

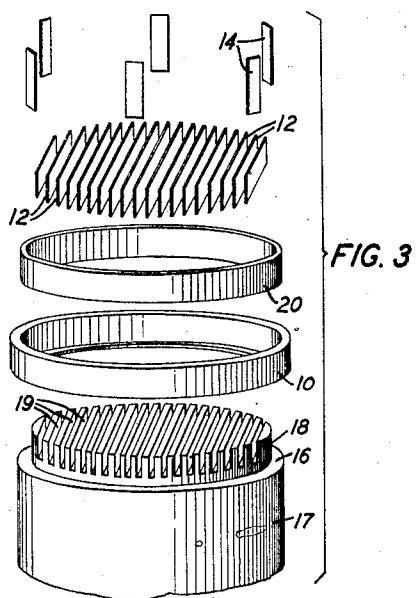
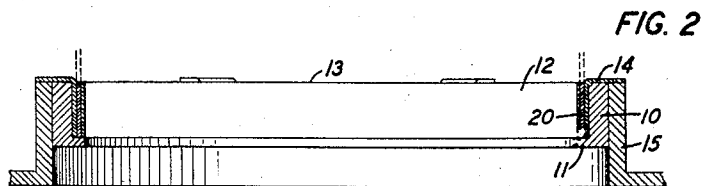
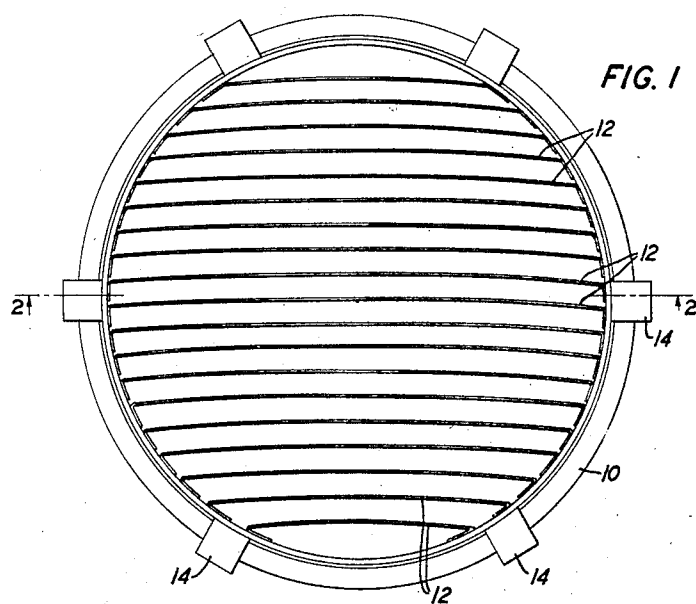
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ELECTRON DISCHARGE DEVICE

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ELECTRON DISCHARGE DEVICE

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4 Claims. (Cl. 250—27.5)

This invention relates to electron discharge devices and more particularly to electrode structures for such devices operable at ultra-high frequencies.

In ultra-high frequency electron discharge devices, certain electrodes, such as the cathode and a grid in cooperative relation therewith or a pair of grids defining a gap in velocity variation devices, are mounted in extremely close space relation. For example, in such devices operable at frequencies corresponding to wave-lengths in the centimeter range, electrode spacings of the order of .020 inch are required. Furthermore, realization of constant operating characteristics for such devices necessitates the maintenance of the predetermined electrode spacings within extremely close limits. During operation of such devices and also during the outgassing treatment thereof in the course of the manufacture of the devices, the electrodes are heated to high temperatures so that expansion and contraction thereof in accordance with temperature variations therein occur. Such expansion and contraction may result in material variations in the electrode spacings with consequent variations in the interelectrode impedances and the operating characteristics of the devices and also may result in contact between two electrodes whereby the devices are rendered inoperative.

One object of this invention is to establish and maintain accurately the spacing between two cooperative electrodes in an electron discharge device. More specifically, one object of this invention is to construct a grid electrode of generally planar form wherein edges of the elements of the grid will maintain a substantially coplanar relation throughout wide ranges of temperature to which the electrode may be subjected during use.

In accordance with one feature of this invention, a grid electrode comprises an annular support and a plurality of edgewise mounted metallic strips constituting the grid elements or wires and having their ends affixed to the support, the strips being bent or bowed in the same direction normal to their major faces. When the strips expand and contract with temperature variations, the movement thereof is substantially entirely in the direction in which they are bent or bowed so that the edges of the strips remain at all times in common fixed planes. Hence, when the grid electrode is mounted in juxtaposition and parallel to another electrode, the position of the grid is fixed with respect to the other electrode and the electrode spacing is

maintained constant even when the grid becomes heated to a high temperature.

