive dag (472a) thereon extending from and electrically connected with said dag (472) in said screen area (458), whereby said screen area (458) is charged to the same potential as said electrically charged shadow mask frame means (460).
- 45 21. An assembly according to claim 1 or 2, characterized in that the frame means (588) is composed of ceramic material such as forsterite secured to said faceplate inner surface (526) on opposed sides of said screen (528) and within said sealing area, and a separate weldable metal cap (580) with a flat surface, said surface having a width in the range of 1.27 mm (0.050 inch) to a width substantially greater than the width of said frame means (588).
- 50 22. An assembly according to claim 21, characterized in that said cap (580) comprises a discrete metal strip secured to said frame means (588), said cap (580) having a width in the range of 1.27 mm (0.050 inch)
- 55



to a width substantially greater than the width of said frame means (588).

23. An assembly according to claim 1 or 2, characterized in that said frame means is a separate metal frame (598) located between said sealing area (21) and said screen (20) for supporting a tensioned foil shadow mask (608) a predetermined distance from said inner surface of said faceplate (602), said frame (598) being integrally secured to a separate frame support means (600) which is in turn secured to said inner surface (601) of said faceplate (602), whereby said frame (598) derives at least a substantial part of its rigidity from said faceplate (602).
24. An assembly according to claim 23, characterized in that said frame means (600) is composed of a material having a coefficient of expansion equal to that of the glass of said faceplate (602), or intermediate to the coefficients of expansion of said glass and said metal frame (598) effective to absorb the stresses produced due to the differing expansion and contraction coefficients of said glass and said metal frame (598).
25. An assembly according to claim 3, characterized in that said frame means (548) comprise four discrete rails (548A-D) of ceramic secured to said inner surface on opposed sides of said screen (528), and means (580) for interconnecting the discrete rails to form a generally rectangular unitary shadow mask support structure, said interconnecting means comprising a continuous or discontinuous weldable metal cap (580) overlying each of the rails (548A-D) for receiving and securing said shadow mask (550) by weldment means.

Patentansprüche

1. Vorderteilzusammenbau (15) für eine Kathodenstrahlröhre (12), mit einem im wesentlichen flachen Schirmträger (16), der an seiner Innenoberfläche einen in der Mitte angeordneten Leuchtschirm (20) aufweist, der von einem peripheren Dichtungsbereich (21) umgeben ist, der mit einem Trichter (22) zusammengeführt werden kann, und mit einer Rahmeneinrichtung (34), die zwischen dem Dichtungsbereich (21) und dem Schirm (20) an der Innenoberfläche verklebt ist, um eine Folienlochmaske (35) unter Spannung mit einem vorbestimmten Abstand (41) zu der Innenoberfläche des Schirmträgers (16) zu tragen und zu halten, wobei die Maske (35) einen zentralen, mit Öffnungen versehenen Bereich und einen peripheren Bereich umfaßt, der an der Rahmeneinrichtung (34) befestigt ist, dadurch gekennzeichnet, daß die Rahmeneinrichtung (34) wenigstens teilweise aus einem schweißgeeigneten Metall gestaltet ist, an das die Maske (35) geschweißt wird, und wobei sich die Rahmeneinrichtung (34) vollständig auf der Schirmseite der Maske (35) in der Röhre (12) befindet.
2. Zusammenbau nach Anspruch 1, dadurch gekennzeichnet, daß der Dichtungsbereich (21) des Schirmträgers (16) drei im wesentlichen radial ausgerichtete, V-förmige Rillen (26A & 26B) aufweist, um den Schirmträger (16) in Verbindung mit zusammenpassend abgerundeten Feststelleinrichtungen (32A, 32B) einzurasten, die dem Trichter (22) zugeordnet sind.
3. Zusammenbau nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Rahmeneinrichtung einen unterbrochenen bzw. mehrteiligen Metallrahmen (44) umfaßt, der an der Innenoberfläche (17) des Schirmträgers (16) befestigt ist.
4. Zusammenbau nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß der Rahmen (84) einen vollständig runden Querschnitt aufweist, oder daß die Rahmeneinrichtung (74) einen dreiecksförmigen Querschnitt aufweist.
5. Zusammenbau nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß der Rahmen (90, 86) einen rechteckigen oder trapezförmigen Querschnitt aufweist.
6. Zusammenbau nach einem der vorstehenden Ansprüche, dadurch gekennzeichnet, daß der Schirmträger (16) der Farbkathodenstrahlröhre (12) während der Herstellung durch ein Radialströmungs-Übergußverfahren einen gleichmäßigen Überzug einer Phosphor-Gießmasse empfangen kann, wobei die Rahmeneinrichtung (34) eine Mehrzahl von Gießmasse-Durchflußgefugen (53) aufweist, die an die Innenoberfläche (17) des Schirmträgers (16) grenzen, um während dem Gießmasse-Ablagerungsvorgang etwaige überschüssige Gießmasse weiterzuleiten.



