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ELECTRODE ASSEMBLY FOR ELECTRICAL
DISCHARGE DEVICES
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FIG. 1

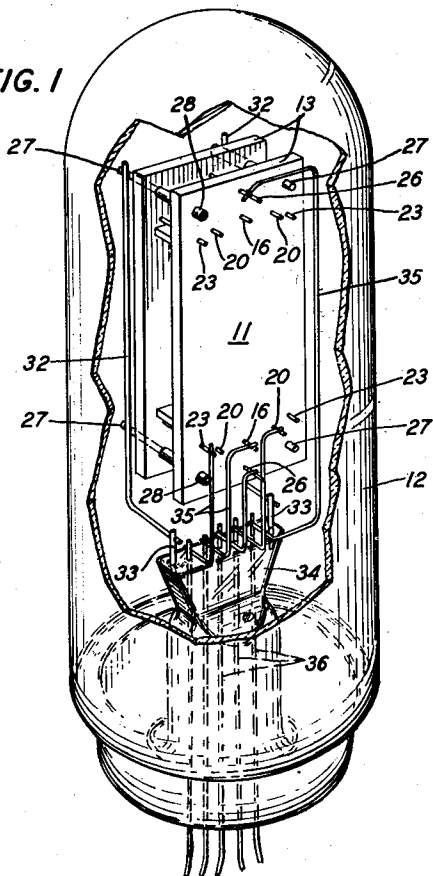


FIG. 2

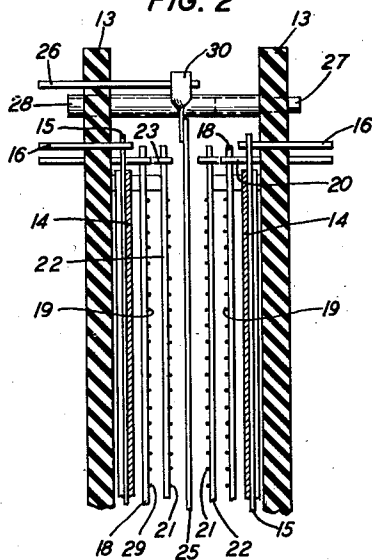


FIG. 3

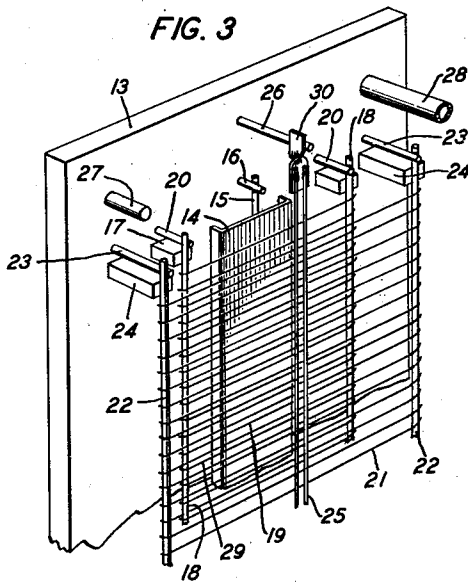
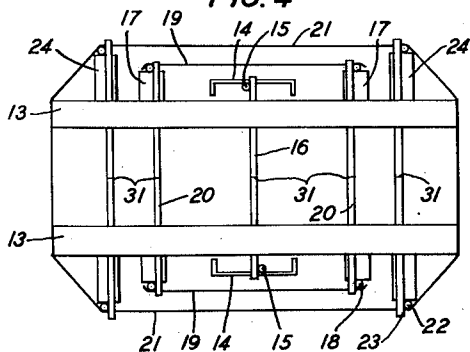


FIG. 4



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ELECTRODE ASSEMBLY FOR ELECTRICAL DISCHARGE DEVICES

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8 Claims. (Cl. 250-27.5)

1

This invention relates to electron discharge devices and more particularly to electrode assemblies and the method of fabricating these assemblies for such devices.

