

July 20, 1948.

W. D. STRATTON
FILAMENTARY ELECTRODE MOUNTING
FOR ELECTRONIC DEVICES
Filed July 30, 1947

2,445,411

FIG. 1

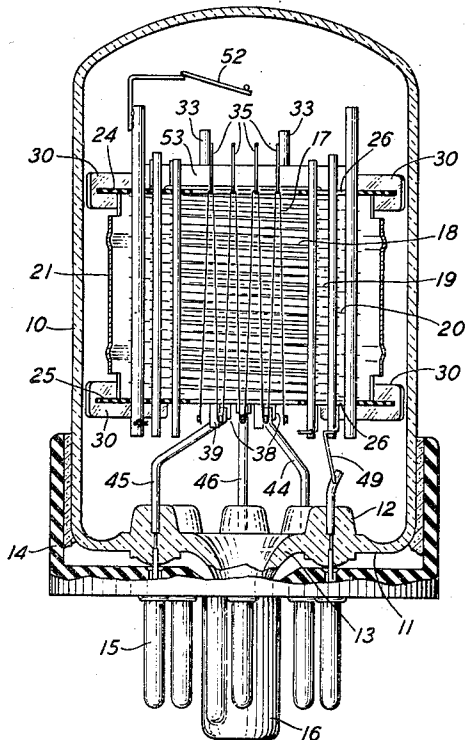


FIG. 2

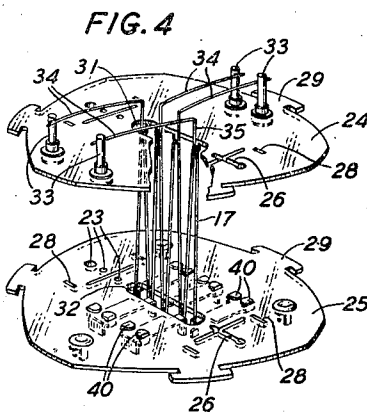
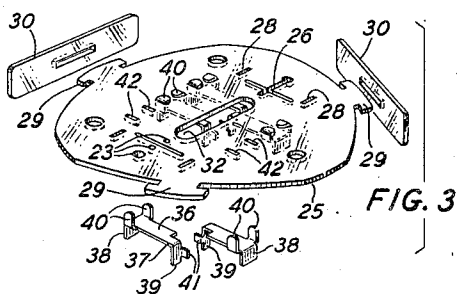
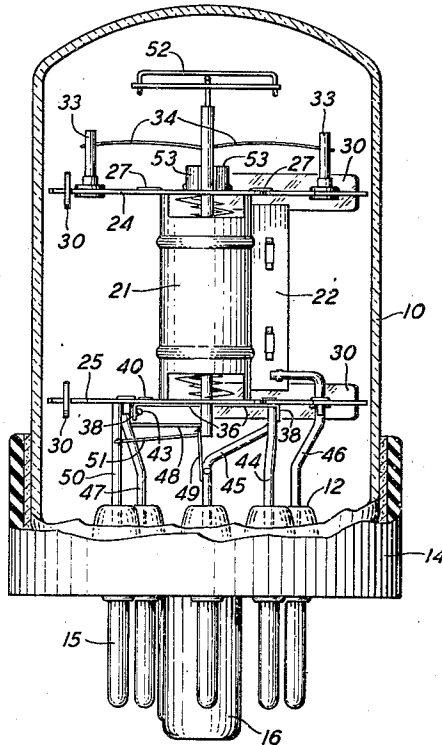
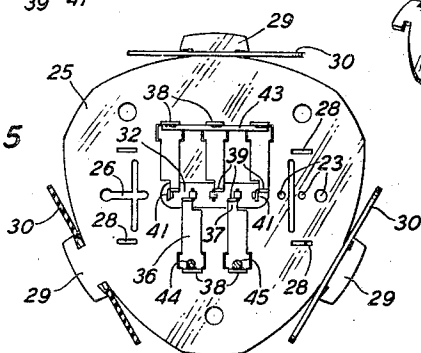


FIG. 5



INVENTOR
W. D. STRATTON
BY *W. D. Stratton*
ATTORNEY

UNITED STATES PATENT OFFICE

2,445,411

FILAMENTARY ELECTRODE MOUNTING
FOR ELECTRONIC DEVICES

William D. Stratton, Paterson, N. J., assignor
to Bell Telephone Laboratories, Incorporated,
New York, N. Y., a corporation of New York

Application July 30, 1947, Serial No. 764,622

7 Claims. (Cl. 250—27.5)

1

This invention relates to electronic discharge devices and more particularly to a mounting for a filamentary cathode or electrode substantially in a plane between other cooperating electrodes in a unitary assembly.

