Dec. 31, 1957 W. R. WHEELER 2,818,522

CERAMIC FRAME GRID

Filed April 19, 1954

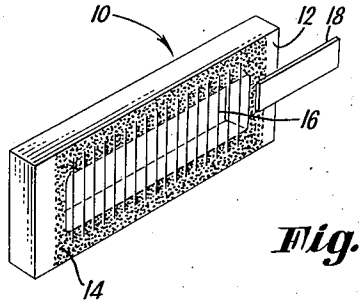


Fig. 1

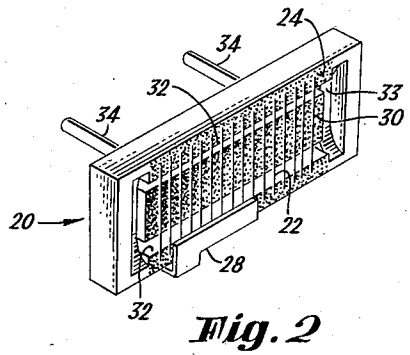


Fig. 2

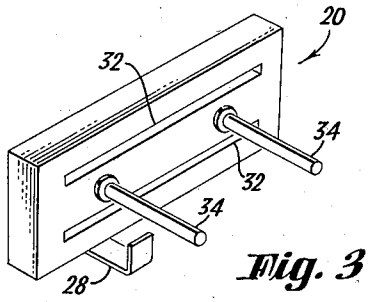


Fig. 3

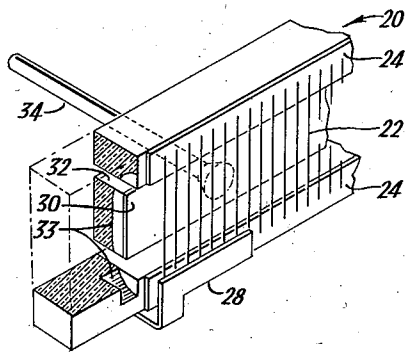


Fig. 4

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CERAMIC FRAME GRID

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4 Claims. (Cl. 313—268)

This invention relates to grid structures such as are employed in vacuum tubes.

The growth of the electron tube manufacture art has progressed to where it is possible to utilize automatic machinery to assemble the component parts of a tube. To lend itself toward such manufacture, tubes have been designed wherein the electrodes are stacked one above the other with insulating spacers therebetween. To lend toward compactness of parts, reduction in number of parts and improvement in tube performance, it has been found desirable to integrate electrodes with the spacers. It is toward these objectives that this invention is directed.

To make a tube with suitable characteristics it is necessary that the spacers shall be of high electrical resistance for preventing leakage, thin for compactness and strong for ruggedness. Ceramics have been found to meet these specifications. One of the better ceramics for this purpose is zircon, the silicate of zirconium, although alumina and steatite have also been found to be useful. But in the past it has been found to be exceedingly difficult to effect a proper bond between the ceramic material and a metal, such for example as the metal of grid laterals of a grid structure. I have discovered that by suitably coating a ceramic support or spacer with a moly-manganese composition and subsequently utilizing a proper brazing compound, I can effectively secure grid wires or other electrode structure to the ceramic material and particularly where the ceramic material is zircon.

I have also discovered that in the past shorts have occurred between the grid laterals and closely adjacent cathode because of the sagging of the grid wires when the cathode was heated. This I found was due mainly to the different coefficients of expansion between the material of the grid support and the grid wire material. I have overcome this deficiency by associating with my selected grid support structure—a zircon frame—wires made of tungsten since tungsten has very nearly the coefficient of expansion of zircon.

My invention will be better understood after consideration of the following specification and the exemplifications of my invention disclosed in the accompanying drawings in which

Fig. 1 discloses a form of integrated insulating spacer and grid,

Fig. 2 discloses another form of integrated spacer and dual electrode structure including an anode and a grid,

Fig. 3 is a perspective view showing the back of the structure of Fig. 2, and

Fig. 4 is an enlarged view similar to Fig. 2 but with a portion broken away to better show end recesses.