The static characteristics of electronic discharge devices determine the scope of use and the efficiency of operation in low frequency applications. However, the requirements encountered in the very high and ultra-high frequency ranges, such as the 100- to 500-megacycle range impose conditions which can only be satisfied by extremely precise mechanical correlation of the elements to produce the essential electrical constants whereby the highest efficiency is attained. The most important characteristic for general use is the transconductance. The transconductance depends on the spacing between the cathode, control grid, and screen grid, the diameter of the grid wire, the spacing thereof, the electrode area and the potentials applied to the electrodes. In order to attain a high transconductance, it is necessary to reduce the diameter of the control-grid lateral wires to a point where the wire is not self-supporting when wound in grid form. Therefore, the fine fragile wire must be wound on a support which maintains the collateral relation of grid and cathode constant at the very close spacings, for example at the order of two mills.

In order to attain the close, precision relationship between electrode surfaces and maintain mechanical stability of the system where fine grid lateral wires, on the order of 0.3 mil in diameter, are employed, it is imperative that some grid support be employed. The grid supports of the prior art, however, have not been satisfactory in the smaller tubes since a support of the size necessary to attain the required mechanical stability has required relatively large electrode spacing and has added undesirable capacitances to the system.

Therefore, an object of this invention is to simplify and improve the structure of close space precision electrode assemblies.

Another object is to reduce the electrode spacing while increasing the mechanical stability of electrode assemblies.

A further object is to improve the fabrication methods employed in the manufacture of close space precision electrode assemblies.

These objects are realized, in one embodiment of this invention, by an electrode assembly composed of two similar subassemblies which are secured together in precise relationship. Each subassembly comprises a base sheet adapted to

2

support a plurality of electrode sections which are fabricated thereon. The electrode sections are supported, with their effective surfaces parallel, from conductive studs projecting from the base sheet. The wire grids of this assembly are fabricated on the base sheet on pairs of coplanar rods so connected to the studs that the outermost edges of each pair define a plane parallel to and critically spaced from the next adjacent electrode. Grid laterals are mounted by winding wire around the sheet and over the outermost edges of these rods, securing the winding to these outermost edges, and cutting away all but the wire extending between the rods. A plurality of grids may thus be constructed one over the other in very close relationship. When the final grid has been fabricated on each subassembly, the two subassemblies are connected together and secured by some convenient method.

While the description and drawings disclose an electrode structure composed of two subassemblies it is to be understood that this is merely illustrative and a complete electrode assembly might be fabricated on a single base without departing from the spirit of this invention.

The invention will be more clearly set forth in the following detailed description of the embodiment disclosed in the accompanying figures in which:

Fig. 1 is a perspective view of a multielement discharge device embodying the features of this invention, with a portion of the vessel broken away to show the electrode structure;

Fig. 2 shows an elevation of the upper portion of the electrode assembly;

Fig. 3 is a perspective view of the upper portion of one of the subassemblies of the discharge device of Fig. 1 showing a portion of the electrode structure in detail; and

Fig. 4 is a plan view of a pair of partially completed assembly sections, having portions of the structure omitted for clarity and showing one method of mounting the grid laterals.

Referring to the drawing, an electron discharge device of micro-midget dimensions embodying features of this invention is disclosed in Fig. 1 wherein an electrode assembly 11 is mounted in an envelope 12. This assembly is made up of two sections of the type shown in Fig. 3 where sheet member 13 of suitable insulating material forms a rigid base upon which is fabricated a plurality of parallel electrode sections, the separations of which are determined by their spacing from the base 13 as a reference plane. The embodiment illustrated is a tetrode

3

comprising an anode 14 supported on a rod 15 which is welded to a pair of conductive studs 16 (only the upper studs appearing in Figs. 2 and 3). Adjacent the anode and critically spaced therefrom as determined by the height of the spacer projections 17 against which the side rods 18 are abutted and by the diameter of the side rods, is the screen grid 19. The screen grid side rods 18 are welded to pairs of studs 20 located adjacent the spacer projections 17. A control grid 21 is positioned next to the screen grid on side rods 22 mounted as those of the screen grid on pairs of conductive studs 23 and abutted against spacer projections 24.

