May 11, 1965 R. D. CULBERTSON ETAL 3,182,845

HOUSING FOR AN ELECTRONIC DEVICE

Filed Aug. 17, 1959

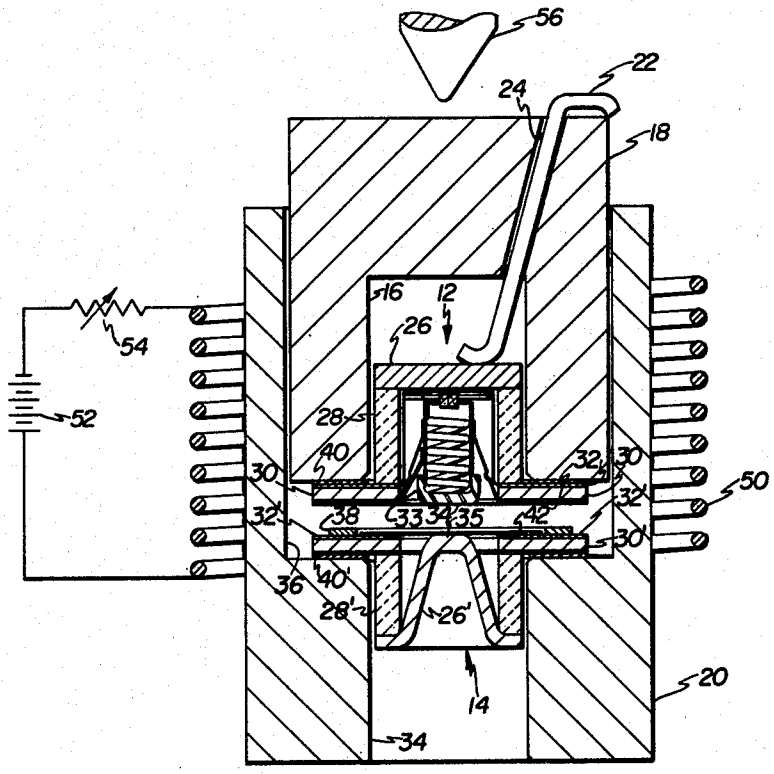


Fig. 1

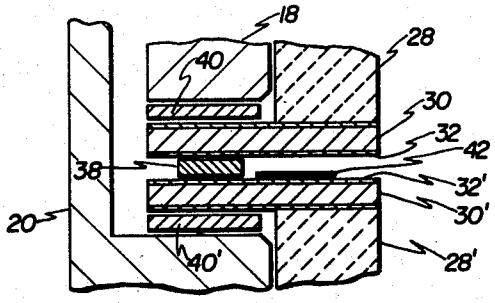


Fig. 2

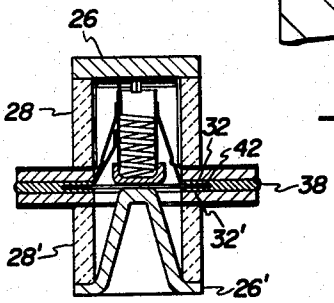


Fig. 3

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United States Patent Office 3,182,84
Patented May 11, 196

3,182,845

HOUSING FOR AN ELECTRONIC DEVICE

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Filed Aug. 17, 1959, Ser. No. 834,219
8 Claims. (Cl. 220—2.3)

This invention relates to an electron tube and more particularly to an electron tube having a pressure seal and to a method of and a means for making such a seal. The term "pressure seal" is defined for use herein as a permanent vacuum-tight seal obtained by the application of pressure at temperatures below the melting point of any of the materials in the seal.

With the introduction of high alumina ceramic electron tubes, various types of pressure seals were developed to seal ceramic to ceramic or ceramic to metal. None of these types of seals are effective in sealing two parts of a miniature electron tube, especially when the tube dimensions are in the order of one-half inch long and one-quarter inch in diameter. In pressure sealing a miniature diode that requires at least three electrical leads and is limited to two ceramic ring insulators, the electrical lead, which is in the form of a ring and positioned between the two ceramics, is required to be made of hard metal such as Kovar so that it will not deform under sealing pressure destroying the metal to ceramic bond, as well as making it difficult to obtain accurate electrical spacing. The art of pressure welding two pieces of metal teaches that hard metals require larger pressures for pressure welding than softer metals. The pressure required to weld Kovar is too high and not practical in the fabrication of a miniature tube.

In this application Kovar refers to metal alloys comprising primarily iron, nickel and cobalt with some manganese and having a coefficient of thermal expansion approximately 5×10^{-6} per degree centigrade.

It is an object of the present invention to provide an electron tube with a pressure seal between two pieces of hard metals.