7. Zusammenbau nach Anspruch 6, dadurch gekennzeichnet, daß die Gießmasse-Durchflußgefüße Säulen (53) umfassen, die an der Innenoberfläche (17) befestigt sind und dazwischen Öffnungen (58) aufweisen, wobei die Säulen (53) eine Querschnittsform aufweisen, die eine Radialströmung der Gießmasse mit minimalem Rücklauf unterstützt.
- 5 8. Zusammenbau nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß die Rahmeneinrichtung (134) eine Spitze (156) aufweist, die darauf eine flache Oberfläche (159) mit einer Breite von 0,13 bis 2,5 mm (5 bis 100 Milliinch) zum Empfang der Folienlochmaske (35) und zum unter Spannung halten der Maske besitzt, und mit einer zweiten Oberfläche, die sich radial auswärts und näher an der Innenoberfläche des Schirmträgers erstreckt als die Spitze (156), so daß die Spitze (156) präzise einen vorbestimmten Q-Abstand von der Maske zu dem Schirm definiert.
- 10 9. Zusammenbau nach Anspruch 8, dadurch gekennzeichnet, daß die Rahmeneinrichtung (168) hohl ist und ungefähr die Querschnittsform eines auf dem Kopf stehenden "Vs" aufweist, wobei die Spitze (172) des Vs eine Oberfläche (174) zur Aufnahme und Befestigung der Folienlochmaske (176) unter Spannung aufweist, sowie eine zweite Oberfläche (178), die sich radial nach außen erstreckt und von der Spitze (172) einen Neigungswinkel nach unten aufweist, wobei sich die zweite Oberfläche (178) näher an der Innenoberfläche (168) des Schirmträgers befindet als die erste Oberfläche (174), so daß die Spitze (172) präzise einen vorbestimmten Q-Abstand von der Maske zu dem Schirm definiert.
- 15 10. Zusammenbau nach Anspruch 9, dadurch gekennzeichnet, daß die Rahmeneinrichtung (168) ein gehärtetes Bindemittel (186) aufweist, das sich in dem Inneren der Einrichtung befindet, wobei das Bindemittel (186) dazu dient, die Rahmeneinrichtung (168) an dem Schirmträger (166) zu befestigen und die Rahmeneinrichtung (168) gegen eine Durchbiegung aufgrund der hohen Spannung der Maske (176) zu verstärken.
- 20 11. Zusammenbau nach Anspruch 8, dadurch gekennzeichnet, daß die Rahmeneinrichtung die Querschnittsform einer hohlen Metallröhre (184) aufweist, die an entgegengesetzten Seiten des Schirms (189) an der Innenoberfläche (186) befestigt ist.
- 25 12. Zusammenbau nach einem der vorstehenden Ansprüche, dadurch gekennzeichnet, daß die Rahmeneinrichtung (334) mindestens einen Fuß (356, 358) aufweist, der an der Innenoberfläche (17) des Schirmträgers (16) anliegt, um die Rahmeneinrichtung (334) gegen eine Stauchung bzw. Umstürzung aufgrund der hohen Spannung der Lochmaske (335) zu versteifen und zu stabilisieren.
- 30 13. Zusammenbau nach Anspruch 12, dadurch gekennzeichnet, daß der Fuß (356, 358) nach innen oder außen gedreht ist, und wobei der Fuß (358) vorzugsweise ein festes Endstück (359) aufweist.
- 35 14. Zusammenbau nach Anspruch 12 oder 13, dadurch gekennzeichnet, daß die Rahmeneinrichtung (334) zwei Füße (356, 358) zur Versteifung und Stabilisierung der Rahmeneinrichtung (334) gegen eine Einwärtsumstürzung aufgrund der hohen Spannung der Maske (335) aufweist.
- 40 15. Zusammenbau nach Anspruch 14, dadurch gekennzeichnet, daß sich einer der Füße (406) nach innen und der andere Fuß (408) nach außen dreht.
- 45 16. Zusammenbau nach Anspruch 14, dadurch gekennzeichnet, daß sich beide Füße (356, 358; 384, 386; 396, 398) nach innen oder nach außen drehen.
- 50 17. Zusammenbau nach einem der Ansprüche 12 bis 16, dadurch gekennzeichnet, daß der Fuß bzw. die Füße (426, 428) darin jeweils mit einer Mehrzahl von Öffnungen mit offenem Ende (436, 437) oder Öffnungen mit verschlossenem Ende (440) oder Kerben (446) versehen sind, wobei die Öffnungen (440) oder Kerben (446) den Durchfluß von Bindemittel zur Befestigung der Tragkonstruktion (424) durch den Fuß (426, 428) an dem Schirmträger (418) ermöglichen und dabei Bindemittel-Berührungskanten vorsehen, die die Befestigung der Konstruktion (424) an der Innenoberfläche (416) verbessern.
- 55 18. Zusammenbau nach einem der vorstehenden Ansprüche, dadurch gekennzeichnet, daß die Schirmfläche (458) an der Innenoberfläche des Schirmträgers (456) die Überzugswerkstoffe des Verfahrens während dem Drehen bei der Herstellung der Kathodenstrahlröhre (10) empfangen kann, dadurch gekennzeichnet, daß die Rahmeneinrichtung (460) an entgegengesetzten Seiten der Schirmfläche (458) an der Innenober-