A filamentary cathode 25 is shown supported on one of the assembly sections from studs 26 projecting from the base 13. No spacer means has been shown associated with the cathode, its position relative to the control grid being determined by a removable jig. However, spacers of the same type as projections 17 and 24 might be employed here. As an alternative method of cathode support, transverse end spacers of conventional form might be employed, such an arrangement taking the form of sheet mica spacers which might be slipped over the ends of the grid side rods 18 and 22 of each subassembly after they have been assembled. A cathode of either a directly or an indirectly heated type might be supported centrally between the control grid sections from these spacers.

Pairs of interlocking studs 27 and tubes 28 mounted on the corners of base 13 are employed to connect two of the subassemblies as shown in Fig. 2. The separation of the subassemblies is determined by the length of the tubes 28 which are slid over their mating studs 27 so that their ends bear against the base 13 of the associated subassembly. The mechanical stability of the system is maintained by welding the tubes on the studs.

The structure described above is especially adapted for simplicity of manufacture while maintaining a high degree of accuracy with small electrode spacings. The subassembly sections are built up separately, base 13 being made up with the studs 16, 20, 23, 26 and 27 and the tubes 28 mounted thereon, and the electrodes are fabricated on these studs. In the case of a base adapted for convenient molding, one of glass or ceramic, the studs and tubes can be molded in the base and integral spacer protuberances 17 and 24 can be formed in a single molding operation. Since the height of the spacers is critical in determining the electrode spacings each is ground to the proper height after being mounted on the base and prior to the fabrication of any of the electrodes. Then the anode support 15 is welded to the anode studs 16, its height from the plane surface of the base being determined by a jig, and the anode 14 is secured to the support rod parallel to the base. Next the two screen grid side rods 18 are welded to the screen grid studs 20 so that their edges outermost from the base define a plane parallel to that of the anode and critically spaced therefrom. The spacing in the embodiment disclosed being determined by the height of the spacers 17 plus the diameter of the side rods, however, the result could be accomplished by positioning the side rods with removable jigs during the welding operation or by employing side rods having a thickness equal to the desired spacing of the grid from the base so that they could be secured flush against the plane surface of the base with their outermost edges

4

defining a plane properly spaced from the anode. Screen grid laterals 29 are then mounted on the side rods by mounting the base 13 and the structure thereon in a winding machine and winding wire suitable for laterals around the whole assembly so that it lays across the grid side rods 18 and extends around the back of the base 13. The lateral wires are then secured to the side rods by welding or brazing, one method being to plate the side rods with a brazing medium such as gold prior to their mounting and passing a heating current through only one rod at a time to braze the laterals to the rod, the heat produced in one rod being so slight as to cause no thermal distortion in the electrode assembly. The portion of the winding which does not extend between the side rods is then cut away and the control grid fabricated in the same manner as the screen grid, by mounting side rods 22 on studs 23 to define with their outermost edges a plane parallel to and critically spaced from the screen grid, winding the grid laterals on the rods, securing them thereto, and cutting away the ineffective portions of the wires. The final step before assembly of the two sections is to mount the cathode upon one of the sections, this being done by welding the ribbon-like member 30 on the cathode stud 26 so that its outermost flat surface is parallel to the plane of the base and is critically spaced from the base to determine the cathode to control grid separation, and then welding the cathode filaments to the outermost surface of the member 30.

The two half sections are then joined as described heretofore, the stud 27 of each section being slipped into and welded in the mating tube 28 of the other section.

Fig. 3 illustrates one method of construction which can be conveniently employed in fabricating subassemblies of the electrode assembly of this invention. The connecting studs 27 and tubes 28 have been omitted from the drawing for purposes of clarity. In this embodiment the studs 16, 20 and 23 extend continuously through and mutually support a pair of spaced parallel base members 13. With such an arrangement, electrode sections are fabricated back to back. Two grids can be wound in a single winding operation by mounting a set of grid side rods on each base, placing the connected subassemblies in a winding machine, and winding the structure with grid lateral wire so that the wire lays across the outermost edges of the rods of both, securing the laterals to the rods in the manner set forth heretofore, and removing that portion of the wire which extends between rods of the two subassemblies. The drawing shows completed screen grid sections, and control grid sections which have not been trimmed of the excessive wire extending around the edges of the bases 13. When the grid structures have been completed the connecting portion of the studs can be severed as indicated at 31 and the sections connected in a structure as disclosed in Fig. 2.

