

March 15, 1960

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2,928,968

CATHODE-RAY TUBE SWITCHING GRID SUPPORT SYSTEM

Filed Feb. 27, 1959

5 Sheets-Sheet 1

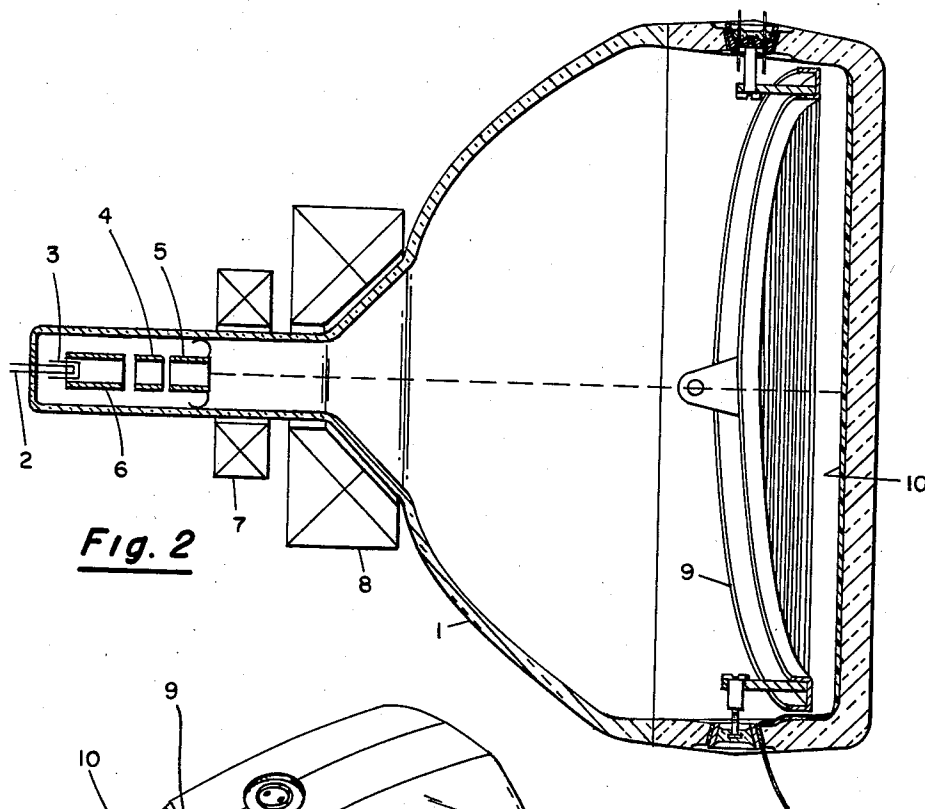


Fig. 2

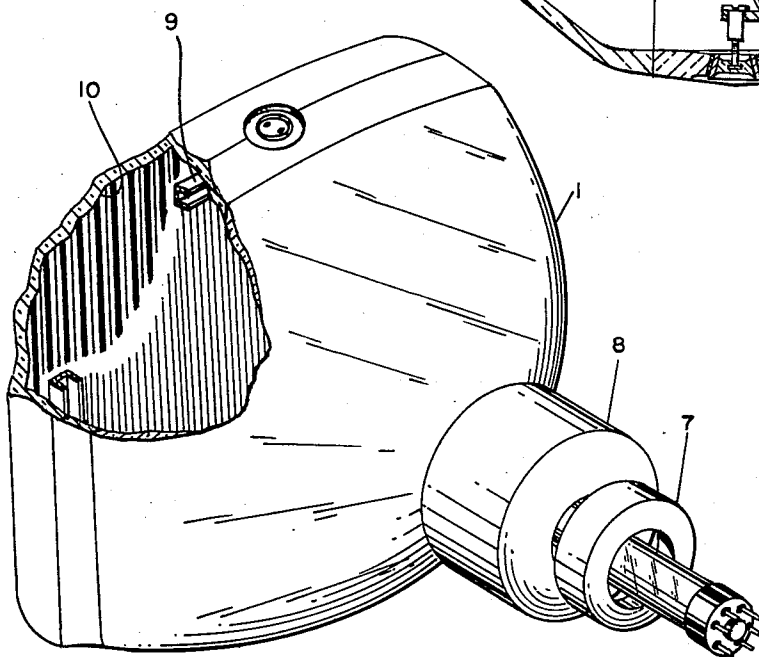


Fig. 1

