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ELECTRON TUBE GRID STRUCTURE

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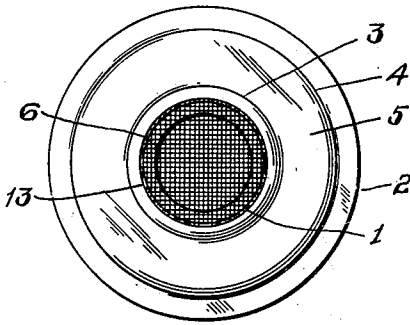


FIG. 1

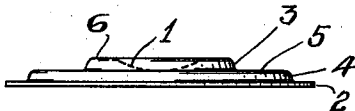


FIG. 2

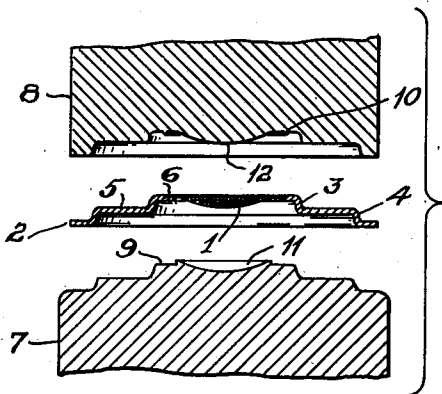


FIG. 3

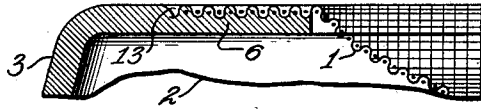


FIG. 5

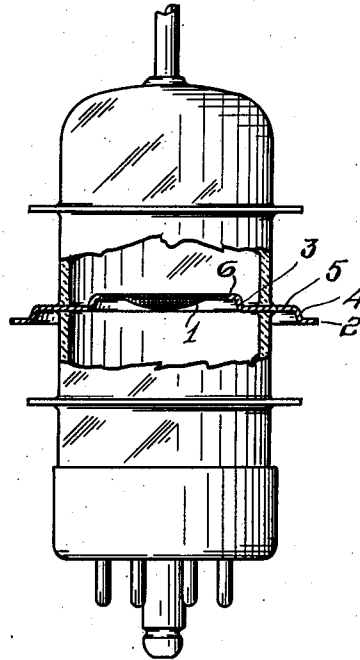


FIG. 4

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ELECTRON TUBE GRID STRUCTURE

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3 Claims. (Cl. 250-27.5)

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This invention relates to electron tubes, more particularly to disc-type mesh grids for use in such tubes, and to the method of making them.

In certain of the electron tubes in which a disc-type mesh grid is used, considerable difficulty has been encountered heretofore in making satisfactory contact between the wires of the grid and the grid frame.

For example, in some velocity modulated tubes and other high frequency disc-seal tubes, it was found that high power output from the tube could be obtained only if each individual wire at the periphery of the grid in the structure was individually welded to the grid frame. This method of making grids is necessarily difficult and with very small grid wires having diameters of the order of $\frac{1}{1000}$ of an inch it becomes virtually impossible to accomplish it.

Furthermore, after the wires are welded in this manner, it is necessary to clean them. This is normally accomplished with the aid of an acid bath or by firing in hydrogen. Cleaning with acid is highly objectionable particularly on wires of small diameter since the acid dissolves part of the wire and the consequent reduction in diameter deleteriously affects the electrical characteristics of the tube produced with such grid. The method of cleaning by firing in hydrogen is also objectionable because it makes the grid wires brittle. Furthermore, inasmuch as the cleaning operation is usually incomplete, a longer exhaust schedule is usually required for outgassing the tubes at a further cost in time which may be added to the original slow method of welding.

Accordingly, an object of this invention is to provide a substitute method of assembling mesh type grids which is not subject to these disadvantages. A further object of the invention is to improve the mechanical and electrical bond between the mesh grid and its frame. Still another object of this invention is to improve the grid structure and the method of making it.

In accordance with my invention, these and other advantages which are incidental to its application, can be obtained by embedding the wires of the grid mesh in the inner periphery of the grid frame. This can be accomplished by holding the grid wire and the frame together in a jig and subjecting them to the application of high pressure. This causes the metal on the frame to flow about the relatively hard grid wires and produces an excellent bond between the two.

In the accompanying drawings which illustrate the preferred forms of the improved structure

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and a method of manufacturing embodying the features of this invention,

Fig. 1 is an axial view of a grid frame with the grid mesh embedded therein.

Fig. 2 is an edge view of the device illustrated in Fig. 1.