The complete assembly is mounted in the envelope 12 on rods 32 extending from suitable pins 33 in the envelope press 34. Straps 35 are connected to the portions of the appropriate studs 16, 20, 23 and 26 projecting from the rear of the support bases 13, these straps extending from the studs of each electrode section to lead-in wires 36 sealed in the press 34 or from only one stud of each electrode, in the latter arrangements (not shown) a supplementary strap ex-

tending between the projecting portion of the studs of the corresponding electrode sections of each subassembly must be used to connect these sections.

The structure resulting from this construction provides close electrodes spacing without the need of piece parts having critical fits since the electrodes are built up on the mechanically stable base by using jigs, thereby making tubes of small dimensions practicable. It is to be noted further, that the grid wires can be conveniently aligned, as shown in Fig. 2, so that the control grid may act as a shield for the screen grid to reduce screen grid current and prolong the life of the tube. Although the electrodes of the tube are shown and described as being mounted on insulating members, it is within the province of the invention to mount them on metallic or conducting base members (not shown), the studs being insulatively mounted therein as by glass beads.

The above description is to be taken as illustrative only and not in a limiting sense the scope of the invention being set forth in the following claims.

What is claimed is:

1. An electrode assembly for an electron discharge device, comprising a base member, studs projecting from said base member, spacers projecting from said base member, and electrodes abutted against said spacers and secured to said studs in parallel relationship with each other and said base member.

2. An electrode assembly for an electron discharge device, comprising a base member, conductive studs extending through said base, a pair of coplanar conductive rods electrically and mechanically connected to said studs in parallel relationship with said base member, and grid laterals secured to said rods.

3. An electrode assembly for an electron discharge device, comprising a base member, conductive studs extending through said base member, conductive rods electrically and mechanically connected to said studs, said rods arranged in coplanar pairs, each pair having its outermost edge define a plane parallel to and critically spaced from the plane of said base, and grid laterals secured to each coplanar pair of rods.

4. An electrode assembly for an electron discharge device, comprising an insulating base, conductive studs extending through said base, spacers mounted on said base, a plurality of conductive rods each electrically and mechanically connected to certain of said studs and abutting said spacers, said rods arranged in coplanar pairs, each pair having its outermost edge define a plane parallel to and critically spaced from the plane of said base, and grid laterals secured to each of said coplanar pair of rods.

5. An electrode assembly for an electron discharge device, comprising a pair of spaced parallel base members, studs projecting from the adjacent faces of each of said base members, and parallel electrodes on each base member supported from said studs in parallel relationship with said base member.

6. An electrode assembly for an electron discharge device, comprising a pair of plane parallel base members, conductive studs extending through each of said base members, conductive rods on said studs on the adjacent faces of said base members, said rods arranged in coplanar pairs, each pair having its outermost edge define a plane parallel to and critically spaced from the plane of its base member, and grid laterals secured to each coplanar pair of rods.

7. An electrode assembly for an electron discharge device, comprising a pair of plane parallel base members, conductive studs extending through each of said base members, spacers on each of said base members, an anode section mounted on the adjacent faces of each of said base members, coplanar pairs of conductive rods supported from said studs and abutting said spacers on the adjacent faces of each of said base members, each pair of said rods having its outer edges parallel to the surface of its associated anode section and critically spaced therefrom, grid laterals secured to each coplanar pair of said rods, and a cathode supported between said base members.

8. An electron tube, comprising an envelope, a plurality of electrical conductors extending through the wall of said envelope, a base member within said envelope, conductive studs extending through said base member, conductive straps extending from said electrical conductors to said studs mechanically supporting said base member, and electrodes secured to said studs in parallel relationship with each other and said base member.

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