Nov. 23, 1948. H. J. McCARTHY 2,454,741

ULTRA HIGH FREQUENCY ELECTRONIC TUBE

Filed May 24, 1944

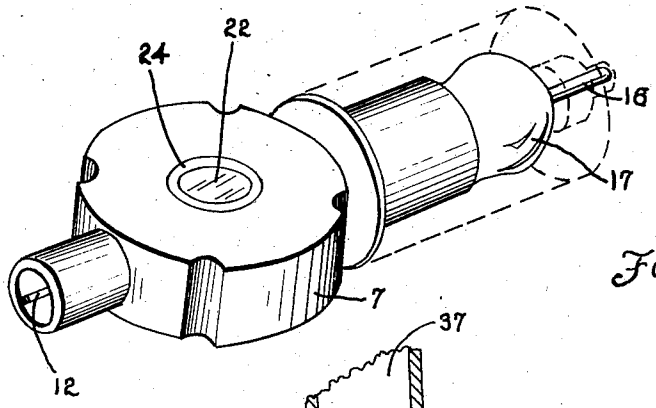

Fig. 1

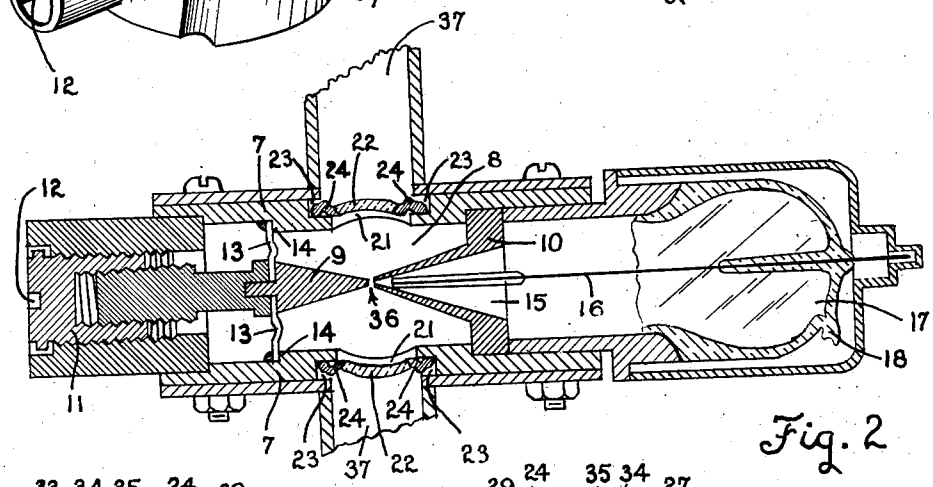

Fig. 2

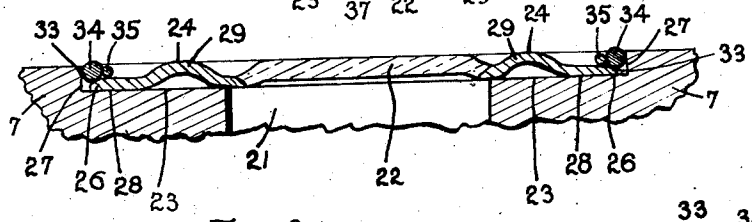

Fig. 3

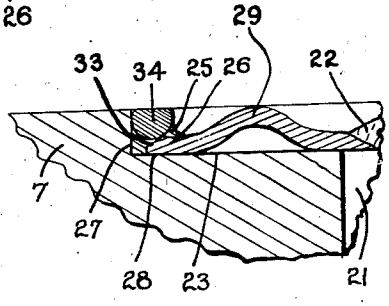

Fig. 4

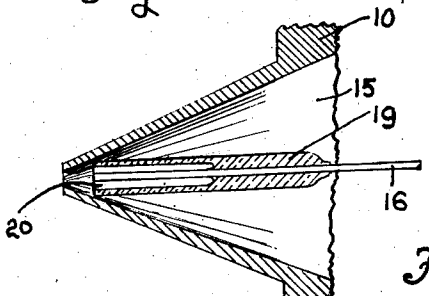

Fig. 5

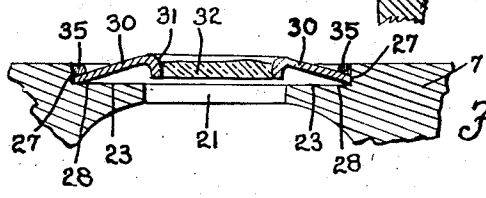

Fig. 6

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ULTRA HIGH FREQUENCY ELECTRONIC TUBE

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Application May 24, 1944, Serial No. 537,145

1 Claim. (Cl. 315—5)

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This invention relates to high frequency electronic devices and particularly to means for facilitating the flow of energy to and from the resonating elements thereof, and has for its general object to provide a gas tight closure for the input and/or output apertures for such devices.

