Jan. 15, 1952 R. S. MOORE 2,582,843

CONTACT SPACED TARGET-MESH ASSEMBLY FOR TELEVISION PICKUP TUBES

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Fig. 3

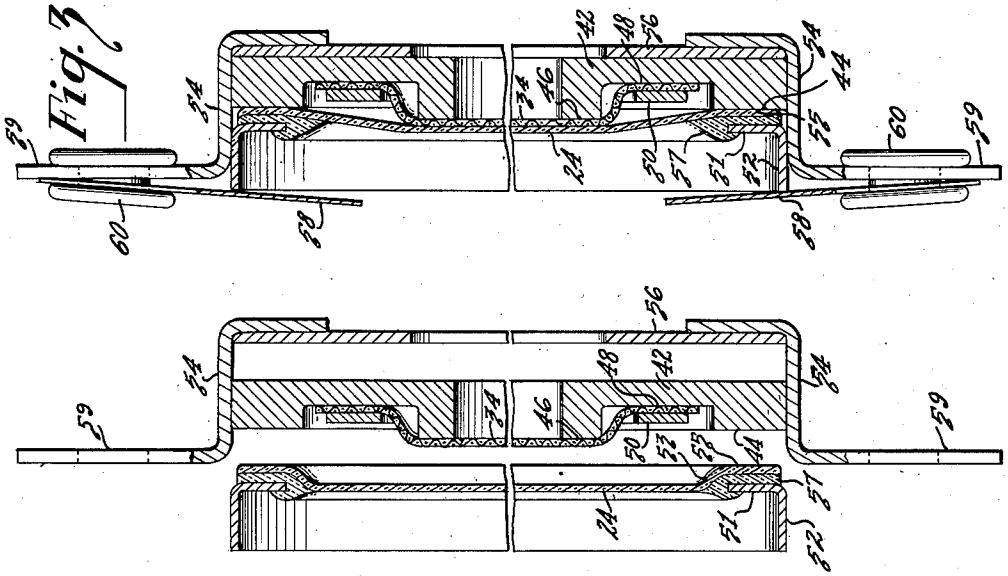


Fig. 2

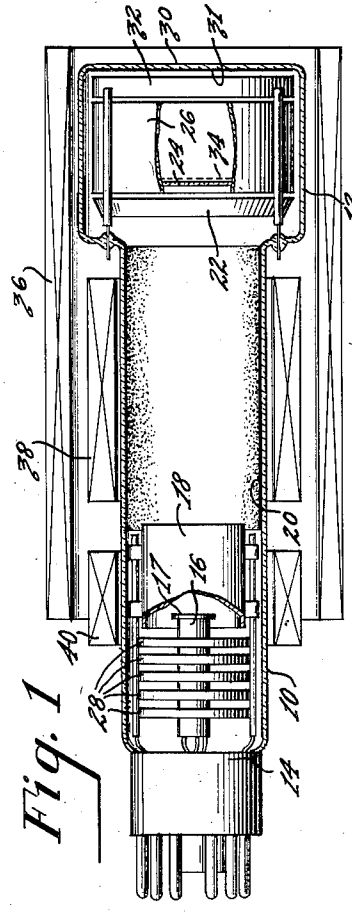


Fig. 1

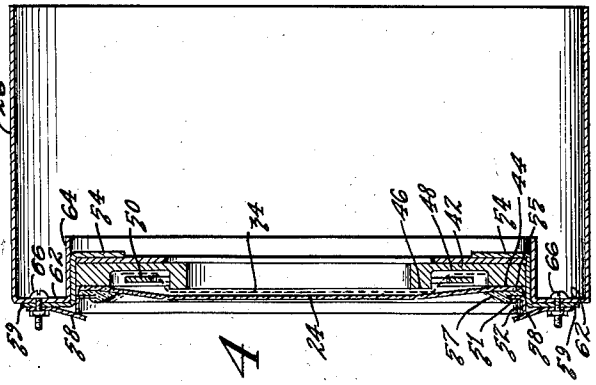


Fig. 4

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CONTACT SPACED TARGET-MESH ASSEMBLY FOR TELEVISION PICKUP TUBES

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13 Claims. (Cl. 313—89)

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This invention relates to target beam tubes, or, more specifically, television pickup tubes.