An object of the invention is to facilitate assembly of the filament under tension in a unit mounting.

Another object of the invention is to improve and expedite the anchoring of multiple sections of the filamentary cathode at opposite ends between insulating spacers which support the cooperating electrodes.

A further object of the invention is to equalize the tension strain on the filament sections so that abnormal stresses are avoided.

These objects are attained in accordance with features of this invention by attaching the lower ends of the filament sections to a plurality of clips or formed cantilever metallic punchings mounted in cooperative relation to the suspension springs at the top of the assembly. The multisection filament is uniformly supported in a medial plane between parallel surfaces of cooperating electrodes to provide a mounting assembly in which wide variations in tension strain are eliminated so that greater efficiency and longer life are attained.

A feature of the invention relates to the mounting of the clips in staggered relation upon a spacer to provide rigid arm supports for the individual sections of the filament and to avoid torsional strain on the fine filament strands. This is accomplished, in one embodiment, by securing a plurality of clips to one side of the spacer to project toward the plane of a quadri-section filament and securing a trio of clips to the other side of the spacer for projecting toward the filament plane, with the free ends of all the clips in alternate relation and opposite the ends of the series sections of the filament.

Another feature relates to the formation of the insulator and filament anchor ends of the clips to facilitate the fixation of the respective ends of the clips to the bottom insulator and of the ends and bights of the filament. One end of each clip or anchor is provided with a pair of bent ears to lock the clip in receiving slots in the spacer and the other end is attenuated and bent to form a perpendicular extension having a right-angle projecting ear or tab in bisecting relation to the normal plane of the filament section. These tabs on alternate clips extend in parallel relation across the longitudinal axial plane of the filament sections and receive the folded bights of

2

the intermediate sections and the ends thereof to anchor the filament ribbon assembly in the electrode mount. This construction provides a compact assembly in which the multisection filament is rigidly supported so that torsional strains are not imposed on the frail filament to cause displacement out of the axial plane of the cooperating electrodes and the dynamic characteristics of the device are therefore maintained constant. Furthermore, the clips provide rigid anchors which preserve the insulation resistance between adjacent sections so that shorts are eliminated between the sections.

Another feature of the invention is concerned with the reenforcement of the tabs which are attached to the junctions of the filament sections. The tabs extend edgewise from the side of angle portions projecting downwardly from the attenuated end of the clips and therefore the angle base of the tab strengthens the filament anchor to prevent twisting or bending thereof.

A further feature relates to the rigid flat bases of the clips which lie in juxtaposed relation to the spacer plane and are provided with crimping ears for engaging the mica through parallel slots to rigidly affix the clips to the spacer. This provides a coupling to maintain the clips in constant parallel relation and together with the alternate relation of the clips forms a multiterminal assembly of compact and rigid construction for the lower junctions of the filament array. In addition, the coupling ends of the clips are provided with bent portions for interconnection of the clips in one line and the filament conductors are attached to the remaining clips.

These and other features and advantages of the invention will be more clearly set forth in and understood from the following detailed description when considered with the accompanying drawing, in which:

Fig. 1 illustrates in cross-section one form of device involving a filament assembly illustrative of this invention;

Fig. 2 is a view in elevation of the same device as Fig. 1 taken from a different angle to show the related elements of the assembly; in this view the wing spacers of the mount are omitted for the sake of clearness;

Fig. 3 is a perspective view of the bottom spacer disc involved in the assembly of the electrode unit or mount with several of the wing supports shown in adjacent relation to the disc and two of the clips removed from the disc;

Fig. 4 shows in a perspective view the combina-

tion of the top and bottom spacers with the multi-section filament mounted in position; and,

Fig. 5 is a plan view of the spacer of Fig. 3 taken from the bottom side to show the layout of clips and the coupling of the filament sections thereto.

