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D. W. POWER

2,296,307

METHOD OF MAKING GLASS-TO-METAL SEALS

Original Filed April 30, 1940

Fig. 1.

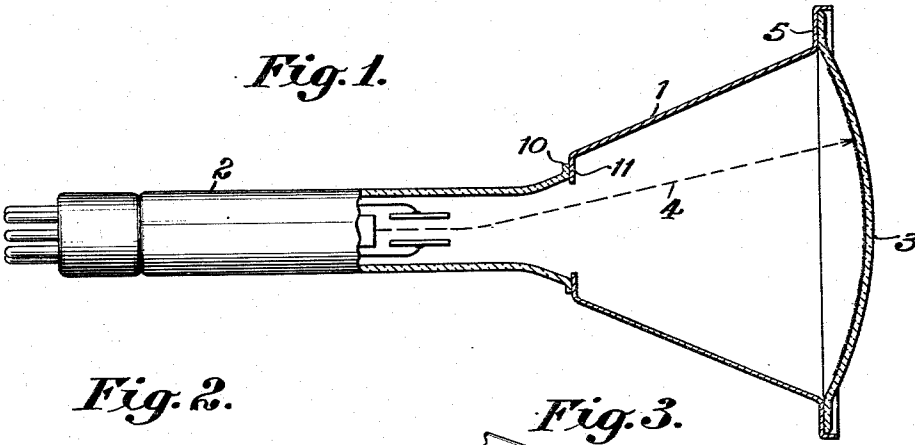


Fig. 2.

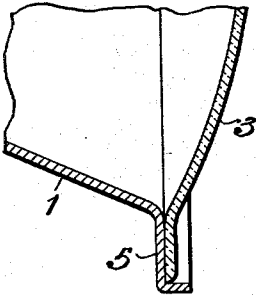


Fig. 3.

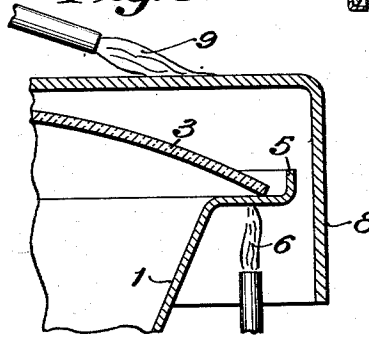


Fig. 4.

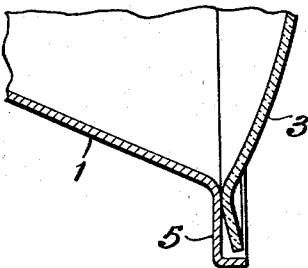


Fig. 5.

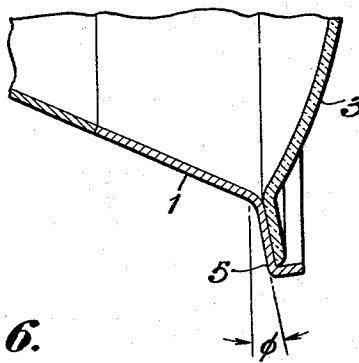
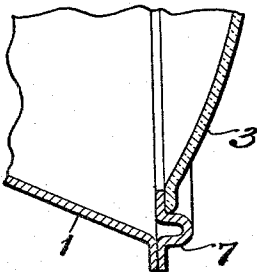


Fig. 6.



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METHOD OF MAKING GLASS-TO-METAL
SEALSDonnell W. Power, Summit, N. J., assignor to
Radio Corporation of America, a corporation
of DelawareOriginal application April 30, 1940, Serial No.
332,537. Divided and this application Febru-
ary 28, 1941, Serial No. 381,206

3 Claims. (Cl. 250—27.5)

My invention relates to cathode ray tubes, particularly to methods of manufacturing the glass-to-metal seals employed in the fabrication of envelopes for such tubes.

This application is a division of my application, Serial No. 332,537, filed April 30, 1940, and entitled Cathode ray tube envelopes.

Electron discharge devices of the cathode ray type usually comprise a conical envelope with an electron gun at the small end of the envelope for directing an electron beam onto a round transparent viewing plate or window joined along its rim to the large end of the conical envelope. For best results the window should have a single radius of curvature over its entire viewing area. Since the window must be of glass or similar transparent plastic, it is important that the window be not distorted when it is heated and sealed to the envelope. Further, because of the relatively large area of the window and the considerable pressure on the window, the seal must be especially strong as well as vacuum-tight and the zones of stress must be uniformly distributed and concentric with the window.

An object of my invention is an improved method of making an envelope for a cathode ray tube in which the window or viewing plate may be joined to the envelope without distortion of the plate.

Another object of my invention is an improved method of making a strong bond between the rim of a cathode ray tube window and the envelope of the tube, said window being in an accurately predetermined position with respect to the beam forming means of the tube.

The characteristic features of my invention are defined in the appended claims and preferred embodiments are described in the following specification and shown in the accompanying drawing in which Figure 1 is a sectioned elevational view of a cathode ray tube made according to my invention, Figure 2 shows a detailed sectional view of my improved window seal, Figure 3 shows a detailed view of the window and envelope in position for sealing according to my invention, Figure 4 shows an alternative form of the window, and Figures 5 and 6 show in detail other seals embodying my invention.