fläche befestigt ist, wobei die Rahmeneinrichtung (460) eine erste Oberfläche (462) für die Aufnahme und die Befestigung einer Folienlochmaske aufweist, sowie eine zweite Oberfläche (464), die von der ersten Oberfläche (462) zu der Schirmfläche (458) geneigt ist und die dazu geeignet ist, während dem Drehvorgang aufgetragenes, überschüssiges Überzugsmaterial von der Schirmfläche (458) zu leiten, wodurch für den Betrachter sichtbare Unterbrechungen des Leuchtstoffüberzugs vermieden werden, sowie ein nichthaltender Zustand des Leuchtstoffs, was ansonsten zu einem Abwaschen und Abplatzen von Leuchtstoff führt.

19. Zusammenbau nach Anspruch 18, dadurch gekennzeichnet, daß der Neigungswinkel der zweiten Oberfläche (464) zu der Ebene der Schirmfläche (458) im Bereich von 91 Grad bis 135 Grad und vorzugsweise bei etwa 120 Grad liegt.
20. Zusammenbau nach Anspruch 18 oder 19, dadurch gekennzeichnet, daß die sich in der Mitte des Schirmträgers (456) befindende Schirmfläche (458) darauf mit einer Ablagerung eines elektrisch leitenden Graphitüberzugs (472) versehen ist, welche die Triaden der durch einen Elektronenstrahl erregbaren Leuchtstoffablagerungen trennt, wobei die Tragkonstruktion (460) der Lochmaske elektrisch geladen ist und darauf eine Ablagerung eines elektrisch leitfähigen Graphitüberzugs (472a) aufweist, der sich von dem leitenden Graphitüberzug (472) in dem Schirmbereich (458) erstreckt und elektrisch mit diesem verbunden ist, wodurch die Schirmfläche (458) auf das gleiche Potential geladen wird wie die elektrisch geladene Rahmeneinrichtung (460) der Lochmaske.
21. Zusammenbau nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Rahmeneinrichtung (588) aus einem Keramikwerkstoff wie etwa Forsterit gestaltet ist, der an entgegengesetzten Seiten des Schirms (528) und innerhalb des Dichtungsbereichs an der Innenoberfläche (526) des Schirmträgers befestigt ist, und mit einem separaten schweißbaren Metallschirm (580) mit einer flachen Oberfläche, wobei die Oberfläche eine Breite im Bereich von 1,27 mm (0,050 Inch) bis zu einer Breite aufweist, die größer ist als die Breite der Rahmeneinrichtung (588).
22. Zusammenbau nach Anspruch 21, dadurch gekennzeichnet, daß der Schirm (580) einen diskreten Metallstreifen umfaßt, der an der Rahmeneinrichtung (588) befestigt ist, wobei der Schirm (580) eine Breite im Bereich von 1,27 mm (0,050 Inch) bis zu einer Breite aufweist, die größer ist als die Breite der Rahmeneinrichtung (588).
23. Zusammenbau nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Rahmeneinrichtung einen separaten Metallrahmen (598) darstellt, der sich zwischen dem Dichtungsbereich (21) und dem Schirm (20) befindet, um eine unter Spannung stehende Folienlochmaske (608) in einem vorbestimmten Abstand zu der Innenoberfläche des Schirmträgers (602) zu tragen, wobei der Rahmen (598) integral an einer getrennten Rahmenträgereinrichtung (600) befestigt ist, die wiederum an der Innenoberfläche (601) des Schirmträgers (602) befestigt ist, wodurch der Rahmen (598) wenigstens einen beachtlichen Teil dessen Steifheit von dem Schirmträger (602) erlangt.
24. Zusammenbau nach Anspruch 23, dadurch gekennzeichnet, daß die Rahmeneinrichtung (600) aus einem Werkstoff gestaltet ist, der einen Ausdehnungskoeffizienten aufweist, der dem des Glases des Schirmträgers (602) entspricht, oder der zwischen den Ausdehnungskoeffizienten des Glases und des Metallrahmens (598) liegt, so daß die Belastungen wirksam aufgenommen werden können, die aufgrund der unterschiedlichen Ausdehnungs- und Zusammenziehungskoeffizienten des Glases und des Metallrahmens (598) erzeugt werden.
25. Zusammenbau nach Anspruch 3, dadurch gekennzeichnet, daß die Rahmeneinrichtung (548) vier getrennte Riegel (548A-D) aus Keramik umfaßt, die an entgegengesetzten Seiten des Schirms (528) an der Innenoberfläche befestigt sind, sowie eine Einrichtung (580), welche die getrennten Riegel miteinander verbindet, so daß eine im allgemeinen rechteckige, unitäre Lochmasken-Tragkonstruktion gestaltet wird, wobei die Verbindungseinrichtung einen ununterbrochenen oder unterbrochenen, schweißbaren Metallschirm (580) umfaßt, der jeden der Riegel (548A-D) überlagert, um die Lochmaske durch Schweißen aufzunehmen und zu befestigen.