One type of television camera pickup tube consists of a photo-cathode upon which the scene to be televised is focussed. The light falling upon the cathode electrode releases a photo-electric emission from all parts of the photo-cathode with an intensity corresponding to the amount of light striking each elemental part. The photo-electrons are maintained in relatively parallel paths and are caused to strike a thin glass target. The energy imparted to the photo-electrons striking the glass target is sufficient to cause a secondary emission from the glass target surface greater than unity. A fine mesh screen overlying the target surface is used as a collector electrode for the secondary emission which will leave a positive charge pattern on the surface of the glass target corresponding to the optical image focussed upon the photo-cathode electrode. The opposite side of the glass target is scanned by an electron beam which is caused to approach the glass target at close to zero velocity. Due to the extreme thinness of the glass target, the electrostatic image on the one side of the target sets up the same image potential on the scanned side of the target. Electrons from the cathode beam will be drawn to the positive areas of the target surface and will be deposited on the target to neutralize the positive potential pattern on the glass. The deposited beam electrons discharge the target surface to cathode potential at which point the remainder of the beam is reflected back along its path and is collected to form the video signal of the tube.

The glass target of the tube described above is preferably made of semi-conducting glass so that the electrons deposited by the beam on one side of the target can move through the glass to neutralize the positive charge pattern on the opposite side. The resistivity and thickness of the glass target are chosen so that the beam electrons will move through the target thickness in less than a frame time of the scanning beam and before the charges deposited on the surface can spread laterally and impair resolution. Targets of this kind are disclosed in the application of Albert Rose filed November 28, 1945, Serial No. 631,441, and now U. S. Patent No. 2,506,741, granted May 9, 1951 and reference is made thereto for further details of the target and its function.

In tubes of the type described, the fine mesh screen collector electrode and the glass target are mounted together as a unitary target assembly. Also, in some tubes of the type described, it is desirable that the fine mesh collector screen be in contact with the thin glass target surface at all points, due to the fact that in practice the mesh screen and glass target have non-planar surfaces. Any non-uniform spacing between the screen and target surfaces results in a variation in the signal level. Also, a fine mesh screen which is in contact with the glass target surface provides increased capacity between the screen and glass target. This results in greater signal output for the tube as well as a greater signal-to-noise ratio.

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It is therefore an object of my invention to provide an improved target assembly for electron beam tubes, and particularly for use in television pickup tubes.

It is a further object of my invention to provide a target and screen assembly for television pickup tubes having uniformity of operation over the target surface.

It is an object of my invention to provide a glass target and screen assembly having an increased capacitance between the screen and glass target surface.

It is another object of my invention to provide a target screen assembly which will produce a greater signal-to-noise ratio.

It is a further object of my invention to provide an assembly in which a mesh screen is in contact with a glass target uniformly over the target surface.

It is another object of my invention to provide a mesh screen in uniform contact with the non-planar surface of a glass target.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims, but the invention itself will best be understood by reference to the following description taken in connection with the accompanying drawing, in which:

Figure 1 is a cross sectional view of a television pickup tube of the type utilizing my invention. Figure 2 is an exploded view of the target assembly structure according to my invention. Figure 3 is a sectional view of the target assembly structure according to my invention and Figure 4 is a sectional view showing the mounting of the target assembly structure on an electrode of the tube of Figure 1.

There is disclosed in Figure 1 a television transmitting tube comprising an envelope 10 of glass, or of some other appropriate material, having an enlarged section 12 at one end thereof. Within the other end of the tubular en-

velope 10 is mounted a conventional electron gun structure 16 for providing an electron beam of low velocity which is focussed and accelerated by an anode electrode 20, formed as a wall coating on the inner surface of the envelope 10. A decelerating electrode 22 reduces the velocity of the electron beam so that it approaches a thin glass target 24 at practically zero velocity. An electro-magnetic coil 36 surrounds the tubular envelope 10 and provides a focussing field aligning the electron beam perpendicularly to the surface of the glass target 24. A neck yoke 38 comprises two pairs of coils (not shown) which provide a pair of scanning or deflecting fields perpendicular to each other and to the axis of the tube for causing the electron beam of the tube to scan the surface of target 24. The pairs of coils of yoke 38 are connected into appropriate circuits (not shown), which provide sawtooth pulses, as is well known in the art, for furnishing the scanning magnetic fields.