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5 Sheets-Sheet 2

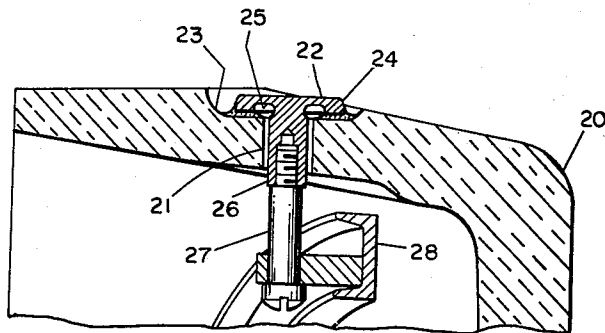


Fig. 3

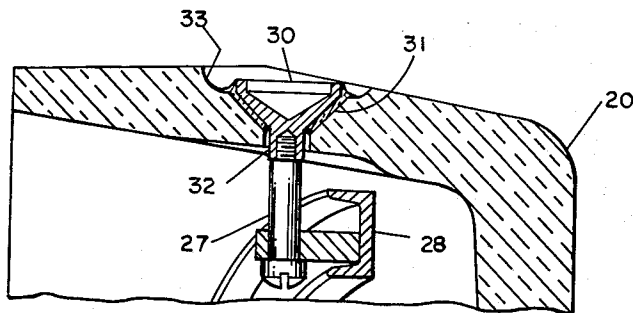


Fig. 4

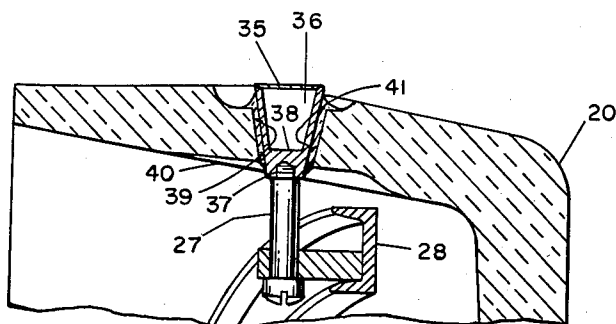


Fig. 5

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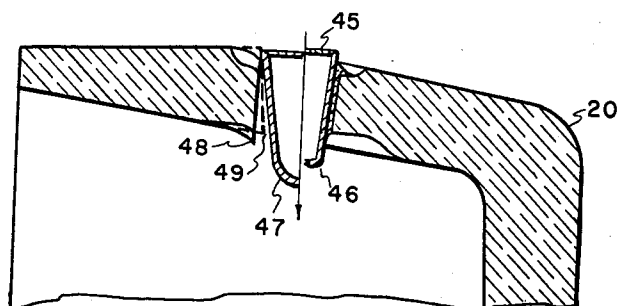