A further object of the invention is to provide a window construction for such high frequency devices which may be manufactured and applied thereto under high volume quantity production methods with a high degree of uniformity and precision.

A further object of the invention is to provide, in a high frequency device, a frangible input and/or output window having means for preventing transmission thereto of destructive thermally produced forces.

Other objects and features will more fully appear from the following description taken in connection with the accompanying drawings and will be particularly pointed out in the claim.

The invention is especially adapted to the type of electronic device which functions at ultra high frequency. Such devices are usually made of metal such as copper having high conductivity to the flow of electric current. In such devices their metallic resonating systems very efficiently confine all oscillations closely within the device itself and to permit a flow of current thereto or therefrom an opening or openings in their otherwise closed body must be provided. Such openings must be impervious to gases because the space charge chambers thereof must be evacuated as in all such devices. Such windows must also be pervious to high frequency currents. To provide for the reception of such windows, apertures are cut in the walls of the resonator chamber and closed by glass plates fused into metallic frames or bezels to form a window structure. This window structure is hermetically sealed into the apertures in a very effective and permanent manner.

The peripheral edges of the bezels only are soldered to the walls of recesses counterbored concentric with the apertures. Desirably also special means is provided for cushioning excessive stresses developed within the device adjacent the window by reason of substantial variations in temperature to which the devices are subjected in operation. The frangible glass plates in the window are thus protected from possible fracture.

To present a better understanding of the invention particular embodiments thereof will now

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be described in connection with the drawings in which:

Figure 1 is a general view in perspective of a device embodying the invention;

Figure 2 is a longitudinal cross section of the device;

Figure 3 is an enlarged detail cross sectional view illustrating the elements employed in sealing an input and/or output window in the apparatus;

Figure 4 is a detail view illustrating the completed seal between the window and its cooperating recess in the body of the device;

Figure 5 is a detail view of the keepalive electrode; and

Figure 6 illustrates a different embodiment of the invention.

Devices of the character herein disclosed are subjected to relatively great temperature changes. The resulting variations in thermal expansion of the various materials out of which they are made, tend to cause destructive stresses to develop which have, prior to the present invention, caused fracture of the glass plates in the windows.

The principals of the invention are applied herein to an ultra high frequency electronic resonating device used as a gas switching tube employed to protect delicate units such as crystal detectors from destructive surges of excessive current. However, the invention may be applied equally well to any high frequency oscillator device having energy conducting openings therein.

The apparatus to which the invention is applied has a metallic generally disc-shaped body member 7 within which a space charge chamber 8 is formed. Within the chamber a pair of cones 9 and 10 are arranged with their slightly truncated apex ends in alignment and slightly separated to form a capacity gap. The cone 9 is adjustable along its axis to vary the frequency at which the resonator functions. The other cone is hermetically sealed into the chamber.

The cone 9 is connected to an adjusting screw device 11 capable of operation by means of a screw driver placed in the slot 12. A flexible hermetic seal is maintained between the cone 9 and the body member 7 by means of a thin diaphragm 13 sealed to a shoulder 14 on the body 7 along its peripheral edge and sealed to the cone at its central portion.

The cone 10 is hollow having an axially tapered aperture 15 extending therethrough and emerging at the small end of the cone and communicating with the chamber 8. Projecting into the

aperture 11 is a keepalive lead 16 which extends outward into a glass bulb 17 and thence through a suitable seal to the outside where it may be connected to a source of electric current. The bulb 17 is sealed to the body 7 and supplied with an exhaust tube 18 adapted to be connected to an exhaust pump to evacuate the chamber 7 after which it is tipped off in the usual manner.

The inner end of the lead 16 is of special construction. It is provided with a sheath of glass or ceramic 19. The lead extends into the aperture 15 with its sheath 19 in contact with the wall of the aperture at its small end. The lead is thus insulated from the cone and mechanically supported therein. In devices of the kind described much trouble has arisen from a partial bridging over across the end of the glass sheath from the lead to the cone. This bridging phenomena is due to an accumulation of metal particles deposited upon the sheath by a slight sputtering of the adjacent metallic areas.

To overcome this tendency to bridge over and partially short circuit the keepalive, an air space 20 is formed between the sheath 19 and the lead, thus preventing the accumulation of particles from the lead to the cone. The construction and operation of the lead 16 is more clearly set forth in another application, filed concurrently by me and bearing the title "Electrode construction for high frequency electronic devices," bearing Serial No. 537,144 and issued as Patent No. 2,419,903.

The body member 7 is provided with apertures 21 extending into the chamber 8 through which a flow of high frequency current may pass in or out. The apertures 21 desirably are situated adjacent the capacity gap between the cones and preferably are cylindrical in form.