Referring to the drawings in greater detail, at **10** there is disclosed a wafer-like rectangular hollow ceramic frame preferably of zircon having on its face **12** a moly-manganese coating **14**. This coating may be formed by applying a moly-manganese powder to a surface of the zircon and firing the same at 1350° C. for ten minutes in a wet hydrogen atmosphere. Most effective results have been obtained if rather a dilute suspension of the powder

consisting of about 80% molybdenum and 20% manganese be painted onto the surface of the zircon and then brazed thereon. The amount of dilution should be such that the coating after firing should not form a bubbly surface, nor be dark nor have a glazed appearance. If such be the case the suspension is too dense. With sufficient dilution, it will be found that the fused surface adheres strongly enough to the ceramic surface even during the process subsequently employed to attach the tungsten grid wires **16** to the fused surface. The suspension is painted only onto the surface of the ceramic to which the grid wires are to be attached, for example, the surface **12**. In order to secure the tungsten wires to the moly-manganese coating on the zircon, a brazing compound including a wetting agent for both the metals of the coating and the grid is necessary. Such a brazing compound is, for example, one utilizing a nickel plated gold-silver alloy, the brazing being accomplished in a moist hydrogen atmosphere, and the nickel being the wetting agent. Also attached to the coating on the ceramic is the molybdenum tab **18** for connection with a suitable terminal in the tube, the molybdenum tab being attached to the ceramic in the same manner as the tungsten wires.

The tungsten wires may conveniently be formed on the ceramic by placing two ceramics back to back with the coated faces outermost, winding a tungsten wire about both ceramics, brazing the wire in place and then with a stiff brush brushing off the wires where they do not adhere to the ceramics. The wire in the manufacture of very small tubes is of very fine diameter and may easily be picked off from the ceramics near the edges of the same where not attached to the ceramic. Each of the two pieces of ceramic now forms a grid structure.

The form shown in Figs. 2, 3, and 4 differs from that in Fig. 1 in that the ceramic **20** not only serves to support the grid wires **22** on the metallized surface **24** but also serves to support an anode moly-manganese coating **30** on the bottom of a recess in the face of the ceramic, the walls of the recess serving as insulating media between the bottom coating **30** and the grid structure. To further insure insulating the anode coating from the grid surface, the ceramic is slitted through as at **32**, the slits in effect forming continuations of two of the walls of the recess. Also the lateral ends of the recess are deepened as at **33** for the same purpose. Anode pins **34** passing through the ceramic and brazed to the coating **30** are provided for connecting the bottom coating with tube terminals. The grid structure is provided with a molybdenum tab **28**, as in the case of the structure of Fig. 1.

Having thus described my invention, what I claim as new is:

1. A combined grid, anode, and insulator comprising a rectangular wafer of ceramic material with a recessed face, a metallic coating at the bottom of the recess forming an anode, and a terminal connected with the anode, the wafer at two opposite boundary edges of the anode having slots through to the back of the wafer, a second metallic coating on the face of the wafer and a grid structure integrated with the second metallic coating and spanning the recess.

2. A combined grid, anode, and insulator comprising a rectangular wafer of ceramic material with a recessed face, a metallic coating at the bottom of the recess forming an anode, and a terminal connected with the anode, the wafer at two opposite boundary edges of the anode having slots through to the back of the wafer, the wafer at the other two edges having further recesses a second metallic coating on the face of the wafer and a grid structure integrated with the second metallic coating and spanning the recess.

3. A combined grid, anode, and insulator comprising a rectangular wafer of ceramic material with a recessed face, a moly-manganese coating at the bottom of the recess and

a terminal connected therewith and extending beyond the wafer, a second moly-manganese coating on the face of the wafer surrounding the recessed portion and a grid structure integrated with the second coating and spanning the recess.

4. A combined grid, anode, and insulator comprising a rectangular wafer of ceramic material with a recessed face, a moly-manganese coating at the bottom of the recess and a terminal connected therewith and extending beyond the wafer, a second moly-manganese coating on the face of the wafer surrounding the recessed portion, a grid structure integrated with the second coating and spanning the recess, and tab structure connected with said second coating.

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