Referring to the drawing, and particularly to Figs. 1 and 2, the filament supporting assembly illustrative of this invention is shown in a pentode type electrode discharge device in which all the electrodes are held in a unitary assembly or mount and supported in a highly evacuated enclosing vessel. The vessel is composed of a glass bulb or receptacle 10 hermetically sealed to a disc stem 11 having a plurality of lead-in wires or conductors sealed in embossments 12. The latter are arranged in a circular boundary surrounding a central exhaust tubulation 13 for evacuating and sealing the vessel after the completion of the assembly of the mount therein. The stem is enclosed in a molded insulating base 14 having a plurality of terminal pins or prongs 15 for the accommodation of the electrode conductors or lead-in wires, and the sealed tubulation is protected by a central index projection 16 formed integral with the base.

The electrode unit or mount supported within the vessel includes a double M-shaped, multisection filamentary cathode 17 surrounded successively by a helical control electrode or grid 18, a screen grid 19, a suppressor grid 20 and an output electrode or anode 21 of closed box formation and having a joining flange or fin 22 projecting from the center of one larger side of the anode. The grids are wound on pairs of support wires or uprights one group of wires extending through individual holes 23 in the top and bottom insulator spacer discs 24 and 25, preferably of mica, on one side of a medial plane across the spacer discs and the other wires extending through a common slot 26 on the other side. The grids are held in accurate spaced relation between the spacer discs by the locking action of the surrounding anode which is provided with bent ears 27 at opposite ends, projecting through slots 28 in the discs and bent over on the exterior surfaces of the spacers. Both discs are provided with equally spaced peripheral locking extensions 29 to receive flexible mica wings 30 which engage the inner wall of the bulb at their ends, to resiliently support or cushion the mount in the glass vessel.

The device is of small size, being shown about twice actual dimensions, so that the electrode mount is proportionally of small dimensions. The filamentary cathode is very frail, being formed in one embodiment of high purity nickel or nickel alloy ribbon .0005 to .0008 inch thickness and .0062 to .012 inch width and of length to attain the required electron emission for a desired power output rating. Such delicate material necessitates extreme care in the assembly of the electrodes in the unit or mount to prevent damage due to kinks, bends, twists or scraping of the usual active coating applied to the filament surface. Accordingly, it is not practical to assemble the filamentary cathode initially in the mount before the other electrodes are placed in position to insure rigidity to the assembly due to the lack of fixation of the spacers of the mount. On the other hand, prior assemblies created undue welding difficulties in affixing the filament sections to the supporting elements if attempts were made to insert the filament after the other electrodes were placed in position.

In accordance with this invention these difficulties are eliminated and the delicate, fine filamentary cathode may be efficiently mounted in the axial plane of the electrodes after such electrodes are affixed to the spacer discs so that a rigid assembly is assured before the filament is inserted in the mount. This is accomplished by a construction as shown in Figs. 3 to 5, inclusive illustrating details of assembly of the filamentary cathode 17 between the mica spacers 24 and 25. Although Fig. 4 shows the filament assembled alone between the spacer discs this is only for clarity since the procedure is preferably reversed, that is the filament is incorporated in the mount after the other electrodes are assembled.

Both mica discs are provided with central elongated slots 31 and 32 respectively, the long axis of each of which coincides with the medial plane of the other electrodes and extends between the grid holes 23 and the common grid slot 26. These elongated slots provide clearance for the supporting elements of the multisection filament 17 and facilitate the insertion of the preformed filament within the electrodes prior to affixing the mount to the conductors in the stem. The top mica spacer 24 is provided with oppositely disposed pairs of studs 33 mounted in eyelets secured to the spacer disc adjacent the periphery and parallel to the slot 31. These studs project vertically from the disc and are arranged in paired relation so that one pair are close together on one side and the other pair are spaced wider apart to provide equal spacing between cantilever type tension springs 34 welded to the ends of the studs. Each pair of springs extend toward the central slot 31 and are provided with downwardly bent hook extensions 35 which are located in the axial plane of the electrodes and extend toward the upper bights of the filament sections, the widely spaced hooks engaging the end bights and the closely spaced hooks engaging the intermediate bights of the double M-shaped filament.

The coupling of the filament sections to the bottom spacer disc 25 in rigid location in the axial plane of the other electrodes is accomplished by a plurality of metallic flat clips or punchings which are affixed to the outer surface of the disc and extend in staggered relation towards the slot 32 to engage the ends and the intermediate lower bights of the multisection filament array. Each clip is formed the same so that a description of one will suffice for all, but the group of clips are mounted in opposing relation towards the slot to provide uniformity of spacing in relation to the tension springs at the top and to the folded sections and ends of the filament at the bottom.