Fig. 6

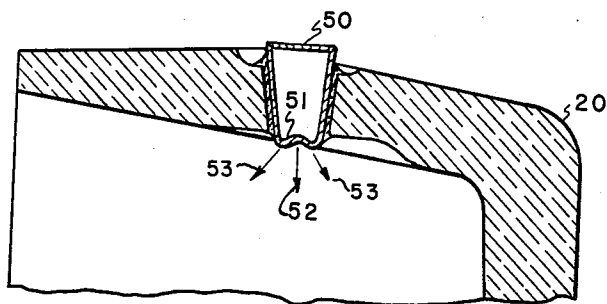


Fig. 7

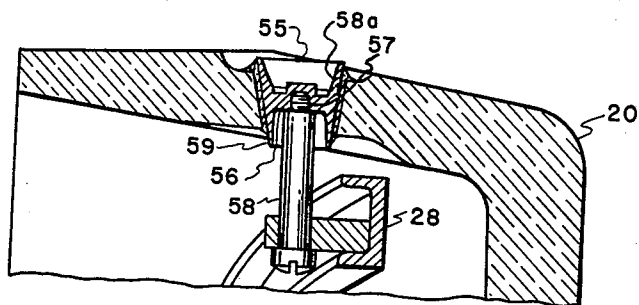


Fig. 8

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Filed Feb. 27, 1959

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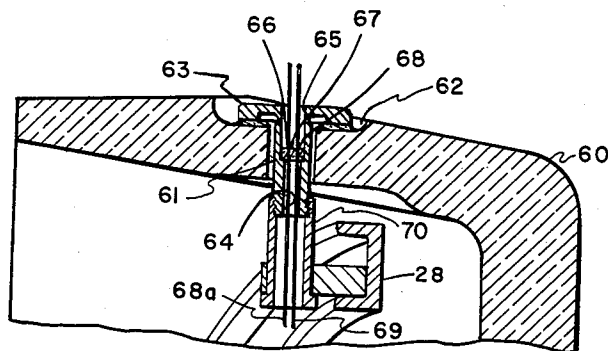


Fig. 9

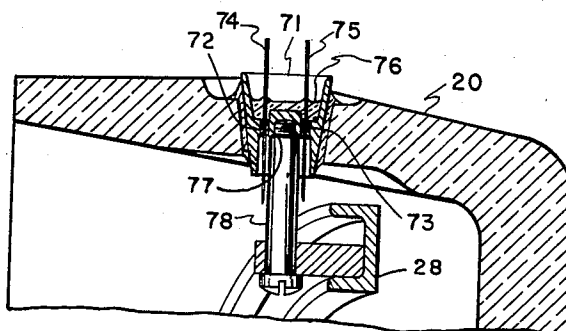


Fig. 10

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Filed Feb. 27, 1959

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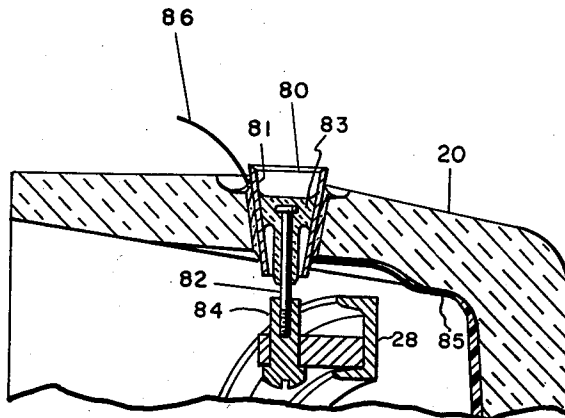


Fig. 11

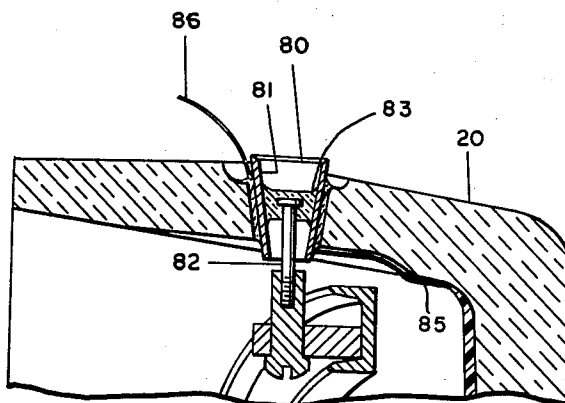


Fig. 12

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2,928,968

CATHODE-RAY TUBE SWITCHING GRID SUPPORT SYSTEM

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Application February 27, 1959, Serial No. 796,001

5 Claims. (Cl. 313-64)

This invention relates in general to cathode-ray tubes of the post acceleration type having color control switching grids and is particularly directed to support means therefore which alleviate over-stressing and rupture of the tube glass under loading conditions in the area of the support, while still permitting access therethrough of connectors for excitation of the internal tube electrodes.

In the applicant's co-pending application Serial No. 719,975, filed March 7, 1958, now abandoned, the invention described therein, and entitled "A Grid Frame Support Structure for Cathode-Ray Tubes," discloses the principles for mounting the switching grid in a Lawrence type color cathode-ray tube, and how the tensile loading of the grid wires of the grid is shared in whole or in part between the grid frame and the glass envelope of the cathode-ray tube. It is necessary, for this particular type support mounting, to exercise caution in order not to over-stress the support points to which the grid is attached. The glass in particular in the immediate area of the support member, because of the tensile stresses to which it is subjected to, could and does rupture and crack thus destroying the vacuum of the tube and eliminating its usefulness as a picture reproducing device. To more clearly show the relationship of support to grid, and the importance of their proper positioning, it may be advisable to describe in a general way the operation of the color tube itself.