Revendications

1. Ensemble avant (15) destiné à un tube à rayons cathodiques (12) comprenant une plaque avant sensiblement plate (16) ayant à sa surface interne un écran luminescent (20) disposé au centre et entouré par une zone périphérique de soudage (21) destinée à coopérer avec un entonnoir (22), et un cadre (34) collé à la surface interne entre la zone de soudage (21) et l'écran (20) et destiné à supporter et maintenir un masque (35) formé d'une feuille mise sous tension à une distance prédéterminée (41) de la surface interne de la plaque avant (16), le masque (35) ayant une zone centrale comprenant des orifices et une zone périphérique fixée au cadre (34), caractérisé en ce que le cadre (34) est formé au moins en partie d'un métal soudable auquel est soudé le masque (35), et le cadre (34) est entièrement disposé du côté du masque (35) tourné vers l'écran dans le tube (12).
2. Ensemble selon la revendication 1, caractérisé en ce que la zone de soudage (21) de la plaque avant (16) comporte trois gorges en V (26A et 26B) pratiquement orientées radialement et destinées à positionner la plaque avant (16) par rapport au dispositif complémentaire arrondi (32A, 32A) de positionnement associé à l'entonnoir (22).
3. Ensemble selon la revendication 1 ou 2, caractérisé en ce que le cadre comporte un cadre élémentaire métallique discontinu ou segmenté (64) fixé à la surface interne (17) de la plaque avant (16).
4. Ensemble selon la revendication 1 ou 2, caractérisé en ce que la cadre élémentaire (84) a une section pleine circulaire ou le cadre (74) a une section triangulaire.
5. Ensemble selon la revendication 1 ou 2, caractérisé en ce que le cadre élémentaire (90, 86) a une section pratiquement rectangulaire ou trapézoïdale.
6. Ensemble selon l'une quelconque des revendications précédentes, caractérisé en ce que la plaque avant (16) du tube à rayons cathodiques (12) en couleurs est destinée à recevoir, pendant la fabrication, un revêtement uniforme d'une suspension luminescente par un procédé de suffusion par écoulement radial, le cadre (34) ayant plusieurs structures (53) de passage de suspension contiguës à la surface interne (17) de la plaque avant (16) pour le passage du surplus éventuel de suspension pendant l'opération de dépôt de suspension.
7. Ensemble selon la revendication 6, caractérisé en ce que les structures de passage de suspension comportent des colonnes (53) fixées à la surface interne (17) et des ouvertures (58) placées entre elles, les colonnes (53) ayant une section favorisant efficacement l'écoulement radial de la suspension avec un entraînement minimal.
8. Ensemble selon l'une quelconque des revendications 1 à 3, caractérisé en ce que le cadre (134) a un pic (156) ayant une surface plate (159) dont la largeur est comprise entre 0,13 et 2,5 mm (5 à 100 mils) pour la réception et la fixation du masque (35) formé d'une feuille sous tension, et une seconde surface disposée radialement vers l'extérieur et plus proche de la surface interne de la plaque avant que le pic (156), afin que le pic (156) délimite avec précision une distance Q prédéterminée entre le masque et l'écran.
9. Ensemble selon la revendication 8, caractérisé en ce que le cadre (168) est creux et a une configuration en coupe correspondant approximativement à un "V" inversé, le pic (172) du cadre formant une surface (174) destinée à recevoir et fixer le masque (176) formé d'une feuille sous tension, et une seconde surface (178) dépassant radialement vers l'extérieur et inclinée vers le bas depuis le pic (172), la seconde surface (178) étant plus proche de la surface interne (168) de la plaque avant que la première surface (174), si bien que le pic (172) délimite avec précision une distance prédéterminée Q entre le masque et l'écran.
10. Ensemble selon la revendication 9, caractérisé en ce que le cadre (168) a une colle durcie (186) placée à l'intérieur, la colle (186) fixant efficacement le cadre (168) à la plaque avant (166) et renforçant le cadre (168) lorsqu'il fléchit du fait de la tension élevée du masque (176).
11. Ensemble selon la revendication 8, caractérisé en ce que le cadre a, en coupe, la configuration d'un tube métallique (184) fixé à la surface interne (186) sur les côtés opposés de l'écran (189).
12. Ensemble selon l'une quelconque des revendications précédentes, caractérisé en ce que le cadre (334)



a au moins un pied (356, 358) en appui à la surface interne (17) de la plaque avant (16) et destiné à renforcer et stabiliser le cadre (334) afin qu'il ne soit pas déformé par la tension élevée du masque (335).