The clips are formed of flat metallic strips, as shown in Fig. 3, having an elongated wide portion 36 and a restricted narrow portion 37. Opposite ends of the strips are bent at right angles in a downward direction to provide terminal portions 38 and 39, respectively. Each clip includes a pair of upwardly bent ears 40 and a right-angle anchor portion 41 which projects outwardly in edgewise direction from one side of the terminal portion 39 for securing a filament section thereto. The clips provide rigid securing means for the lower ends of the filaments, in which the wide portion 36 prevents twisting movement of the clip, the restricted or attenuated portion 37 insures sufficient insulation impedance between adjacent anchor portions of the clips and the downwardly bent terminal portion 39 reinforces

5

the edgewise anchor 41 projecting outwardly from the clip. The terminal portion 38 on the other end of the clip provides a strong base for the attachment or welding of conductors for supplying heating energy to the filament, without being in direct contact with the filament and also facilitates the coupling of the conductors to the filament in the mounting of the unit on the stem of the device. The clips are attached to the lower surface of the spacer 25 by inserting the ears 40 in pairs of short transverse slots 42 and bending the ears over on the other side of the disc toward each other to lock the clips to the spacer disc.

The clips are mounted in two groups on opposite sides of the slot 32 for the specific double M-shaped filament array 17 to distribute the clips in uniform relation with respect to the sections of the filament. A trio of clips are affixed to the disc, on one side of the slot 32 and a pair of clips are attached to the other side. The several clips are in alternate lateral relation so that adjacent clips project from opposite directions but coincide in the plane of the lower surface of the spacer disc. This arrangement causes the anchor portions 41 to bisect the medial plane of the slot, where they are in lateral spaced relation to the sections of the filament and since these portions are below the plane of the disc, the filament ends and lower bends therebetween may be readily welded to the portions 41.

In mounting the ribbon filament in the assembly, the filament, after coating, is folded in the form of a double M shape and the portions projecting through the lower spacer are scraped to remove the coating so that an efficient weld joint may be performed at the junction with the clip anchors. The preformed filament is inserted through the top slot 31 to project the lower ends toward the clips on the lower spacer. Since the ribbon is flat it is preferable to mount the sections in edgewise relation to the long dimension of the electrodes so that the flat sides of the ends and lower sections are parallel to the anchor portions 41 of the clips. This provides an efficient method of attachment for the filament sections since the scraped ends can be welded to the inside surfaces of the anchors on the end clips of the triple group while the medial bend straddles the anchor of the mid-clip of the same group. In the same manner, the intermediate bend of each M-shaped section straddles the anchor of the opposite clips and since all these surfaces are in parallel relation and exposed below the spacer disc 25, the welding operation to affix the filament sections to the clips is performed efficiently and high resistance connections due to defective welding contact are avoided. After the lower ends are attached to the clips, the upper folds or bights of the filament may be positioned by guiding the bends over the stressed hooks until the released hooks impart the necessary tension on the filament sections.

The rigid clip mounting of the lower sections of the filament not only provides an assembly which readily permits the subsequent insertion of the filament in the mount but also facilitates the fabrication of the unit or mount apart from the stem structure. Furthermore, the clips provide a rigid mounting which eliminates torsion strains in the filament sections and, due to the flat contact of the anchors and the filament bends, removes irregularities in the welded union at these points.

Another advantage of this construction is the

6

manner in which the heating energy is supplied to the multisection filament to reduce inequalities in temperature of the sections so that variations at the weld joints and in adjacent sections of the filament array are minimized. One method of supplying the energy to the filament is to heat all the sections in series-parallel to provide uniform temperature conditions in all the sections. This is accomplished by tying the triple clips together with a strap wire 43 and connecting the lead-in conductors 44 and 45, respectively, to the pair of clips on the other side of the slot, as shown in Fig. 5. The heating current is then supplied to the middle junctions of the two M-shaped sections and the current flows in parallel through the sections through the triple tied clips.

When the filament is secured to the conductors in the stem, the anode 21 is connected to conductor 46 which extends through an eyelet in the lower disc and is attached to the fin 22 as by welding. The suppressor grid 20 is connected to conductor 47 by a bridging wire 48 and the screen grid is attached to another conductor in the stem by a tie wire 49, while the control grid is connected to the remaining conductor 50 by a bridging wire 51, conductors 47 and 50 being extended to join eyelet fastenings secured in the lower disc spacer to add rigidity to the mount in the enclosing vessel.