The cathode-ray picture tube utilizing the switching grid above referred to, incorporates the principle known as "post deflection focusing" (PDF). The tube itself is designed with a relatively large number of narrow component color phosphor strips laid down in a predetermined manner or sequence to form a screen or target electrode on the face plate or viewing surface of the tube. The phosphor strips luminesce in various component colors of the images to be synthesized when impacted by the cathode-ray beam. For example, the order in which the phosphor strips are laid down may be red, green, blue, green, red, green and so forth, keeping in mind that the color of a phosphor as used in the instant invention refers to the color of light emitted therefrom which reaches the eye of the observer. In order that the path of an electron arriving at the phosphor screen from the cathode emitter may be controlled in a selective manner in the vicinity of a target, a grid assembly is provided and located adjacent to the phosphor screen. The grid and screen together comprise a color control structure of the type to which the present invention is particularly applicable and directed to. The grid in question consists of a large number of fine wires or linear conductors extending in the same general direction as the phosphor strips, and lying in the path of the moving electrons which are directed to the target electrode from the electron gun of the cathode-ray tube. The wires of the grid assembly are electron-optically related to the phosphor strips so that, in the electron-optical sense, there is a grid wire aligned with each blue strip, and also a wire aligned with each red strip. Between the actual or nominal plane of the

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wire assembly and the conductive coating on the phosphor strip, a difference of potential is established. By properly choosing the amplitude and polarity of this potential difference, a series of converging electrostatic fields for controlling the beam electrons is produced or effected. These converging fields may be akin, in an optical sense, to cylindrical lenses because a beam electron arriving at the wire grid from the electron gun of the tube is made to converge and form a fine line pattern on the surface of the phosphor target. It will be appreciated that the particular scanning operation, by means of which the beam electrons are caused to trace out a raster pattern at the surface of the grid wires, has no direct geometrical relationship to the actual line structure developed on the target electrode, the latter being determined solely by the configuration of the wires of the grid assembly.

Inasmuch as the grid wires above stated are electron-optically aligned with the phosphor strips, a zero potential difference say between the red and blue terminals of the wire grid will result in the beam electrons undergoing a focusing action alone, therefore, the electrons may be caused to impinge the target within the boundaries of a particular strip such as green. Subsequently the conductors associated with the red strips are made positive relative to the conductors electron-optically related to the blue strip so that the beam electrons will now be subjected to an auxiliary or micro-deflection over and above that due to the deflection providing the raster. Under these conditions the lines of impingement of the electrons will lie within the respective boundaries of the red strip. Similarly, electrons will strike the blue strip when the wires associated therewith are suitably positive with respect to the red wires. Different component colors of the images are thus displayed according to the potential difference, if any, between the two sections of the grid wire assembly.

In designing the color structure of the above type, the grid wires must be maintained in positive relation to the phosphor strips of the target electrode. The spacing between the grid surface and phosphor coated surface of the target is critical in many respects and must remain substantially unchanged during the operation of the color tube. This substantially means a suitable mounting support properly and accurately attached to the glass bulb for supporting the grid with no appreciable movements or displacement thereto resulting from temperature changes, mechanical movements of the tube and the like. Any changes in the relative positioning of a grid with respect to the target surface may result in color impurity or contamination and distortion of the picture image. To obviate these shortcomings and limitations, it is the purpose of the instant invention to provide a specially designed ferrule type mounting support for the grid structure, suitably affixed to the glass of the tube so as to provide a minimum amount of tensile stresses to the glass surface under loading conditions at the point of support.

Prior support members, to which the grid structure was attached, were generally of the rigid and inflexible type and properly so in order to adequately support the said grid structure. However, under conditions of temperature cycling and under certain load conditions, the glass in the area of the support member has a tendency to move in a direction away from the said support. Because of the rigidity of the support member, the said member failed to follow the movement of the glass so that a rupture occurred at the point where glass and support were bonded. This rupture destroyed the usefulness of the tube as a picture reproducing device. Therefore, another object of the present invention is to provide a support member for the grid structure which will be rigid enough to properly support the said grid, but will still be flexible, sufficiently so, as to follow the move-

ment of the glass in the area of the said support under said temperature cycling and loading conditions, thus avoiding the rupture of the glass bulb in the area of the said support member.