The enlarged portion 12 of the tube envelope 10 is closed by a transparent face plate 30 on the inner surface of which is formed a photocathode surface 31. A scene, which is to be televised, is optically focussed upon the photocathode surface 31 and causes photoelectrons to be emitted from each elemental area of the photocathode surface in proportion to the amount of light striking the elemental areas of the photosurface. The electron emission from the photocathode surface is focussed on the target 24 by the magnetic field of coil 36 and the accelerating fields of electrodes 32 and 26. The photoelectrons are accelerated to such an extent that they strike the surface of the glass target 24 with sufficient energy to cause a secondary electron emission greater than unity. A fine mesh screen 34 is closely spaced from the surface of the glass target 24 and is maintained during tube operation at a potential up to several volts positive relative to the cathode potential of the electron gun 16.

The low velocity electron beam of gun 16 scanning the surface of target 24 will bring the potential of the glass target 24 to approximately that of the cathode of the gun 16. At this potential the scanning electron beam will not land on the target surface but will be electrostatically reflected back along the axis of the tube 10. The secondary emission caused by the bombardment of target 24 by the photo-electrons from the photosurface 31 will leave the surface of the glass target 24 facing the photocathode charged in a positive charge pattern varying according to the optical image focussed upon the photocathode 31. Due to the extreme thinness of glass target 24, positive charges on the right hand side of the target of Figure 1, will set up a corresponding positive potential pattern on the opposite or scanned side of target 24. As the electron beam of gun 16 is caused to scan the surface of the target 24, electrons from the beam will be drawn to the positive areas of the target surface and will be deposited to neutralize the positive potential pattern on the glass. The deposited beam electrons will discharge the target surface to cathode potential, at which point the remainder of the electron beam is reflected back toward the gun structure 16. The negative charges deposited on the gun side of target 24 will unite by conduction through the glass target with the positive charges on the photocathode side of the glass target within a frame time. The reflected electron beam will be modulated by the subtraction of the electrons deposited

upon the surface of glass target 24 and in accordance with the positive charge pattern formed thereon. The modulated return beam will strike the end 17 of the gun structure 16, which is a dynode surface and forms the first stage of a multiplier section 28. The modulated return beam is thus amplified by the multiplier section 28, the collector 29 of which is connected into appropriate circuits (not shown) to form a video signal. A television pickup tube of the type described and utilizing a similar multiplier section is disclosed in United States Patent 2,433,941 to Paul K. Weimer. A coil 40 surrounds the end of the electron gun structure 16 for correctly aligning the primary electron beam with the axis of the electrode system.

In some types of tubes, graphically disclosed in Figure 1, it is desirable that the collector screen 34 be in contact with the surface of the glass target 24. If the screen 34 is in contact with the surface of the glass target 24, the capacity between screen 34 and the adjacent target surface is greatly increased and a better signal-to-noise ratio is achieved.

Due to the manner in which target 34 is formed, it has been difficult in the past to provide a satisfactory target assembly in which the mesh screen 34 is in contact with the surface of glass sheet 24. Also due to the thickness of the glass sheet 24 which averages around 0.1 mil, and due to the manner in which it is made, it is difficult to form such a thin sheet lying wholly in one plane. Consequently, if contact between screen 34 and target 24 is achieved, screen 34 will touch at some points but not at others. This non-uniformity of spacing between the screen 34 and the glass film 24 causes a variation in signal intensity from one point of the glass target to another.

In Figure 2, there is shown a novel arrangement for mounting the mesh screen 34 in contact with the glass target 24 and by which the previous difficulties encountered are largely eliminated. There is provided a flat mesh support frame or mounting ring 42, having two surfaces 44 and 46 respectively with a depressed surface portion 48 therebetween. The portions 44 and 46 form annular ribs extending completely around the frame 42. These ribs or extending surface portions 44 and 46, as shown in Figure 2, are coaxial with each other and with frame 42. The fine mesh screen 34 is mounted on the support ring 42 by placing the peripheral edge of the screen over the depressed portion 48 between rib portions 44 and 46 and welding a ring 50 through screen 34 to the bottom of the depression 48 to tightly clamp the edge of screen 34 therebetween. The welding ring 50 has a thickness less than the depth of the depressed portion 48 so that the exposed surface of ring 50 is below the surface of the ribbed portions 44 and 46.

