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MANUFACTURE OF GRIDS FOR ELECTRON DISCHARGE DEVICES

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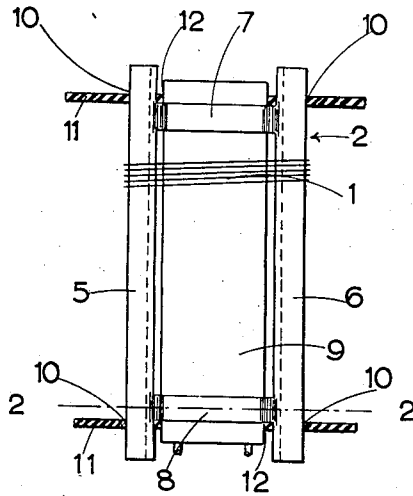


FIG. 1.

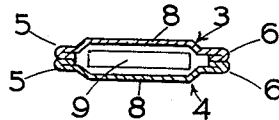


FIG. 2.

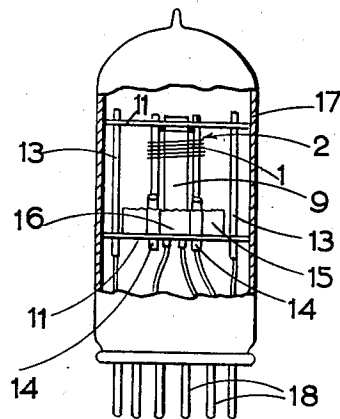


FIG. 3.

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MANUFACTURE OF GRIDS FOR ELECTRON DISCHARGE DEVICES

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3 Claims. (Cl. 29—25.17)

This invention relates to the manufacture of grids for electron discharge devices.

In thermionic valves the grid surrounding the cathode or another electrode such as a further grid is usually formed by winding wire around a pair of spaced apart support rods. However, in thermionic valves for use at very high frequencies a very small and accurate spacing is required between the grid and the cathode or other electrode. The grid wire employed must of necessity be of a very small diameter, such as less than 0.02 mm., and must be wound under tension on a very rigid frame to maintain the dimensional accuracy required. Heretofore the manufacture of a rigid frame has presented some difficulty owing to the small dimensions of the frame and the requirement for the thickness of the frame to be maintained with a high degree of accuracy, since it is the thickness of the frame which mainly determines the spacing of the grid wire from opposite surfaces of the cathode. Furthermore the frame must be constructed so that after winding the grid thereon a cathode or other electrode can be inserted into the interior of the grid.

The object of the present invention is to provide an improved method of manufacturing a grid wound on a frame in which the latter is formed in such a manner that consistent accurate dimensions can be obtained.

According to the invention there is provided a method of making a grid for an electron discharge device which comprises forming a frame by securing together a pair of frame members each having side portions spaced apart by cross-bars at opposite ends thereof with the side portions abutting one another and with the cross-bars at opposite ends spaced apart to enable another electrode to be inserted through said spaced cross-bars, subjecting the sides of said frame which are formed by said side portions to a pressing operation to impart a required thickness to said sides and then winding a grid around the sides of said frame.

In manufacturing the frame the latter may be formed from two identical frame members which may be pressings made from molybdenum and after securing the frame members together, preferably by brazing, the thickness of the side portions of the frame are made slightly oversize so that on subjecting the sides of the frame to said pressing operation they are reduced to the required dimensions and in this manner it is possible to maintain an accuracy of ± 0.00025 inch.

In order that the said invention may be clearly understood and readily carried into effect, it will now be more fully described with reference to the accompanying drawings, in which:

Figure 1 illustrates a side elevation view of a grid in accordance with the invention,

Figure 2 is a cross-section view taken along the line 2—2 of Figure 1, and

Figure 3 illustrates a grid in accordance with the invention in an electron discharge device.

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As shown in Figures 1 and 2 of the drawings, the grid is formed by winding grid wire, a few turns of which are indicated at 1 in Figure 1 around a frame 2 of molybdenum. The frame 2 in the embodiments shown is made from two identical pressings 3 and 4 forming a pair of frame members, each frame member having side portions 5 and 6 which are spaced apart by cross-bars 7 and 8. The side portions of each frame member are bent over on themselves as indicated in Figure 2 and the bent over portions are arranged in abutting relationship. The frame members may be provided with a plating of copper and are assembled together in a suitable jig and heated to a sufficient temperature to cause said frame members to become brazed together. After brazing the sides of the frame which are formed by said side portions 5 and 6 they are then subjected to a pressing operation so that the thickness of the sides of the frame is reduced to a desired dimension. In one particular grid the frame members 3 and 4 may be pressed from metal having a thickness of 0.0085 inch, the length of the sides of the frame may be 0.480 inch, the width of the frame 0.240 inch and the width of the side portions 5 and 6 and the cross-bars 0.040 inch. Prior to subjecting the sides of the frame to said pressing operation the thickness of the sides may be 0.032 to 0.034 inch and after pressing the thickness of the sides is reduced to a thickness of 0.0315 inch ± 0.00025 inch. After forming the frame in the manner above-described, the grid 1 is wound thereon, the grid having, for example, 400 turns per inch and being wound with wire of 0.004 inch diameter.