In the post acceleration type cathode-ray tube where a pair of switching grids are operably disposed, the excitation thereof requires holes to be drilled into the glass to allow the passage of conductors for purposes of exciting the switching grids. Another hole through the glass bulb is necessary in order to permit the entrance of a conductor for exciting the high voltage anode. It is obvious that the larger the number of bores and holes in the glass bulb, the weaker and more costly the tube becomes. It is, therefore, another object of the invention to provide support members so disposed as to permit access therethrough of grid switching and high voltage anode connectors without the need for additional holes through the glass bulb, while simultaneously permitting the grids to be supported by the said support members.

In the bonding procedure for attaching a support member to the glass panel, the said member must and should be accurately centered with respect to the bore through the glass panel. Failure to accurately position the support member with respect to the hole results in an error with respect to the positioning of the grid structure relative to the target surface on the face plate panel. This error results in a faulty picture image as previously stated. It is therefore a still further object of the invention to provide a support member which is self-centering with respect to the bore when bonded to the glass panel in the area of the said bore. Other advantages and objects of the invention will become apparent from a careful study of the specifications and accompanying drawings and wherein;

Figs. 1 and 2 show a cathode-ray tube employing the post-deflection grid principle and the relative positioning of the grid with respect to the target surface and its support according to the invention;

Figs. 3-5 show several types of support members for the grid structure according to the invention;

Figs. 6-8 illustrate the development of the support member for the grid structure and how it is supported;

Figs. 9-12 show various types of support members according to the invention and also the manner of permitting the penetration of conductors therethrough for the purpose of exciting the internal electrodes of a cathode-ray tube.

Throughout the following description of the invention, to better facilitate the understanding thereof, like parts will be designated by the same reference numbers wherever it is at all feasible. Now referring to Figs. 1 and 2 there is shown a cathode-ray tube which, as previously stated, incorporates the principles known as the "post deflection focusing" (PDF). There is associated with a tube the conventional components for controlling, in part, the path of flow of the electrons as they emanate from the electron source. In particular, there is a heater type filament 2 and a cathode 3 associated therewith for the purpose of providing a source of electrons. The first and second anodes 4 and 5 respectively, along with the control grid 6, are for the usual purpose of controlling the velocity of the electron beam along with the high voltage anode 5. The focusing control device 7 and deflection control means 8 are also provided for suitably deflecting and focusing the beam to produce the usual raster pattern. The (PDF) switching or color control grid 9 is so disposed within the tube envelope as to have each of the control wires comprising the grid appropriately aligned with a phosphor strip of the target surface 10. The proper alignment of the grid structure requires suitable supports that allow a minimum amount of tensile stresses about the support point at the inner part of the tube when loaded. Applicant, in his prior application above referred to, explained that tensile stresses of the grid wires were taken up in part or whole by the tube

glass. However, the glass under such loading conditions in the area of the support member behaves analogous to a simple structural beam loaded at the central part thereof. In such a case, the bottom portion of the beam is in tension and the top portion in compression in the area of the loading point. Since glass is relatively weak in tension as compared to compression, the tendency of the glass is to break, crack or rupture in the area of the said tensile loading. To alleviate or obviate this condition, the applicant has conceived the idea that in the area of the loading, a support member should be used that could resist the effect of the bending tendency of the glass or at least reduce this effect to a minimum. Figs. 3-8 show the development sequence of the support member which gave the desired end result.

In particular there is shown in Fig. 3 a glass panel member 20 having a hole 21 bored therethrough, and a support member 22 inserted within the hole and appropriately bonded. The bore or hole 21 in the glass panel 20 has an upper counterbore 23 of greater diameter communicating therewith. The support member 22 has an upper flange 24 which seats along the surface of the counterbore 23 and is there bonded by some suitable cement or glass frit. The flanged end portion of the support member has an annular groove 25 running along the inner periphery which defines an annular space when the said member is seatably mounted upon the face plate panel along the said counterbore. The support member 22 has an internally threaded portion 26 at the extremity opposite to the flange 24 for receiving a threaded bolt 27 which fixedly connects the switching grid 28 to the support member when threadably engaged therewith. The ferrule 22 is cemented or bonded to the panel by a glass frit suitably applied between the said counterbore and upper surfaces of the support member. The glass frit can be any of those generally designated as the devitrifying types well known in the art and which matches the thermal expansion characteristic of both glass and metal to which it is bonded. It is possible under heated conditions for the frit to flow so that the support member may and does sometimes undergo a slight movement or displacement. Also the frit may freely flow into the bore in an uncontrolled manner. The support member, under these conditions, may not be truly aligned, axially, with the bore so that the grid relative to the target may be slightly off and also the bond between support members and glass may be weakened. To alleviate this condition another type of support member, such as that shown and illustrated in Fig. 4 was devised.