It is another object of the present invention to provide a pressure sealing method between hard metal surfaces which do not require optical flat joining surfaces.

It is yet another object of the present invention to provide a pressure seal, a method of and a means for making such seal between hard metal rings in an electron tube.

In one embodiment the invention involves making hard metal pressure seals for electron tubes by plating the hard metal sealing rings with a soft ductile metal. A soft ductile metal sealing gasket is placed between the two soft metal clad surfaces on each of the hard metal rings. Force is applied to the hard metal rings until the gasket yields and deforms. In so doing the basket adheres to the plated surfaces.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth in the following description of the invention. It is to be understood that the invention is not limited to the disclosed species, as variant embodiments thereof are contemplated and may be adopted within the scope of the claims.

Referring to the drawings:

FIGURE 1 is a sectional elevation of a typical die press fixture, through which pressure is applied to the sealing rim of an electron tube.

FIGURE 2 is an enlarged view of the sealing rim of an electron tube before pressure is applied.

FIGURE 3 is a sectional elevation of the sealed electron tube.

Referring now to the drawings and to FIGURE 1 particular, there is shown an electron tube in two sectio which are to be sealed together. The two sections a cathode section 12 and an anode section 14. The catho section 12 is suspended within an axial well 16 form in a ram 18. The ram 18 and a die 20 form a die pre fixture. The cathode section is held by a wire 22 whi is suspended through an aperture 24 in the ram 18. T end of the wire 22 within the well 16 is fixed to a seali means 26 which is a metallic plate joined to a ceram cylinder 28 of the cathode section 12 by means of a co ventional ceramic-to-metal bond. Wire 22 may be fix to sealing means 26 with soft solder. The wire is th passed through aperture 24 and the cathode section drawn up tight against the ram 18. The wire's free e protruding from the ram is bent to hold the catho section in place. On the other end of the ceramic c inder 28 is bonded a terminal sealing ring 30 preferab made of Kovar. The terminal sealing ring 30 is plat with a soft, highly ductile metal 32 such as oxygen-fr high conductivity copper, which in this embodiment plated on both sides of the Kovar, as shown, althou it is actually necessary to plate only the side of the Kov to be pressure sealed. The plating is preferably betwe .001 and .002 inch thick and the ring 30 is about .0 inch thick. A cathode 33 with an emitting surface coplanar with the terminal ring 30 is mounted theret

The anode section 14 is similar to the cathode secti in that sealing means 26′ formed into a cup-shaped me section is sealed to a similar ceramic cylinder 28′ a a terminal ring 30′ is joined to the other end of the c ramic cylinder 28′ by means of a conventional cerami to-metal bond. Ring 30′ is also made of a hard me such as Kovar. The sealing means 26′ is the anode wi a face 35 coplanar with terminal sealing ring 30′. Sin larly to ring 30, the ring 30′ is also copper plated as re resented by plated layers 32′. The anode section 14 f into the die 20 with the ceramic section 28′ disposed wit in a bore 34 of the die 20 and the terminal sealing ri 30′ bearing on a shoulder formed by a larger bore into which is disposed the ram 18.

The pressure seal is formed between the two rings and 30′ by first cleaning the sealing surfaces which a the copper plated surfaces 32 and 32′ which face ea other and cleaning a soft, highly ductile metallic seali gasket 38 made of the same material as the plated su faces 32 and 32′, and in this embodiment being oxyg free, high conductivity copper, all being cleaned with standard acid process. The two sections 12 and 14 a the copper gasket 38 are afterward wet-hydrogen fired approximately 800° C. to anneal, degas and remo carbon residue. The two sections 12 and 14 are assembl to the ram 18 and die 20, as shown in FIGURE 1, wi hard metal washers 40 and 40′ disposed between t terminal sealing ring 30 and the ram 18 and between t terminal sealing ring 30′ and the die 20, clearly shown FIGURE 2. The hard metal washers 40 and 40′ a preferably made of Kovar and are used to prevent t copper plating on the rings 30 and 30′ adjacent the ra and the die from adhering thereto. The sealing gask 38 is placed on the plated layer 32′. Also on the plat layer 32′ is placed a hard metal spacer washer 42, al preferably made of Kovar. The washer 42 is thinn than the sealing gaskets 38, and it is used to limit t space between the anode face 35 and the emitting surfa 34. The ram 18 and die 20, along with the tube a enclosed in a vacuum envelope (not shown) and vacuu fired between 600° and 700° C. The vacuum pressure reduced to 1×10^{-4} mm. of mercury at this temperatu An electrical resistance coil 50 may be used for t vacuum firing process. The coil 50 is powered by a su

