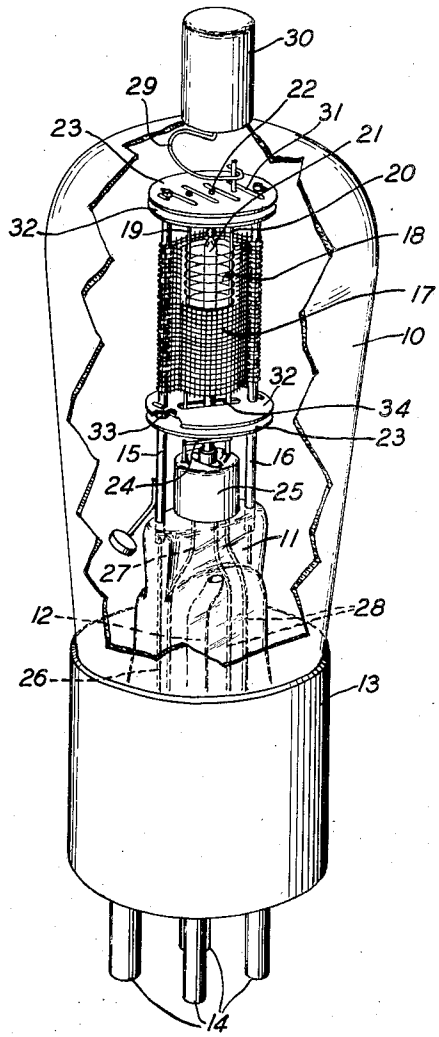
July 20, 1937. J. O. McNALLY 2,087,327

ELECTRON DISCHARGE DEVICE

Filed Sept. 7, 1934

FIG. 1



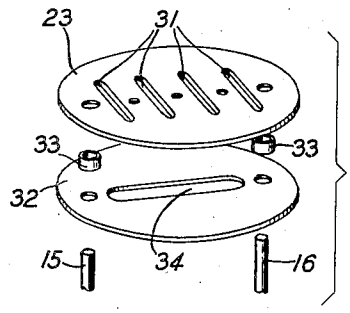


FIG. 2

FIG. 3

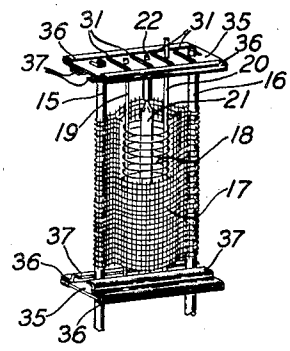


FIG. 4

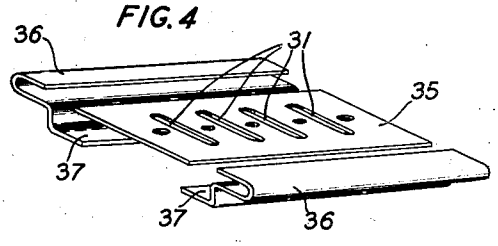
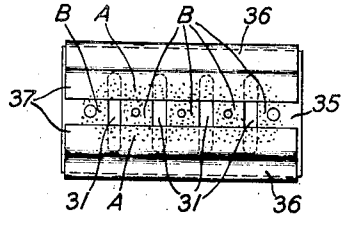


FIG. 5



INVENTOR
J. O. McNALLY

BY

Walter C. Kiesel

ATTORNEY

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ELECTRON DISCHARGE DEVICE

James O. McNally, Maplewood, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

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12 Claims. (Cl. 250—27.5)

This invention relates to electron discharge devices and particularly to such devices in which a diffusible material deposited on the electrode spacer endangers the insulation resistance between the electrodes.

An object of this invention is to prevent the formation of continuous conductive paths on the surface of spacing members which maintain the inter-relation between the electrodes in the device.

Another object of the invention relates to an efficient electrode unit which may be assembled with dispatch and may be produced at low cost.

In accordance with one embodiment of this invention the usual electrodes of a triode, such as a cathode, a grid and an anode, are uniformly spaced in cooperative relation, to attain desirable operating characteristics, by an insulating spacer member which is provided with parallel slots between the extensions or supports of the electrodes held in the spacer member and a baffle or shield is positioned between the spacer member and the electrodes and provided with an elongated opening which exposes the center portions of the slots in the spacer member but masks the ends of the slots and the adjoining surface of the spacer member. Consequently, any conductive materials deposited on the spacer member through the opening of the baffle or shield will not form a continuous path between adjacent electrodes because of the impedance of the gap of the slots which is very large and therefore localizes the presence of the path to the individual electrode supports. Since the baffle or shield protects the remainder of the surface of the spacer member, the conductive material will be deposited on the baffle, but in view of the fact that the baffle is only connected to one electrode the conductive material thereon will not endanger the insulation resistance of the device.