Fig. 4 shows a support member 30, the upper portion 31 of which is conical in shape, the lower portion 32 or remainder being similar in design to the configuration shown in Fig. 3. In this particular type of design, the conical portion is self-centering when seated upon the conical bore 33 and forcibly engaged therewith under loading conditions. This self-centering effect alleviated in part the displacement tendencies of the support member 22 in Fig. 3 when bonded to the glass of the cathode-ray tube. However, here again it may be appreciated that the frit which bonds the support member 31 to the panel 20 flows freely in an uncontrolled manner when fired within the area between the lower portion of the said support member and panel. This freely flowing frit runs into the panel thereby leaving an uneven distribution of frit about the support member to create an unsuitable bond between the said tube glass and support member. This effect weakens the structural support for the tube grid. To offset this undesirable condition as illustrated in Figs. 3 and 4, a thimble type ferrule support 35, as shown in Fig. 5, was developed.

In Fig. 5, the support member 35 is similar in shape to a frustrum of a cone, the major diameter being exposed to the external or outer portion of the tube and the minor diameter exposed to the inside or internal part of the

tube. The support member 35 has recessed cavities 36 and 37 running from both ends of the support member inwardly to a central transverse wafer like part 38 which separates the said cavities. The upper cavity 36 facing the outside portion of the tube is relatively deep compared to the lower cavity 37. The wall thickness of the support member along the upper cavity portion is relatively thin as compared to the wall thickness of the said support member along the lower cavity. The outer periphery of the lower cavity of the said support member is threaded for receiving a threaded bolt member 27 in a manner similar to that shown in Fig. 3 for attaching the grid structure to the said support. The support member 35, because of its tapering design, produces a downward force or pressure all along the bearing surface between the said support and bore 39 through the glass panel. Because of this bearing pressure, the frit lodged within the area bounded by the glass panel and support is prevented from freely running or otherwise flowing out of the area defined by the said support and bore when under fired or fused conditions. Instead the frit is evenly and uniformly distributed about the bearing surfaces in a controllable manner so that adequate and even bonding results. Further because of the controlled fused frit, a proper amount thereof extends beyond the upper and lower ends of the ferrule and flows between the said ferrule and panel member to form a fillet. The fillets are added safeguards against cracking and chipping of the glass corners. The tapered design feature of the ferrule causes it to become self-centering when seated in the bore of the glass panel regardless of loading and firing conditions. When the ferrule or support member 35 is under loaded conditions, there is a tendency for the glass at the area under tension about the lower periphery 40 of the tapered bore 41 to separate from the support member or ferrule. This tendency to separate under loaded conditions causes the rupturing of the glass. To more clearly understand this particular phenomenon, there is shown in Fig. 6 an illustration of the effects occurring between the glass and ferrule when the said ferrule is under loaded and unloaded conditions. In Fig. 6, the glass face plate panel 20 has a ferrule type member 45, similar in design to that shown in Fig. 5 and designated by reference member 35. The ferrule in Fig. 6 is shown in two parts, the unloaded part 46 being normal in shape, and the loaded part 47 distorted, but distortion being exaggerated here for purposes of illustration. The ferrule 47, when undergoing a downward pull or force tends to pull the glass down in the area of the bore at the lower extremity thereof as indicated by the reference member 48. The bending or pulling down action of the glass panel member in the area of a bore is illustrated by solid lines, and the unloaded condition of the panel illustrated by dotted lines. It thus can be seen that there is a definite separation between the glass panel and ferrule, as shown by the gap 49, here also exaggerated for purposes of illustration. The ferrule member because of its rigidity fails to follow this distensible movement of the glass under loaded conditions. Hence, this failure to follow results in separation or rupture of the glass, a condition which cannot possibly be tolerated. This undesirable condition may be alleviated if the said ferrule were flexible in the area of the bending so that it could follow the distensible movements of the glass. Another way of eliminating this undesirable condition would be to have the lower portion of the ferrule press outward in a direction to follow the distensible movement of the glass under loaded conditions. The ferrule 50, of the type shown in Fig. 7, could be used which would satisfy in part the condition of flexibility at the base portion of the ferrule, and simultaneously therewith provide a radial movement outward at the said base to follow the distensible movement of the glass panel member.

