ABSTRACT

The clamp includes essentially two rectangular metal frames between which the various glass plates to be assembled are held with the frames applying pressure to the edges of the plates. The metal plates are pressed against the glass plates with resilient members which provide a spring-like effect.

9 Claims, 3 Drawing Figures
CLAMP FOR USE IN ASSEMBLING DISPLAY DEVICE

BACKGROUND OF THE INVENTION

The electron tube art has produced many jigs and fixtures for use in manufacturing tubes. However, with the advent of flat display panels, new jigs and fixtures are required which are not found in the prior art. The relatively new display panels generally comprise a plurality of glass plates and electrodes which are secured together by means of a powdered glass frit cement which is placed along the edges of the panel in contact with the various plates and then heated to form the desired seal. A clamp is required to hold the parts together and particularly to apply the proper pressure to the seal area as the seal is formed. Suitable apparatus of this type which can meet the special requirements of gas-filled panels is not known in the prior art.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective, exploded view of the clamp of the invention;
FIG. 2 is a sectional view, along the lines 2—2 in FIG. 1, showing the clamp assembled; and
FIG. 3 is a sectional view, along the lines 3—3 in FIG. 1, showing the clamp assembled.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Clamp apparatus 10 embodying the invention includes a pair of relatively long, identical, narrow metal rods 20 which have a generally rectangular cross-section and which include a top surface 30 and a bottom surface 40. The top surface 30 of each is provided with a cutout portion 50 which occupies, for example, the central one-third of the top surface of each rod, and these portions have tapered side walls 60. The two rods 20 are positioned side by side, and they have open ends 70 which are adapted to receive vertical posts 80 which can be secured in place by means of screws 90 or the like.

A generally rectangular metal frame 100 is adapted to rest on the two rods 20 and, particularly, on the rectangular area defined by the cutout portions 50 of the top surfaces 30 of the rods. The lower surface of the frame 100 is notched as at 104 to receive the rods 20 and thus to determine the spacing between the rods 20. The frame 100 is shaped and dimensioned so that the assembly of plates 106 (FIG. 2) and electrodes, (not shown), to be sealed together is seated on the top surface of this frame, with the frame supporting the peripheral portion of these parts where the seal is formed.

The clamp 10 includes a second similar rectangular frame 120 which is seated on the assembly of plates 106, also in contact with the peripheral seal portions of the plates 106 to be assembled. The second rectangular frame 120 includes two long side arms 130 which are notched at 140 to receive and locate two cross members 144 which can be secured thereto by means of screws or the like 150. Finally, a pair of flexible, resilient pressure bars 160 are secured to the two vertical posts 80, and they extend across the assembly, overlaying the cross bars 144. Each member 160 is, in effect, a leaf spring and has an adjustable screw 170 which extends through the member into contact with the cross bar 144 beneath it and by means of which pressure can be applied to the plates 106 and to the rectangular frame 120 and thus to the assembly of plates to be sealed together.

The clamp of the invention is used after it is assembled with panel parts secured in place by applying a quantity of a cement such as a glass frit to the aligned edges of the insulating plates 106. The entire assembly is then placed in a stationary oven, or passed through a conveyor oven, to permit the glass frit to melt and to form the desired seal after the assembly is cooled.

The apparatus of the invention has the important advantage that, particularly because of the spring-like cross members, optimum pressure can be applied to the parts to be sealed together. In addition, the mass of the clamp is such that, as the assembly is heated in a sealing oven, it heats and cools relatively quickly. Another advantage arises from the fact that the clamp is relatively open and permits the parts being sealed to be inspected, both from above and below. The viewability is further facilitated by the taper of the side walls of the two bottom rods 20.

All of the materials used in the clamp, except elements 160, are preferably steel of a type which will not deform at temperatures at which the glass plates of the panel are sealed together. They are also preferably all of the same type of steel so that they have the same expansion characteristics. Cross members 160 are preferably a spring material such that the spring constant remains constant as the material passes through the temperature and pressure range encountered during the formation of the seal between the glass plates.

It is clear that the number of cross bars 20, 144, and 160 are selected to provide the requisite balanced pressure on rectangular frames 100 and 120. If the size of the assembly permits, one cross bar arrangement might be sufficient, or more than two of each might be required.

What is claimed is:
1. A clamp for use in coupling together a plurality of plates to be sealed together comprising:
   at least two first cross members,
   a first generally rectangular frame having a lower surface seated on said first cross members,
   the top surface of said first rectangular frame being adapted to receive and support, near their peripheries, a plurality of plates to be sealed together, said plates being spaced from said first cross members so that substantially all of the surface of at least one of said plates can be seen by a viewer,
   a second rectangular frame adapted to be seated on the top surface of said plates near their peripheries,
   at least two second cross members seated on the top surface of said second frame and shaped so as not to obstruct the view of the surface of at least one of said plates, and
   a pair of resilient leaf spring cross members secured to said at least two first cross members and having adjusting screws by which they can apply pressure to said second cross members and to said second rectangular frame member and thereby to said plates.
2. The clamp defined in claim 1 wherein said cross members and said rectangular frames are made of the same steel, and said leaf spring cross members are made of a different material which retains its resilience through the heating cycle used to seal said plates together.

3. A clamp for use in coupling together a plurality of plates to be sealed together by the application of heat, comprising:
   first and second lower cross members,
   a first generally rectangular frame seated on said lower cross members,
   the top surface of said first rectangular frame being adapted to receive and support, near their peripheries, a plurality of plates to be sealed together,
   said first rectangular frame serving to space said plates from said cross members so that substantially the entire surface area of said plates can be inspected from below,
   a second rectangular frame adapted to be seated on the top surface of said plates near their peripheries,
   first and second upper cross members seated on the top surface of said second frame and spaced from said plates whereby substantially the entire surface area of said plates can be inspected from above, and
   a resilient leaf spring cross member overlaying each of said first and second upper cross members but secured to said lower cross members and having an adjusting screw by which they can apply pressure to said first and second upper cross members and thereby to said first and second rectangular frame members and to said plurality of plates, said resilient leaf spring cross members having the characteristic that they retain their leaf spring character throughout the entire temperature range experienced by said plates, and all parts of said clamp having matching thermal expansion characteristics.

4. The clamp defined in claim 3 wherein each leaf spring member is secured at its ends to the associated ends of one of said first and second lower cross members.

5. The apparatus defined in claim 3 and including an adjusting screw carried by each of said leaf spring cross members and each adapted to engage one of said upper cross members whereby controlled pressure may be applied to said cross members and to said frames.

6. The apparatus defined in claim 3 wherein said lower cross members have a tapered cross-section defined by side walls which slope toward each other in the direction of said plates whereby the viewability of the entire surface of said plates from below is facilitated.

7. The apparatus defined in claim 3 wherein each lower cross member is aligned with one of said spring members, and including a plurality of support posts, each secured at one end to one end of a lower support member and adjustably secured at the other end to the aligned corresponding end of the associated spring member.

8. The apparatus defined in claim 3 wherein said lower cross members are elongated members having ends positioned beyond said first and second frames, each secured at one end to the ends of said lower cross members, said spring members being elongated and having ends positioned beyond said first and second frames and threaded on the opposite ends of said posts and adjustably secured thereto.

9. The apparatus defined in claim 3 wherein the lower surface of said first frame is notched to receive said lower cross members, and the upper surface of said second frame is notched to receive said upper cross members.