Fig. 3 is a sectional view of the grid, the grid frame, and a jig used in pressing them together.

Fig. 4 is a side elevation, partly in section, of an electron tube incorporating the assembled grid and grid frame.

Fig. 5 is a large fragmentary cross-section of the grid frame showing the embedded wire.

The embodiment of the disc-type grid of my invention illustrated in the drawing comprises an electrode made of a circular piece of wire mesh grid 1 mounted on an annular grid frame 2. In a particular application for which such a structure was used, the grid mesh was woven of tungsten wire 0.0012 inch in diameter, while the electrode support or grid frame was formed from copper sheet.

The grid frame may be shaped in any manner suitable to the design of the tube in which it is to be used. In this instance, it is shown with shoulders 3 and 4 to promote rigidity, a flat area 5 positioned between the shoulders, adapted for sealing the sections of glass tubing which make up part of the glass envelope of the tube and an inner annular flat area 6 in which the grid wire is embedded.

The shape and size of the grid mesh 1 may naturally be chosen to conform with the desired electrical properties of the tube. Furthermore, the jigs used in pressing the grid wires into the frame may, as will be hereinafter explained, aid in giving the grid its desired shape.

A preferred method of assembling the grid frame and mesh is clearly illustrated in Fig. 3 of the drawing. In the embodiments there shown, the jig is composed of two sections 7 and 8 which are formed in such manner as to conform with the shape of the grid support shown in the remaining figures of the drawing. It could, naturally, conform to other desired shapes.

When using a jig of this type, a shaped annular disc provided with an opening of the proper size, is placed on the surface 9 of section 7 of the jig with its inner circular opening abutting edge 15. A circular section of the desired grid mesh is then placed over the circular opening of the disc with its edge overlying a substantial area of the immediately adjacent grid frame. The two sections 7 and 8 of the jig are then brought together under considerable pressure. Due to the shape of the

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jig parts, this will simultaneously cause the grid wire to become embedded in the relatively softer grid frame at point 6 as around the inner edge of the annulus and cause the wire mesh 1 to assume the curvature of the curved surfaces 11 and 12 of the jig sections 7 and 8 respectively.

In the particular embodiment of the jig illustrated, a circular projecting edge 10 is additionally provided in section 8 of the jig. This projecting edge is located where the extremities of the grid wires fall on the disc. When pressure is brought to bear, this edge forms a circular groove 13 in the grid frame and causes the end of the wires to be turned downward and become embedded therein.

When the pressure is released and the jig removed, the grid frame and grid mesh wire form a single unitary structure in which the periphery of the grid mesh 1 cannot move in any direction with respect to the grid frame and the shape of the curved central portion is precisely maintained. Furthermore, the process of joining the two parts is purely mechanical, no chemical action of any kind is involved and no subsequent treatment is necessary. There is, therefore, no corrosion or oxidation of the type normally encountered when using the prior art welding technique.

It is naturally understandable that the shape of the jig could be such that it could also simultaneously form the grid frame from a flat annular disc as well as to embed the mesh 1 into the grid frame. The method illustrated is merely a preferred one in which the frame is previously formed and the wire mesh embedding operation is carried out subsequently.

The pressure used in this operation will also naturally vary within wide limits depending upon many variables including the wire size, materials used, the depth of embedding desired and the shape of the finished grid. It has been found, for example, that a pressure of 2 tons is adequate for making a grid of the design shown in the drawing when the grid frame is made of copper and the wire is 0.0012 inch tungsten.

A grid and grid frame embodying the features

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of this invention are shown incorporated in an electron tube in Fig. 4. The disc 2 is sealed between sections of the tubular envelope holding the mesh 1 in the center of the tube where it acts as a control element for an axial electron beam.

While the above description and the drawings submitted herewith disclose preferred and practical embodiments of the grid mesh and frame assembly of this invention, it will be understood by those skilled in the art, that the specific details of construction and arrangement of parts as shown and described are by way of illustration, and are not to be construed as limiting the scope of the invention.

What I claim is:

1. A mesh grid for an electron tube comprising a mesh of relatively hard wires and an annular grid frame of softer metal, the wires having their ends embedded adjacent the inner edge of the annular grid frame.

2. A grid and grid frame assembly for an electron tube comprising a disc-like mesh of wires having its circular periphery embedded adjacent the inner circumference of an annular disc, the ends of said grid wires being embedded in a circular groove in said disc.

3. In an electron tube having an evacuated tubular envelope, a central electrode comprising a mesh of wires with its periphery embedded in an annular disc adjacent the inner circumference, said disc projecting through said envelope and being sealed thereto with its outer periphery outside said envelope.

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