In Fig. 7 the ferrule 50 being somewhat thimble-like in shape has at the base thereof a dimple-like extension at the center of the base to which the load is affixed. A downward pull or force 52 at the point or location of the

dimple produces outward and downward radial forces 53 along the ferrule base to follow the distensible movement of the glass panel as previously mentioned.

Fig. 8 shows a support member 55 encompassing some of the desirable features shown in Figs. 5 and 7. The support member 55 is shaped like a frustum of a cone and in sections appears generally H-shaped. The central or bridging arm 56 of the H-portion has a threaded hole 57 for receiving threaded bolt 58 which in turn supports the grid structure 28. The upper and lower arm portions 58a and 59 respectively of the H-section of the ferrule 55 are both tapered outwardly from the bridging arm of the H-section to the ends of the ferrule so as to create end sections which are relatively flexible with respect to the control part of the said ferrule. A factor to consider with respect to support member 55, is that because of the flexibility of the lower ring portion 59, there is a tendency for it to follow the distensible movement of the glass to which it is bonded so that there will be no separation or rupture of glass and ferrule resulting from such movements. It can thus be appreciated that the support member 55 provides a means for supporting the grid structure 28 in such a manner so as to overcome the tendency of the glass panel to rupture in the area of the support due to undue tensile stresses operating thereat when under grid loading conditions. As previously mentioned, flexibility of the ferrule at the inner surface of the panel prevents rupture of the glass, since it is here that the glass panel is under tensile stresses when normally loaded. However, if for some reason the tube were subjected to shock of one nature or another, such as in handling and shipping, the loading effect on the panel would be outward as opposed to inward normal conditions. This means the outer part of the glass panel would be under tensile stresses while the inner part of the panel would be under compressive stresses. To guard against rupture of the glass at the external surface under such conditions, the ferrule, as stated above, is tapered outwardly to provide the necessary flexibility to follow the distensible movement of the glass.

Now referring to Figs. 9 and 10 there is shown ferrule support members, according to the invention, of an added feature consisting of connecting leads or conductors passing through the ferrule. In particular, Fig. 9 shows a glass panel member 60 having a bore 61 and counterbore 62 for receiving support member 63 to which it is bonded. The support member 63 has a central hole 64, the upper part 65 thereof being of a greater diameter. A glass wafer 66 having a pair of apertures 67 and 68 for receiving conductors 68a and 69 respectively, is seated upon the shoulder separating the upper and lower parts of the central hole 64, and bonded by a suitable cement. The lower portion of the support member is externally threaded for receiving internally threaded mounting bolts 70 attached to the grid structure for the support thereof.

The support ferrule 71 in Fig. 10 is similar in shape and design to the ferrule 55 of Fig. 8, but in addition thereto has a pair of holes 72 and 73 for the H-portion of the ferrule for receiving conductors 74 and 75, the said conductors provided for the purpose of exciting the switching grids of the tube when connected thereto. The conductors 74 and 75, in particular are bonded to and insulated from the body of the ferrule 71 by glass 76 or some other suitable type of insulating material. Here also, as in Fig. 8, the H-portion of the ferrule has a central threaded hole 77 for receiving externally threaded bolt 78 in threadable engagement to support the said grid structure.