The apertures must be closed to the passage of gas since the chamber is evacuated. The window must also permit free passage of electromagnetic current therethrough. To accomplish this end the apertures are closed by means of glass windows 22. Desirably the windows are secured in counterbored recesses 23 concentric with the apertures 21.

The glass portion of the windows are sealed in gas tight union within metallic frames or bezels 24 in any suitable manner. The bezels in turn are sealed in the recesses 23 by means of solder 25 applied along their peripheral edge 26 only, and to the peripheral wall 27 of the recess 23. The selection of materials to insure proper functioning of the device in other respects results in the use of materials for the body 7 and the bezels 24 which have different coefficients of thermal expansion. If the sides of the bezels were soldered to the bottom walls 28 of the recesses therefore, a bimetallic action would take place between the two metals which would cause distortion of the bezels and probable fracture of the glass. By soldering the edges only of the bezels, this source of trouble is largely overcome.

To further reduce the breakage of the glass windows the bezels are provided with resilient means acting to absorb stresses developed by the unequal expansion of the materials. This may desirably be done by forming an annular fold 29 in the bezels between the glass and their peripheral edges. Radial stresses developed by thermal expansion are thus absorbed by the resiliency of the fold. The glass is thus protected and the device will continue to function despite the wide range of temperatures to which it is subjected.

A modified form of the window is illustrated in Figure 6 wherein the bezel 30 is of special form. Its general shape is that of a flat frustrum of a cone and desirably is provided with a central interned flange 31 within which the glass plate 32 is sealed. The peripheral edge of the bezel is soldered to the wall 27 of the recess 23. In this form of the invention stresses created by thermal expansion are absorbed by the flexibility of the cone which is deflected upward upon the application of excessive stress thereto thus protecting the glass from intensive radial pressure.

The bezel in this form of the invention is so placed in the recess that its side faces slope away from the bottom wall 28 of the recess 23. Consequently, solder applied to the peripheral edge of the bezel to seal the window in place will be confined to its peripheral portions only.

Referring to the window construction first described, it is desirable that the bezels employed in their construction be coated in any suitable manner to repel the flow of solder to all areas except their peripheral edges. It may be found that in the process of manufacturing when the glass plates are fused into their bezels that sufficient oxide or other coating is deposited on the surface thereof to repel the solder in the manner desired. In such case before the windows are sealed in their recesses the peripheral edges of the bezels must be cleaned to receive the solder.

To further secure an absolutely tight and uniform union of the window with the recess the bezel should be slightly less in diameter than the recess thus insuring free flow of solder at the joint. The bezels desirably are also chamfered along their edges as at 33 and a ring of copper 34 or other suitable metal may be placed between the bevel face 33 and the wall 27 of the recess prior to the soldering operation. In this manner additional strength and uniformity is imparted to the seal since the solder will flow along the increased surface areas afforded by the ring and the chamfer.

In the interest of rapid and accurate production of the device and the maintenance of uniformly high quality of workmanship, it is desirable that just the correct amount of solder be applied to and evenly distributed throughout the joint. To accomplish this end a ring of solder 35 of the desired size is placed in the joint before the application of heat thereto.

As above suggested the tube described herein may be employed in various capacities. One such adaptation is that of a gas switching tube. In such case the keepalive 16 is energized by a local source of current such as a battery thereby maintaining a feeble flow of electrons at the gap 36 to insure instantaneous operation of the device. An incoming flow of energy is fed to the chamber 8 from a source such as an incoming signal through one of the apertures 21 and flows out through the other aperture. The current is fed to and from the device by means of wave guides 37. The tube functions in a manner well known to those skilled in the art to pass a current of allowable intensity but to automatically block an excessive volume of current.

The resonator system for sustaining the operation of the tube composes the cones 9 and 10, the walls of the chamber 7 and the capacity gap 36. The paths of the current in the resonator system follow planes extending radially outward from the axis of the cones to form a generally toroidal figure.

What I claim is:

A high frequency electronic device having a rigid metallic body member, a space charge

chamber therein whose walls present a resonator system said body having a plurality of apertures communicating from said chamber to the outside, glass windows for said openings, sheet metal bezels in which said windows are hermetically sealed, said bezels having a bevelled peripheral edge, a coating repellant to solder covering all but the peripheral edge of said bezels, a solder joint hermetically sealing said bezels along their peripheral edge in said apertures including metallic rings extending around the periphery of the bezels engaging the walls of said apertures and the bevelled edge of the bezels, said rings acting to reinforce the solder joint and means forming part of the bezels acting to impart radial resiliency thereto whereby thermally imposed radially acting forces are absorbed without damage to the windows.

HENRY J. McCARTHY.

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