13. Ensemble selon la revendication 12, caractérisé en ce que le pied (356, 358) est tourné vers l'intérieur ou l'extérieur, et le pied (358) a de préférence un talon important (359).
14. Ensemble selon la revendication 12 ou 13, caractérisé en ce que le cadre (334) a deux pieds (356, 358) destinés à renforcer et stabiliser le cadre (334) afin qu'il ne soit pas déformé vers l'intérieur par la tension élevée du masque (335).
15. Ensemble selon la revendication 14, caractérisé en ce que l'un des pieds (406) est tourné vers l'intérieur et l'autre (408) vers l'extérieur.
16. Ensemble selon la revendication 14, caractérisé en ce que les deux pieds (356, 358 ; 395, 386 ; 396, 398) sont tournés vers l'intérieur ou l'extérieur.
17. Ensemble selon l'une quelconque des revendications 12 à 16, caractérisé en ce que le pied ou chaque pied (426, 428) a plusieurs ouvertures (436, 437) à extrémités ouvertes ou plusieurs ouvertures (440) à extrémités fermées ou des encoches (446), les ouvertures (440) ou encoches (446) facilitant le passage de la colle pour la fixation de la structure de support (424) à la plaque avant (418) par l'intermédiaire du pied (426, 428), et présentant des bords destinés à être au contact de la colle et à augmenter la fixation de la structure (424) à la surface interne (416).
18. Ensemble selon l'une quelconque des revendications précédentes, dans lequel la zone (458) de l'écran à la surface interne de la plaque avant (456) est destinée à recevoir des matières de revêtement pendant l'application par rotation au cours de la fabrication du tube à rayons cathodiques (10), caractérisé en ce que le cadre (460) est fixé à la surface interne sur les côtés opposés de la zone de l'écran (458), le cadre (460) ayant une première surface (462) destinée à recevoir et fixer un masque sous forme d'une feuille, et une seconde surface (464) inclinée de la première surface (462) vers la zone de l'écran (458) et destinée à conduire efficacement, à distance de la zone de l'écran (458), tout excès de matière de revêtement appliquée pendant l'opération d'application par rotation, si bien que les discontinuités d'application de la matière luminescente, visibles par l'utilisateur, sont évitées, et le défaut d'adhérence de la matière luminescente résultant d'un écaillage ou d'un entraînement de la matière luminescente est aussi évité.
19. Ensemble selon la revendication 18, caractérisé en ce que l'inclinaison de la seconde surface (464) est comprise entre 91 et 135° et est de préférence d'environ 120° par rapport au plan de la zone d'écran (458).