A feature of the invention relates to the assembly of the spacer member and baffle in such a manner that it is very easy to mount the elements of the device. Since the baffle or shield presents such a large opening for the passage of the electrode supports to the spacer member, it is unnecessary to exercise extreme precautions in fabricating the assembly. This arrangement avoids exact precision and highly technical workers which are necessary when the same object is attained by an assembly requiring absolute alignment of cooperating apertures in the baffle and spacer members.

In accordance with another aspect of the invention, the baffle member may be formed of two parts which overlie the ends of the slots in the spacer member and provide a central passageway for the supports of the electrodes. In this arrangement, the parts of the baffle member may be attached to the long edges of the spacer member by metallic clips in order to support the baffle member in parallel relation with respect to the spacer member. A feature of this arrangement is that the baffle may be arranged in position after the electrodes are all assembled in a unit.

These and other features of the invention will be more clearly understood from the following detailed description taken in connection with the accompanying drawing:

Fig. 1 is a perspective view of a complete electron discharge device made in accordance with this invention in which the enclosing vessel is broken away to more clearly show the detailed structure of the electrode unit and the features of this invention;

Fig. 2 is a perspective view of the combined spacer and baffle members shown in separated fashion to more clearly disclose the correlation of the separate members;

Fig. 3 is a perspective view of an electrode unit similar to the unit in Fig. 1 which illustrates a modification of the invention in which the baffle or shield is formed of bi-part elements;

Fig. 4 is an enlarged perspective view of the separate elements which enter into the assembly of a single spacer unit at one end of the electrode assembly in Fig. 3; and

Fig. 5 illustrates in elevation the assembled parts of the elements shown in Fig. 4 and the relation of the bi-part baffle member with respect to the slots in the spacer members.

Referring to Fig. 1, the complete assembly of the electron discharge device made in accordance with this invention comprises an enclosing vessel 10 having an inwardly projecting stem press 11 which also includes an outwardly extending thin glass tubulation 12 communicating with the interior of the vessel for evacuating the space in which a plurality of electrodes are mounted. The reduced end of the vessel 10 is affixed to a cup-shaped insulating base 13 carrying a plurality of terminals 14 to which the leading-in wires from the electrodes are attached for external connection in an electrical circuit. A pair of relatively heavy parallel supporting members or rods 15 and 16 are sealed in the press and extend towards the opposite end of the vessel 10. A cylindrical wire mesh anode 17 is located between the support rods 15 and 16 and has flanged portions

welded to the rods to support it in accurate position. A control electrode or grid 18 is positioned within the anode 17 and consists of a helical wire wound on two parallel supporting wires 19 and 20. An equipotential cathode 21 is centrally positioned within the grid 18 and has a stub wire 22 extending from the top thereof. In order to accurately align the cathode and grid coaxially within the anode 17, the support rods 15 and 16 carry a spacer member or disc 23 at opposite ends of the anode and each of these discs is provided with a plurality of aligned holes to receive the support wires of the anode, cathode and grid. The lower end of the cathode extends through the lower disc 23 and is welded to a transverse wire 24 attached at its ends to two short wires extending from the press 11 which also support a cylindrical shield 25 above the press 11. The support rod 15 connected to the anode 17 is joined to a leading-in wire 26 which is soldered to one of the terminals on the base. A cathode leading-in wire 27 extends through the press to one of the short wires connected to the transverse wire 24 and is connected at the other end to one of the terminals 14 on the base. The remaining leading-in wires 28 in the press 11 are connected to a heater element within the cathode and also to the other terminals on the base. The leading-in connection for the grid is provided by a resilient loop 29 which is connected to the support wire 20 of the grid at the top of the electrode assembly and then connected to a terminal cap 30 affixed to the top of the enclosing vessel 10.

In operation, the equipotential cathode 21 emits a copious supply of electrons to the anode and over an extended period some of the emissive coating material of the cathode is diffused to the surrounding structure and may be deposited on the surface of the spacer members situated at the top and bottom of the electrode assembly. This conductive material eventually breaks down the insulation resistance between the electrodes, due to their close proximity to each other in the spacer members, and materially lessens the useful life of the device.