Another feature of the invention involves the use of the support ferrule as a means for providing access through of a connector which excites the high voltage anode of the cathode-ray tube. In particular, Figs. 11 and 12 show several types of ferrule 80 which embody this particular feature while still retaining all the other advantages inherent in this type of support, as previously

described above. In particular, the ferrule support member 80 comprises a shell-like casing 81 shaped like a cone frustum and having a threaded bolt 82 centrally disposed within the casing and fixedly bonded to and insulated therefrom by a volume of glass 83 in which the said bolt is encased, the glass occupying the volume space defined by the bolt and inner surface of the shell. Again the grid structure 28 is supported to the glass panel 20 by the threaded bolt 84 which threadably engages the threaded bolt 82. The high voltage anode 85, coated to the inner surface of the tube, is electrically connected to the lower extremity of the shell, and the external connector 86, which carries the high voltage potential for exciting the high voltage anode 85, is electrically connected to the upper extremity of the shell 81. It may thus be appreciated that by providing one ferrule of the type shown in Fig. 10 and another of the type shown in Fig. 11, and placing them at the opposite extremities of at least one of a pair of grid axis, as shown in Fig. 2, it is possible to not only suitably support the grid structure, but also to excite the internal tube electrodes without the need for additional apertures, holes or conductors penetrating the face plate panel.

It may be appreciated that many changes in the designs of the various support members and the manner of sealing them to the glass panel may be made, and that such support members may find use in cathode-ray tubes other than the types disclosed herein, all without detracting from the true purpose and intent of the invention.

Having defined the invention, what is claimed is:

1. In a cathode-ray tube having a glass face plate panel upon which a phosphor coated target screen is disposed to display images and a color control grid structure in proximity thereto and spacially aligned therewith incorporated within the panel, a support system for the grid structure comprising support means including a support member having flexible outer extremities bonded to the glass panel for supporting the grid structure adjacent to said screen to maintain the fixed spacial alignment therewith, means for mounting the grid structure to the said support means, the support member being so disposed when bonded to the glass panel member to have the said flexible outer extremities follow the distensible movements of the glass panel in the area of the support when under tensile stresses due to the grid structure loading effect.

2. In a cathode-ray tube having a substantially rectangular glass face plate panel with tapered holes at opposing ends of at least one of a pair of axis of the panel and a phosphor coated target screen disposed to display color images, a color control switching grid structure in proximity to the said screen and support members, therefore, in combination the grid structure comprising a grid frame having a dual set of switching grids defining a common surface with each insulated from the other and each composed of a plurality of parallel spaced fine wires running from edge to edge of at least one of a pair of ends of the said grid frame, tapered support members cemented within the said holes and compatible therewith, means for securing the said grid to the said support members to maintain the proximate relation between the said grid structure and screen, the said support member being so disposed when supporting the said grid to constrain the glass panel from rupturing in the area of the support member and hole.

3. In a cathode-ray tube according to claim 2 and wherein the said grid securing means includes a transverse structural member within the said support member to which the grid is supported and which transfers outwardly radial forces of the said support member to follow the distensible movements of the glass panel member when under tensile stresses.

4. In a cathode-ray tube with a glass face plate panel having at least a pair of holes therethrough and upon which a phosphor coated screen, having a high voltage anode, is disposed to display television images and a grid structure in proximity thereto and spacially aligned therewith incorporated within the panel, a support system for the grid structure comprising support means including a shell-like ferrule type support member bonded to the glass panel within the holes for supporting the grid structure adjacent to said screen to maintain the fixed spacial alignment therewith, means for mounting the grid structure to the said support means, the support member being so disposed when bonded to the glass panel member within the hole to constrain the glass from rupturing in the area of the support when under temperature cycling and tensile stresses due to the grid structure loading effect when mounted to the said support means, and means confined within the said support means including a central support member for supporting the said grid to the said ferrule and insulated from the shell of the said ferrule thereby permitting the excitation of the said high voltage anode used from the shell portion of the ferrule.

5. In a cathode-ray tube with a glass face plate panel having at least a pair of holes therethrough and upon which a phosphor coated target screen is disposed to display images and a grid structure in proximity thereto and spacially aligned therewith incorporated within the panel, a support system for the grid structure comprising support means including a support member bonded to the glass panel within the holes for supporting the grid structure adjacent to said screen to maintain the fixed spacial alignment therewith, means for mounting the grid structure to the said support means, the support member being so disposed when bonded to the glass panel member within the hole to constrain the glass from rupturing in the area of the support when under temperature cycling and tensile stresses due to the grid structure loading effect when mounted to the said support means, and means including a disc like wafer of insulating material bonded to the support member and having a plurality of apertures therethrough for receiving a plurality of conductors for exciting at least one or more electrodes within the said cathode-ray tube.

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