A getter supporting loop 52 extends from the upper end of one of the suppressor grid supports and a two-piece metallic strap shield 53 surrounds the ends of the grids and the filament springs above the top spacer disc.

While the invention has been disclosed with respect to a specific assembly of the electrode mount, it is, of course, understood that various modifications may be made in the detailed assembly of the elements without departing from the scope and spirit of the invention as defined in the appended claims.

What is claimed is:

1. An electron discharge device comprising an enclosing vessel, an electrode unit mounted therein including a folded filamentary cathode and a pair of spacer discs on opposite ends of the electrodes having elongated slots therein in line with said cathode, a plurality of tension springs on one disc engaging the bights of said cathode, a plurality of metallic clips secured to the outer surface of the other disc, said clips having portions projecting across the slot in said other disc, and bent tabs on said portions secured to the ends and intermediate sections of said cathode.

2. An electron discharge device comprising an enclosing vessel, an electrode unit mounted therein including a pair of spacer discs on opposite ends of the electrodes and a multisection filament of folded form extending through aligned slots in said discs, a plurality of tension springs on one side of one of said discs engaging the bights of said filament, a plurality of anchor members secured to the bottom of said other disc and extending toward the slot therein, said members having bent portions located in the plane of said filament, the ends and remaining bights of said filaments being attached to said bent portions, and conductors secured to said members for supplying heating energy to said multisection filament.

3. An electron discharge device comprising an enclosing vessel, an electrode mount therein including a pair of spacer discs at opposite ends of the electrodes and a multisection filament of folded form extending through aligned slots in said discs, a plurality of tension springs on one

of said discs engaging the bights of said filament, a plurality of flat clips secured to said other disc and extending toward the slot therein, said clips having angle bends located in the plane of said filament, the ends and the remaining bights of said filament being attached to said bends, and conductors connected to said clips.

4. An electron discharge device comprising an enclosing vessel, an electrode mount therein including a pair of spacer discs at opposite ends of the electrodes and a multisection filament of folded form extending through aligned slots in said discs, a plurality of tension springs on one side of one of said discs engaging the bights of said filament, a plurality of flat clips secured to the other side of the other disc and extending toward the slot therein, said clips having downwardly bent portions on opposite ends, means projecting from the bent portions adjacent said slot for engaging the folds of said filament sections, and conductors secured to the bent portions disposed away from said slot.

5. An electron discharge device comprising an enclosing vessel, an electrode mount therein including a pair of spacer discs at opposite ends of the electrodes and a multisection filament of folded form extending through aligned slots in said discs, a plurality of tension springs on one side of one of said discs engaging the bights of said filament, a plurality of flat metallic clips secured to the bottom of said other disc and extending in opposed relation in alternate positions toward the slot therein, and edgewise tabs on said clips extending across the central plane of said slot, the sections of said filaments being attached thereto.

6. An electron discharge device comprising an enclosing vessel, an electrode mount therein including top and bottom spacer discs at opposite ends of the electrodes and a multisection filamentary electrode extending through aligned, central elongated slots in said discs, a plurality

of tension springs on said top disc engaging the bights of said sections, a plurality of pairs of transverse slots on opposite sides of said elongated slot in said bottom disc, a trio of flat clips parallelly extending toward said central slot in said bottom disc, each of said clips having a pair of ears projecting through a related pair of transverse slots in the bottom disc and bent over on the opposite side of said disc, a pair of similar clips extending toward said central slot in said bottom disc from the opposite direction and mounted in alternate relation with said trio of clips, said similar clips having ears projecting through pairs of transverse slots in the bottom disc and bent over on said disc, and oppositely disposed bent extensions on said clips in the plane of said filament sections secured thereto to mount said filament assembly in a central plane between said discs.

7. An electron discharge device comprising an enclosing vessel, an electrode mount therein including a pair of spacer discs at opposite ends of the electrodes and having central slots therein and a double M-shaped ribbon filament having a plurality of sections, the flat sides thereof being transverse to the axial plane of said filament, a plurality of staggered metallic clips extending parallel to said disc toward the central slot in the lower disc, each clip having a downwardly bent portion extending away from said disc and a plurality of ears projecting through said disc and bent over on the other side, each clip also having a restricted portion overhanging the confines of said slot, the latter portion having a bent terminal part removed from said slot and a transverse edgewise tab extending across said plane, successive sections of said filament being connected to alternate tabs of said clips, and conductors attached to said downwardly bent portions of said clips.

WILLIAM D. STRATTON.