In order to overcome the effects of the conductive deposits on the spacer members, in accordance with this invention, the spacer member 23 is provided with a plurality of parallel slots 31 which are arranged intermediate the apertures through which the supports of the electrodes extend, the direction of the slots being at right angles to the diametrical line of the apertures in the spacer member. These slots create a gap of high resistance between each adjacent electrode and materially increase the insulation resistance of the spacer member supporting the electrodes. In order to eliminate the establishment of continuous conductive paths along the surface of the spacer member 23, in accordance with this invention, a baffle disc or barrier 32 is situated between each spacer member 23 and the electrodes and spaced therefrom by small bushings 33 of insulating material, such as "Isolantite" or the like. The baffle disc 32 is provided with an elongated opening or slot 34 which spans the center portions of the slots 31 in the spacer disc 23 while the adjacent sides of the baffle disc 32 mask the ends of the slots 31 and thereby prevent the deposition of conductive material on the spacer member across the whole area thereof. The fact that the conductive material may be deposited on the baffle disc will not deteriorate from the usefulness of the device since this disc is only connected to the anode and therefore does not form a connecting medium to any of the other electrodes. In this arrangement, the correlation of the differently shaped slots in the spacer member and baffle disc tends to introduce paths of high resistance between the adjacent electrodes and thereby materially prolongs the operating life of the device even though some conductive material is deposited on the spacer member and baffle disc.

The benefits accruing from the structure described above may be realized in the arrangement shown in Fig. 3 in which the electrode assembly is constructed as a unit or mount and after assembly the unit may be mounted on a stem of the device shown in Fig. 1. In this arrangement the support rods 15 and 16 carrying the anode 17, the grid 18 and the cathode 21 may be arranged in the same cooperative relation as described in connection with Fig. 1 and then these electrodes are mounted as a unit between two rectangular mica plates or spacer members 35 having the slots 31 arranged between the holes through which the supports of the electrodes extend in the same manner as the spacer member 23 described in connection with Fig. 1. This construction completes the assembly of the electrodes as a unit after which it may be mounted on the stem of a vessel.

In accordance with this invention, the establishment of continuous conductive paths on the spacer member is prevented by employing a bi-part baffle element which consists of two parallel bent strips or marginal projections which may be applied to the side of the spacer member 35 exposed to the active surfaces of the electrodes. In the form shown these strips may be formed of metal in which each strip is provided with a longitudinal clip portion 36 which fits over the edge of the spacer member 35 and an angular bent shelf portion or masking strip 37 which extends over the ends of the slots 31 in the spacing member 35 and therefore masks these ends of the slots against the precipitation of active material from the electrodes on the spacer member in the area of the ends of the slots. Another advantage of this construction is that the bi-part baffle member may be applied to the electrode assembly after it is constructed as a unit to reduce the cost of assembly and considerably save time in fabrication. While the clip mounting is disclosed in the assembly of the bi-part baffle strips, it is readily understood that various other ways may be employed for securing the strips to the spacer member or to the supports of the unit forming the main frame.

In order to visualize the benefits of this invention as applied to the structure shown in Fig. 3, reference is made to Fig. 5 which shows the composite assembly of the spacer member and baffle strips in a position looking along the axial line of the electrodes. By way of illustration, let it be assumed that the composite assembly shown in Fig. 5 is removed from a discharge device which has been in operation a considerable period of time. It will then be noticed that a flaky deposit of conductive material will appear on the masking surfaces 37 of the baffle strip and this deposit is represented by A. A similar deposit will appear around each of the apertures in the spacer member 35 as indicated at B. No deposit will be present in the gap 31 or on the surface of the spacer member 35 underneath the masking strip 37. Consequently, each deposit area is localized to an individual support of an electrode which is separated from the next lo-

calized area by the gap 31 which offers a high resistance for the conduction of current. Similarly, no conductive path can be established around the ends of the slots 31 since the conductive material ordinarily capable of depositing on the spacer member is deposited on the masking strip as indicated by A. Consequently, the operating life of the device employing this invention will be prolonged for a considerable time and the characteristics will be more stable in operation.

While the bi-part baffle strips have been described as metallic, it is, of course, understood that these parts may be formed of insulating material, such as mica, to perform the same purpose as the metallic strips, although one advantage of the metallic strips is that they have a beneficial action in serving as magnetic shields for the electrode unit. Various other changes may be made in the application of this invention to discharge devices without departing from the scope of the invention as defined in the appended claims.