The cross-bars 7 and 8 at each end of said frame are spaced apart from one another, as will be observed from Figure 2 of the drawings, so that after winding the grid an indirectly heated cathode 9 can be inserted into the interior of the wound grid. The width of the cathode may be 0.120 inch and its thickness 0.0265 inch.

The side portions 5 and 6 preferably extend beyond the cross-bars 7 and 8, so that the extended portions can serve as locating lugs for locating the grid in apertures 10 formed in a pair of insulating supports 11. The cross-bars 7 and 8 may be arranged to abut against the surfaces of the insulating supports 11 so that the grid is prevented from axial movement relatively to the insulating supports. The insulating supports 11 are also provided with apertures 12 in which the ends of the cathode 9 are located.

Figure 3 of the drawings illustrates a grid in accordance with the invention in an electron discharge device of the triode type, the electrode structure shown therein comprising a pair of support rods 13 on which the insulating supports 11 are assembled. Additional support rods are carried by the insulating supports 11 as indicated at 14, these additional support rods serving to support between the insulating supports 11 an anode 15 which is formed with a re-entrant portion 16 which is disposed close to the grid 1, a similar anode being provided on the opposite side of the device to that shown in Figure 3. The electrode structure is arranged within an evacuated envelope 17 and contact pins 18 are provided at the base of the envelope 17 to which the various electrodes are electrically connected in known manner.

The wire from which the grid is wound is preferably tungsten wire and is gilded before winding by drawing the wire through a molten bead of gold in a reducing atmosphere such as hydrogen. The use of tungsten wire with a frame made of molybdenum is advantageous since the coefficients of expansion of these metals is substantially the same. The gilded wire is then wound on the frame under tension and the first few turns and the final few turns of the grid which may lie over the cross-bars may be temporarily held in position by means of a suitable volatile cement, such as a nitro-cellulose

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cement. In order to secure the individual turns of the grid wire to the frame, the wires and the copper-plated frame are heated to a temperature of about 700 to 1000° C. for a short time in order to braze the gilded wire to the copper plated frame. Although the temperature referred to is below the melting point of either copper or gold, brazing is effected at this temperature due to the formation of a gold-copper eutectic alloy. By copper plating the frame as aforesaid and gilding the wire the brazing temperature for the securing of the wire in position is substantially lower than that required for ordinary gold brazing, with the result that the grid convolutions can be maintained at a higher tension.

Although the grid is shown in Figure 3 as applied to a triode valve where it serves as the control grid, it is to be understood that a grid in accordance with the invention can be employed in other types of electron discharge devices. For example it could be employed as the screening grid in a tetrode valve.

What we claim is:

1. A method of making a frame type grid electrode for an electron discharge device which comprises forming a frame having sides and cross-bars consisting of a pair of frame members each having side portions spaced apart by cross-bars at opposite ends thereof, bending over on themselves each of the side portions, arranging said frame members with said bent over portions contacting one another and with the cross-bars at opposite ends spaced apart, connecting said side portions together, subjecting the sides of said frame to a pressing operation to compress said bent-over portions and to impart a predetermined thickness to said sides and then winding a grid around the sides of said frame.

2. A method of making a frame type grid electrode for an electron discharge device which comprises forming a frame having sides and cross-bars consisting of

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a pair of frame members each having side portions spaced apart by cross-bars at opposite ends thereof, bending over on themselves each of the side portions, arranging said members with said bent over portions contacting one another and with the cross-bars at opposite ends spaced apart, brazing said side portions together, subjecting the sides of said frame to a pressing operation to compress said bent-over portions and to impart a predetermined thickness to said sides and then winding a grid around the sides of said frame.

3. A method of making a frame type grid electrode for an electron discharge device which comprises forming a frame having sides and cross-bars consisting of a pair of frame members each having side portions spaced apart by cross-bars at opposite ends thereof, bending over on themselves each of the side portions, arranging said members with said bent over portions contacting one another and with the cross-bars at opposite ends spaced apart, brazing said side portions together, subjecting the sides of said frame to a pressing operation to compress said bent-over portions and to impart a predetermined thickness to said sides, providing a coating of copper on said frame, winding a gilded grid wire around said frame and brazing the wound grid to said frame by heating the frame and the turns of said grid.

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