The invention and the above-noted and other features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawing, in which:

Fig. 1 is a face view of a grid electrode constructed in accordance with this invention;

Fig. 2 is a view in section of the grid electrode illustrated in Fig. 1 and of a portion of a support therefor, illustrating one way in which the electrode may be mounted; and

Fig. 3 is an exploded perspective view illustrating the constituent elements of the grid electrode shown in Figs. 1 and 2 and illustrating also a mandrel or tool employed in the fabrication of the grid electrode.

Referring now to the drawing, the grid electrode illustrated therein comprises an annular support 10, for example of nickel, having an annular inwardly extending flange 11. Seated on the flange 11 are a plurality of equally spaced, edgewise mounted, metallic strips 12, for example of copper-plated molybdenum, the end portions of the strips lying along the inner surface of the support 10 and being secured thereto as described hereinafter. As shown clearly in Fig. 1, the intermediate portions of the strips 12 are bowed in the same direction, normal to the major surfaces thereof. The strips are of the same width and preferably of such width that the outer edges 13 thereof are in the plane of the end face of the support 10 remote from the flange 11. Hence, these edges of the strips are substantially coplanar and define, in common, a planar electrode surface. A plurality of metallic tabs 14 are secured to the inner surface of the support 10 and provide a means for securing the electrode to a mounting therefor.

It will be noted that the strips are inherently relatively rigid in the direction of their width so that when the electrode is subjected to a range of temperature variations when incorporated in an electron discharge device, expansion or contraction of the strips in this direction is extremely small. However, because of the thinness of the strips 12 and the bowed form thereof, the strips may expand and contract freely with temperature variations therein, such expansion and contraction being accomplished by increased or lessened bowing of the intermediate portions of the strips in the direction of a diameter of the support 10. Because of the bowed form of the strips, all of the strips will be displaced in the same direction in

accordance with temperature variations of the grid electrode so that contact between adjacent strips is prevented and the initial spacing of the strips relative to one another is maintained.

Such displacement of the strips as may occur with variations in the temperature of the electrode is normal to the plane in which the edges 13 or the strips lie so that, when the electrode is mounted, this plane remains fixed in position. Consequently, it will be appreciated that other electrodes may be mounted in very close space relation to the faces of the grid electrode without danger of contact between such electrodes and the grid due to displacement of the faces of the grid with temperature variations therein.

As illustrated in Fig. 2, the support 10 may be fitted in the cylindrical portion of a mount 15 and secured thereto by the tabs 14, which are bent over against the mount and affixed thereto, as by soldering or welding. The mount may be supported rigidly in a suitable manner in an electron discharge device, for example by sealing thereof to the enclosing vessel of the device.

In the fabrication of the grid electrode, the support 10 is seated on the shoulder 16 of a tool or mandrel 17, the tool having a head 18 of smaller diameter than the internal diameter of the support 10 and being provided with a plurality of parallel, equally spaced slots 19 of a width somewhat greater than the thickness of the strips 12. A ring 20 of solder is then placed within the support 10, the outer diameter of the ring 20 being the same as the internal diameter of the support 10. The strips 12 are then inserted edgewise into the slots 19 and the ends thereof bent to fit between the head 18 and the solder ring 20 whereby each strip is bowed until it contacts a wall of the slot in which it is positioned. Inasmuch as the slots are equally spaced and of the same width, the bowed strips will be equally spaced and substantially concentrically bowed. The tabs 14 are inserted between the solder ring 20 and the support 10. Subsequently, the entire

assembly is heated, for example in hydrogen, to melt the solder, whereby the strips 12 and tabs 14 are securely affixed to the support 10, after which the assembly is removed from the tool or mandrel.

Although a specific embodiment of the invention has been shown and described, it will be appreciated that it is but illustrative and that various modifications may be made therein without departing from the scope and spirit of this invention as defined in the appended claims.

What is claimed is:

1. A grid electrode for electron discharge devices comprising a support having an aperture therein, and a plurality of uniformly spaced metallic members extending across said aperture and having their ends secured to said support, said members being bowed in the same direction laterally with respect to said support.

2. A grid electrode for electron discharge devices comprising an annular support, and a plurality of spaced metallic strips extending across said support and having their ends secured thereto, said strips being mounted edgewise and curved in the direction of a diameter of said support.

3. A grid electrode for electron discharge devices comprising a plurality of spaced arcuate metallic strip members mounted edgewise and having their edges substantially coplanar, said members being bowed in the same direction and normal to the faces thereof, and a support encompassing and secured to said strip members at the ends thereof.

4. A grid electrode for electron discharge devices comprising a plurality of uniformly spaced, substantially concentrically curved strip members mounted edgewise and having their corresponding edges substantially coplanar, and an annular support encompassing and secured to said strip members at the ends thereof.

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