The glass target 24 (Figures 2 and 3) is mounted within a support ring 52 having an inwardly turned flange portion 51 to which the glass sheet 24 is sealed. The formation of thin glass targets, similar to that used in this invention, is fully disclosed in the application Serial No. 631,441, filed November 28, 1945, by Albert Rose.

The glass target support ring 52 is coated on the flange portion 51 with a low melting point glass shown at 57. The glass sheet 24 is formed from a large glass bubble and is placed on the supporting flange portion 51 of the ring 52. The assembly is then heated in an oven, where at appropriate temperatures the low melting point

glass coating 57 on flange 51 will soften and seal the edge 55 of the glass target 24 to the ring 52. At the same time, the glass of the sheet 24 will also soften, and due to the surface tension of the softened glass material, the bubble from which the sheet 24 is formed will draw up and contract to form a relatively flat sheet 24. As is shown in both Figures 2 and 3, during the process of sealing, the glass target 24 is pulled down from its peripheral edge 57 by the low melting point glass so that the plane of sheet 24 does not include the surface of the target edge 55. That is, around the annular inner edge of the flange 51, the glass sheet drops away from the edge 55 of the target surface as indicated at 53. It has been found that the glass sheet 24 will thus sink into the opening of the support ring 52, in places as much as 4 mils from its peripheral edge portion 55. This tendency of the glass to sink into the ring opening makes it difficult to place the mesh screen 34 in contact with the whole surface of sheet 24 and also provides variable spacings between the screen 34 and glass surface 24 from 2 to 4 mils.

However, the novel design of the mesh support frame 42 provides a means to place screen 34 in contact with the target surface 24 and also eliminates any variable spacing between the screen 34 and the glass target 24. The rib surface 46 of the support frame 42 projects outwardly a greater distance than the rib surface 44. Thus, as is shown in Figure 3, when the target support ring 52 with the glass sheet 24 is brought down into contact with the screen support frame 42, the periphery 55 of the glass target 24 is forced tightly into contact with the lower rib surface 44. The higher rib surface 46 forces the mesh screen 34 against the glass sheet 24 and also displaces the center of glass sheet 24 farther away from the plane of its periphery 55. Within limits, the glass sheet 24 is sufficiently flexible that it will not be broken when displaced by the rib surface 46. In this manner, the rib portion 46 not only presses the screen 34 into contact with the sheet 24, but also tends to stretch the glass sheet 24 across the open center of the annular rib portion 46 of the supporting frame 42. This arrangement eliminates any spacing between the glass sheet 24 and the screen 34. Furthermore, if, during its formation, the sheet 24 results in being non-planar due to the non-uniform sinking of the sheet into the opening of ring 52, the annular rib surface 46 by displacing the sheet 24, within its flexible limits, will cause that part of sheet 24 within the opening of the rib 46 to lie essentially in one plane and in contact with the mesh screen 34. Targets made in this manner have shown a consistent uniformity of contact between the screen 34 and the glass sheet 24 in which the variations in spacing do not exceed more than 0.1 mil.

For the very thin glass targets used in these tubes, the displacement of the center of the glass target 24 from its peripheral edge 55 by the rib surface 46 is rather critical to prevent breakage of the glass. For example, in a tube of the type shown in Figure 1, which has been successfully operated, a glass sheet 24 having a thickness of approximately 0.1 mil is used. Also, in this tube, the rib surface 46 extends beyond the rib surface 44 by a distance of 4 mils and the distance between the rib surfaces 44 and 46 is 82 mils. Within these dimensions, the glass sheet 24 has sufficient flexibility that it may be displaced by the rib 46 without breaking. The difference in the levels of surfaces 44 and 46 is held to a close tolerance of plus or minus 0.5 mil. The mesh screen welding ring 50 extends below the surface of both ribs 44 and 46 at 48, as described above. Thus, when the target support ring 52 is placed in contact with the screen support ring 42, the screen welding ring 50 will not contact the surface of the glass and cause breakage.