The cathode ray tube as illustrated in Figure 1 comprises a conical envelope 1 joined at its small end to a cylindrical portion 2 enclosing the electron gun and sealed along its outer rim to the edge of a concaved window or plate of glass 3. The window is sealed to the envelope with the plane through the rim of the window

normal to and coaxial with the center line of the electron gun. If this symmetrical position of the window is not established in manufacture, the electron beam can only be focused on part of the window. The window 3, further, must be homogeneous in composition and uniform in thickness. It has been found particularly difficult in manufacture to prevent waves of varying thickness in the window during high temperature sealing operations and to bring the window to the desired positional relation with respect to the electron gun.

The conical envelope 1, is, in the tube shown, made of drawn sheet metal and is provided along its outer rim with a flange 5 joined to the rim of the glass window. As shown in greater detail in Figure 2, the rim of the window is fitted to the envelope flange and is hermetically joined to the flange over a considerable area of contact. The window has a fixed radius of curvature over its entire area and up to the rim of the cone, which affords maximum usable scanning and viewing area on the window. In the manufacture of an envelope according to my invention, the window is heated to annealing temperature and yet maintained below deformation temperature while the rim of the window is sealed to the flange. The cone is preferably held with its axis vertical, as shown in Figure 3, and the window is placed on the cone with the rim of the window in contact with the flange. A metal hood 8 is placed over the window and flood fires 9 played on the hood until the window, heated by radiation, is raised to annealing temperature. The time required to uniformly heat up the window by radiant heat is found to be considerably less than the time required to heat the entire body of glass in the window by conduction, as when flames are played directly on the glass. The greater permeability of glass to radiated heat, as distinguished from conducted heat, apparently accounts for the more rapid and uniform heating of the glass window 3. When the window is at or near annealing temperature, sharp pointed gas flames 6 are directed at the rim and flange of the metal cone. For uniformity of heating, the envelope flange may be rotated over a series of spaced gas flames 6. As the glass at the point of contact softens and seals, the flames are moved radially inward, the progress of the inward travel of the flame being slow enough to permit the glass to settle uniformly along the rim and seal to the flange and to expel air from between the glass and metal as the seal moves inwardly toward the rim of the cone. When the window has set-

tled the desired distance, the flames 6 are removed and the sealing glass hardens and immediately stops the window. At no time is the viewing areas of the window heated to deformation temperature.

An up-turned flange as shown in Figure 4 may be press-molded on the rim of the window, and the sealing started at the rim of the cone and moved outwardly.

To strengthen the seal it has been found desirable to incline the flange 5 of the cone to the plane of the base of the cone as shown in Figure 5. The degree of inclination ϕ , sufficient to give the conical section of the flange strength against deflection by blows delivered to the outer edge of the flange, may vary between 5 and 30 degrees, 15 degrees being preferred.

If it is not desired to make the entire envelope cone of the metal selected for sealing to the glass plate, the flange ring 7, Figure 6, of the selected metal may be separately formed and welded to the end of the cone. The ring may be channeled as shown to cushion the seal against shock. Alternatively, the body of the cone, of iron or steel, may be lap or butt welded or brazed to a chrome-iron ring carrying the flange 5, as shown in Figure 5. A chrome-iron flange may be sealed to commercial lime window plate glass of the type known as "Libby-Owens-Ford" window glass. This plate glass may easily be heated and pressed to the desired shape.

My novel method of sealing may advantageously be employed in joining the cylinder 2 to the small end of the metal cone. As shown in Figure 1, the cylinder 2 is formed with an outwardly extending flange 10 sealed to an inwardly extending flange 11. As the glass flange is softened, the cylinder is slowly pushed forward to flatten the softened flange against the metal. As the glass-to-metal area of contact expands, air is squeezed from the seal and the final seal is free of bubbles and air pockets.

My novel method of making cathode ray tubes and of joining the window to the envelope provides a simple, strong structure that is easily made in manufacture and leaves the viewing plate without distortions.

I claim:

1. The method of uniting a tubular sheet metal envelope to a convexed glass plate comprising outwardly flaring the end of the envelope to form a flange of considerable radial extent, rotatably mounting said envelope with the flange upward, placing said glass plate on said flange with the convex side upward and with the edge only of the plate in line contact with the outer periphery of the flange, heating the entire plate to a temperature intermediate annealing and deformation temperature of the glass and locally heating said edge of the plate to sealing temperature, and continuing said local heating as said glass plate settles, axially of the envelope, and until the glass is in contact with substantially the entire upper surface of the flange.

2. The method of uniting a convex glass plate to the end of a sheet metal envelope having a flange extending a substantial distance outwardly from the rim of the envelope, comprising mounting the envelope vertically with the flange upward and positioned horizontally, setting the convex glass plate on the flange with the edge of the plate concentric with and adjacent the outer edge of the flange, heating to sealing temperature said flange and the contacting edge of the plate, gradually laying by gravity the glass of the plate against the flange as the glass heats progressively from its edge, and continuing the heating of the flange and edge portion of the glass plate until the plate settles to a position where the contacting area of glass and metal is adjacent the inner edge of the flange.

3. The method of making an envelope for a cathode ray tube with a glass window at the end of the envelope comprising forming an annular flange around the rim of said envelope, laying a glass plate on the envelope with the plate contacting said flange only along a single line of contact, heating said plate by radiant heat to a temperature intermediate annealing and deformation temperatures of the glass, and heating said flange along said line by direct heat to the sealing temperature of the glass.

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