20. Ensemble selon la revendication 18 ou 19, caractérisé en ce que la zone d'écran (458) placée au centre de la plaque avant (456) porte un dépôt d'une couche conductrice de l'électricité (472) séparant des triades de dépôts luminescents excitables par un faisceau électronique, la structure (460) de support du masque étant chargée électriquement et ayant un dépôt de la couche conductrice de l'électricité (472a) partant de la couche (472) formée sur la zone d'écran (458) et reliée électriquement à cette couche, si bien que la zone d'écran (458) est chargée au même potentiel que le cadre (460) du masque chargé électriquement.
21. Ensemble selon la revendication 1 ou 3, caractérisé en ce que le cadre (588) est composé d'une matière céramique, telle que la forstérite, fixée à la surface interne (528) de la plaque avant sur les côtés opposés de l'écran (528) et dans la zone de soudage, et d'un capuchon métallique soudable séparé (580) ayant une surface plate, la surface ayant une largeur comprise entre 1,27 mm (0,050 pouce) et une valeur nettement supérieure à la largeur du cadre (588).
22. Ensemble selon la revendication 21, caractérisé en ce que le capuchon (580) est une bande métallique séparée au cadre (588), le capuchon (580) ayant une largeur comprise entre 1,27 mm (0,050 pouce) et une valeur nettement supérieure à la largeur du cadre (588).
23. Ensemble selon la revendication 1 ou 2, caractérisé en ce que le cadre est un cadre élémentaire métallique séparé (598) fixé entre la zone de soudage (21) et l'écran (20) afin qu'il supporte un masque (608) formé d'une feuille sous tension à une distance prédéterminée de la surface interne de la plaque avant (602), la cadre élémentaire (598) étant fixé afin qu'il soit solidaire d'un dispositif de support séparé (600) de cadre qui est fixé à son tour à la surface interne (601) de la plaque avant (602), si bien que le cadre (598)



dérive une partie importante de sa rigidité au moins de la plaque avant (602).

- 5 24. Ensemble selon la revendication 23, caractérisé en ce que le cadre (600) est composé d'une matière ayant un coefficient de dilatation égal à celui du verre de la plaque avant (602) ou compris entre les coefficients de dilatation du verre et du cadre métallique élémentaire (598) afin qu'il absorbe les contraintes produites dues aux différences de coefficients de dilatation et de contraction du verre et du cadre métallique élémentaire (598).
- 10 25. Ensemble selon la revendication 3, caractérisé en ce que le cadre (548) comporte quatre rails séparés (548A-D) d'une céramique, fixés à la surface interne sur les côtés opposés de l'écran (528), et un dispositif (580) d'interconnexion des rails séparés afin qu'ils forment une structure unitaire de support de masque de forme générale rectangulaire, le dispositif d'interconnexion comprenant un capuchon métallique soudable continu ou discontinu (580) qui recouvre tous les rails (548A-D) afin qu'il reçoive et fixe le masque (550) par un dispositif de soudage.
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