The glass target support ring 52 and the mesh screen support ring 42 may be fixed together as shown in Figure 3 in any desired manner. However, one form of support means is disclosed in Figures 2 and 3. This support means consists first of a welding ring 56 to which is fixed by welding or other means, a plurality of brackets 54 in the position shown in Figures 2 and 3. The welding ring 56 is then welded to the mesh support ring 42. The welding ring 56 is preferably a thin ring so that less current needs to be used in welding brackets 54 thereto. This keeps the warping of metal parts to a minimum in assembling the target structure. The glass target supporting ring 52 is next placed in contact with the mesh screen support ring 42. The two rings 42 and 52 are then clamped rigidly together by flexible spring tabs 58 placed over the edge of the ring 52 and fixed to the brackets 54 by eyelets 60 passing through both tabs 58 and extensions 59 of the brackets 54. The edges of the eyelets are tightly crimped over to lock the spring tabs 58 to brackets 54. This forces the target support ring 52 against the screen support ring 42 and with the peripheral edge 55 of the glass sheet 24 forced into contact with the rib surface 44.

The target assembly shown in Figure 3 may be also mounted within the tube 10 of Figure 1 in any desired manner. However, Figure 4 shows one form in which this may be done. The target assembly of Figure 3 is attached to the electrode 26 of the tube 10. One end of the tubular electrode 26 is partially closed by an annular wall portion 62 having an inwardly turned flange portion 64. The aperture defined by the flange portion 64 is slightly larger than the dimensions of the mount rings 42 and 52 so that the target assembly of Figure 3 may be positioned in the aperture. The extensions 59 of brackets 54 will contact the annular wall portion 62 of the electrode 26. The brackets 54 may be attached to the annular wall 62 also, in any desired manner, such as, for example, by bolts 66 passing through openings in the wall portion 62 and through the eyelets 60 of the target assembly. However, eyelets 60 need not be used, but additional mounting brackets may be fixed to the welding ring 56 and can be used for bolting the target assembly to the annular wall 62.

The contact spacing of screen 34 to the glass surface of sheet 24 provides a higher capacitance and a better and more uniform signal over the surface of the target. Furthermore, all non-uniformities caused in sealing of sheet 24 to its support ring 52 are eliminated. With the increased target capacitance the uniform spacing increases the signal-to-noise ratio over prior structure.

While certain specific embodiments have been illustrated and described, it will be understood that various changes and modifications may be made therein without departing from the spirit and scope of the invention.

What I claim as new is:

1. A target assembly for an electron discharge device comprising a flat support ring, a screen fixed to one face of said support ring across the

open center of said ring, a thin target sheet mounted around its periphery on said support ring face, said support ring having an annular portion about the center of said ring and within the periphery of said target sheet, said annular portion projecting above the surface of said support ring face and pressing said screen into contact with said sheet.

2. A target assembly for a cathode ray tube, said assembly comprising a flat support frame having an open center, a fine mesh screen mounted on one face of said support frame across the open center thereof, a thin glass sheet mounted around its periphery on a first portion of said support frame face and over said screen, said support frame face having a second portion within the periphery of said target sheet pressing said screen into contact with said glass sheet, said second portion projecting above said first support frame face portion, and displacing the center portion of said glass sheet relative to the periphery of said glass sheet.

3. A target assembly comprising a flat support frame having a rib around the inner periphery of said frame, a fine mesh screen fixed to said support frame face, a thin glass sheet extending over the center of said frame and fixed to said support frame face adjacent the outer periphery of said frame, said rib projecting above the surface of said support frame and pressing said screen into contact with said glass sheet, said rib displacing the glass sheet relative to the periphery of said sheet.

4. A target assembly comprising a flat support frame having an open center and a portion between the inner and outer edges of said frame and depressed below the surface of one face thereof, a screen mounted on said support frame face, the periphery of said screen attached to said support frame within said depressed portion, a target sheet mounted on said support frame face and extending over said depressed portion whereby the inner edge of said frame places the screen in contact with said sheet.

5. A target assembly comprising a flat support ring, a pair of spaced rib portions projecting above the surface of one face of said support ring, a screen extending over the center of said ring, means between said spaced ribs attaching said screen to said support ring face, a target sheet mounted on said rib portions and extending over said screen.