power supply 52 and controlled by a variable resistor
The tube is processed in a standard manner during
vacuum firing.
fter vacuum firing and still maintaining a high vac-
ı, the ram 18 is then forced against the die 20 by a
s 56. A pressure of about 25,000 p.s.i. on the sealing
:et 38 is applied for 2 to 5 minutes at a temperature
bout 500°–600° C. The pressure, temperature, time
ıbination can be varied somewhat as long as the tem-
ıture is below the melting temperature of copper and
ve the annealing temperature; the lower the tempera-
, the greater the pressure and time requirement and
versa. The sealing gasket 38 is extruded under this
sure causing it to adhere to the layers 32 and 32'
a like metal to like metal (copper to copper) seal is
le. The spacer washer 42 limits the spacing between
rings 30 and 30' and also prevents the sealing gasket
n extruding into the tube and making an electrical
:t.
ılthough the seal is a copper-to-copper seal, rings 30
30' made entirely of copper are not practical since
per will extrude and deform during the pressing opera-
. This deformation of the copper would destroy the
ıum tight bond with the ceramic. A ring 30 and 30'
le of hard metal such as Kovar does not deform in
ting the seal and therefore retains the vacuum tight
d with the ceramic. Further, if copper were used,
spacer washer 42 would imbed itself in the terminal
ing rings and no longer serves the purpose of fixing
cathode, anode spacing.
'IGURE 3 shows the sealed electron tube. The tube
hown in cross-section in order to illustrate what hap-
s to the copper gasket 38 after pressure is applied.
: copper flows under pressure and is prevented from
/ing into the vacuum envelope by the spacer washer
The copper in thus flowing adheres to the adjacent
per plating strips 32 and 32'.
Vhat is claimed is:
. An electron tube comprising a first vacuum envelope
ion and a second vacuum envelope section sealed to-
ıer by a pressure weld seal, said pressure weld seal
ıprising a first hard metal sealing ring forming part
said first section and a second hard metal sealing ring
ning part of said second section, soft ductile metal
ting on said first and second rings, and a soft ductile
ling gasket between said sealing rings bonded to said
ings and forming a vacuum tight seal between said
ling rings, and said sealing gasket and said metal plat-
being the same metal.
. An electron tube as claimed in claim 1 wherein said
d metal is Kovar, and said soft ductile metal is copper.
. An electron tube comprising a first vacuum envelope
tion and a second vacuum envelope section sealed
ether by a pressure seal, said pressure seal comprising
rst hard metal sealing ring bonded to said first section
l a second hard metal sealing ring bonded to said second
tion, said sealing rings protruding outwardly from
l envelope sections forming rims, soft ductile metal
ting on said sealing rings, a hard metal spacer ring
posed between said first and second plated hard metal
ling rings, and a soft ductile meatl sealing gasket dis-
ed exterior of said hard metal spacer ring and ex-
led to adhere to said plated sealing rings forming a

vacuum tight seal, said metal spacer ring being of a metal substantially as hard as said metal in said sealing rings, said sealing gasket and said metal plating being of the same soft metal.

4. An electron tube as claimed in claim 3 wherein said hard metal is Kovar, and said soft metal is copper.

5. An electron tube having two envelope sections each comprising a ceramic ring and a metal sealing ring bonded thereto, said metal sealing rings being bonded together by a pressure weld seal, said pressure weld seal comprising annular rims on said metal rings projecting outwardly beyond said ceramic rings, said rims being made of hard metal coated on their adjacent sides with a relatively soft metal, a sealing gasket between said rims, a non-melt pressure weld bonding said gasket to said coatings and forming a vacuum tight seal between said rims, and said sealing gasket being of a softer metal than said hard metal.

6. An electron tube as claimed in claim 5 in which a spacer ring is positioned between said sealing rings, said spacer ring being made of material which is harder than said sealing gasket.

7. An electron tube comprising a first vacuum envelope section and a second vacuum envelope section sealed together by a pressure weld seal, an electrode supported by each of said sections, said pressure weld seal comprising a first metal sealing ring forming part of said first section and a second metal sealing ring forming part of said second section, a metal sealing gasket between said sealing rings, a non-melt pressure weld bonding said gasket to said rings to form a vacuum tight seal between said sealing rings, and a spacer ring between said sealing rings, said spacer ring being made of a relatively hard material compared to said sealing gasket.

8. A housing for an electronic device comprising a first envelope section and a second envelope section sealed together by a pressure weld seal, said pressure weld seal comprising a first hard metal sealing flange forming part of said first section and a second hard metal sealing flange forming part of said second section, a soft ductile metal plating on said first and second flanges, and a soft ductile sealing gasket between said sealing flanges bonded to said platings and forming an hermetic seal between said sealing flanges, and said sealing gasket and said metal plating being the same metal.

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