6. A target assembly for an electron discharge device comprising a flat support frame having an open center portion, a pair of spaced rib portions projecting above the surface of one face of said support frame, said rib portions extending around the open center of said frame, a fine mesh screen extending over the center of said frame and fixed to said support ring face between and below the tops of said spaced rib portions, a glass sheet mounted at the periphery of said support frame face and over said screen whereby said spaced rib portions support said glass sheet in contact with said screen.

7. A target assembly comprising a flat support ring, a pair of spaced rib portions projecting above the surface of one face of said support ring, said spaced rib portions extending coaxially around the center of said ring, a fine mesh screen extending over the center of said ring and fixed to said support ring face between said spaced rib portions, a glass sheet extending over said screen and mounted around its periphery on the outer of said spaced rib portions, the inner of said spaced rib portions pressing said screen into contact with said glass sheet.

8. A target assembly for an electron device comprising a flat support ring, a pair of spaced rib portions projecting above the surface of one face of said support ring, said spaced rib portions extending coaxially around the center of said ring, a fine mesh screen extending over the center of said ring and fixed to said support ring face between said spaced rib portions, a glass sheet extending over said screen and mounted around its periphery on the outer of said spaced rib portions, the inner of said spaced rib portions pressing said screen into contact with said glass sheet, said inner rib portion projecting from said support ring surface beyond said outer rib portion whereby the center portion of said glass sheet is displaced relative to the periphery of said glass sheet.

9. An electron discharge device comprising, an envelope, an electron gun mounted within the envelope for producing an electron beam along a path, a target assembly mounted within said envelope and spaced from said electron gun transversely to and along said beam path, said target assembly including a flat support ring, a screen fixed to one face of said support ring across the center of said ring, a thin target sheet mounted around its periphery on a first portion of said support ring face, said support ring face having a second portion within the periphery of said target sheet pressing said screen into contact with said target sheet, said second portion projecting above the surface of said first portion and displacing the center portion of said target sheet relative to the periphery of said target sheet.

10. An electron discharge device comprising, an envelope, an electron gun mounted within the envelope for producing an electron beam along a path, a target assembly mounted within said envelope and spaced from said electron gun transversely to and along said beam path, said target assembly including a flat support ring, a fine mesh screen mounted on one face of said support ring across the open center thereof, a thin glass sheet mounted around its periphery on a first portion of said support ring face and over said screen, said support ring having a rib extending around the inner periphery thereof, said rib extending above said support ring face portion and pressing said screen into contact with said glass sheet, said rib displacing the center portion of said glass sheet relative to the periphery of said glass sheet.

11. An electron discharge device comprising, an envelope, an electron gun mounted within the envelope for producing an electron beam along a path, a target assembly mounted within said envelope and spaced from said electron gun transversely to and along said beam path, said target assembly including a flat support ring, a pair of spaced rib portions projecting above the surface of one face of said support ring, said spaced rib portions extending coaxially around the center of said ring, a fine mesh screen extending over the center of said ring and fixed to said support ring face between said spaced rib portions, a glass sheet extending over said screen and mounted around its periphery on the outer of said spaced rib portions, the inner of said spaced rib portions pressing said screen into contact with said glass sheet.

12. A target assembly comprising, a flat mounting ring having a pair of spaced rib por-

tions projecting above the surface of one face of said mounting ring, said rib portions extending around the open center of said mounting ring, a screen extending over the center of said ring, means between said spaced ribs attaching said screen to said mounting ring face and below the tops of said ribs, an annular support ring, a dielectric sheet fixed across the open center of said annular support ring, means mounting said support ring in contact with said face of said mounting ring whereby said spaced rib portions press said screen in contact with said dielectric sheet.

13. A target assembly for an electron discharge device comprising, a flat mounting ring, a pair of spaced rib portions projecting above the surface of one face of said mounting ring, said spaced rib portions extending around the center of said ring, a fine mesh screen stretched over the center of said ring and fixed to said mounting ring face between said spaced rib portions, a support ring, a glass sheet sealed across the center of said support ring, means mounting said support ring in contact with said mounting ring and with the periphery of said glass sheet on the outer one of said spaced rib portions, the inner one of said spaced rib portions placing said screen into contact with said glass sheet, said inner rib portion projecting from said mounting ring surface beyond said outer rib portion whereby the center of said glass sheet is displaced relative to the periphery of said glass sheet.

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