What is claimed is:

1. An electron discharge device comprising a vessel having a stem, an electrode assembly supported from said stem including a cathode, grid and anode, and means positioned at one end of the electrodes comprising a spacer element having a plurality of parallel slots arranged intermediate the electrode supports and a baffle means having a passageway arranged transverse to the center portions of the slots in said spacer element.

2. An electrode mount comprising a plurality of electrodes, supports therefor, and connecting spacer members at opposite ends of the electrodes having apertures for receiving said supports and individual slots between each pair of apertures, and auxiliary means adjacent each spacer member interposed between said electrodes and spacer member but spaced therefrom, said means having an elongated passageway traversing said slots and having portions which mask the ends of said slots facing the electrodes.

3. An electron discharge device comprising a vessel having a stem, a plurality of cooperating electrodes having supports extending from said stem, an insulating member extending across said electrodes and engaging said supports for maintaining a definite spacial relation between said electrodes, said member having a plurality of parallel slots, successive slots being arranged intermediate adjacent electrode supports, and a baffle member interposed between said insulating member and said electrodes, said baffle having a central elongated opening transverse to the slots in said insulating member, the elongated opening exposing separated sections of said insulating member, adjacent parallel portions of the baffle member masking the opposite ends of all the slots of said insulating member.

4. An electron discharge device comprising a plurality of electrodes, supports for the electrodes and a pair of parallel cooperating elements connecting the ends of said supports and electrodes into a unit, one of the elements having all the supports in contact therewith and having a series of slots each alternating with the supports in said element, the other element being arranged between the first element and the electrodes and having portions which shield the ends of the series of slots and a central cut-out portion which extends along a dimension at right angles to the series of slots.

5. An electron discharge device comprising a vessel having a stem, an electrode assembly including a cathode, a grid and an anode, and supports therefor located beyond said stem, a spacer member at one end of the electrode assembly for receiving the supports of the electrodes to maintain said electrodes in a definite spacial relation, said spacer member having parallel slots alternating with the electrode supports extending therethrough, and oppositely disposed masking strips secured to said spacer member and extending over the ends of the slots therein, the center portions of the slots of the spacer member being unmasked.

6. An electron discharge device comprising a vessel having a stem, a plurality of cooperating electrodes having supports extending from said stem, an insulating member extending across said electrodes and engaging said supports maintaining a definite spacial relation between said electrodes, said member having a plurality of parallel slots, the individual slots being located between the electrode supports, and means secured to opposite edges of said insulating member and located between said member and said electrodes, said means extending across the ends of the parallel slots in said insulating member and forming a central passageway between said insulating member and said electrodes.

7. An electron discharge device comprising a vessel having a stem, an electrode assembly including a cathode, a grid and an anode supported from said stem, a spacer member at one end of said electrode assembly for receiving the supports of the electrodes to maintain said electrodes in a definite spacial relation, said spacer member having parallel slots alternating with the electrode supports extending therethrough, and marginal projecting members on said spacer member extending across the end portions of the slots with an interspace between said spacer member and the marginal projecting members.

8. An electron discharge device comprising a vessel having a stem, an electrode assembly supported from said stem, a spacer member at one end of said electrode assembly for receiving the supports of said electrodes to maintain said electrodes in a definite spacial relation, and baffle members adjacent said spacer member having overlapping extensions on opposite edges of said spacer member, said members having parallel edges.

9. An electron discharge device comprising a vessel having a stem, an electrode assembly supported from said stem, a spacer member at one end of the electrode assembly for receiving the supports of said electrodes, said spacer member having parallel slots alternating with the electrode supports extending therethrough, and metallic clips secured to said spacer member, said clips having a spaced shelf portion extending over the ends of the slots in said member.

10. An electrode unit comprising a plurality of electrodes, individual supports therefor, a spacing insulator at each end of said electrodes having apertures for receiving the electrode supports, said member also having successive slots interspersed between the apertures, and a pair of bent metallic clips on opposite edges of said spacing member, said clips having a portion extending around the edge of said member and clamped along the length thereof and having an elongated angular shaped portion spaced from the surface of said member and covering the ends of said slots.

11. An electrode unit comprising a plurality of electrodes, a spacer disc extending across said electrodes, means for connecting each of the electrodes to said disc to hold the electrodes in uniform spaced relation, said disc having a short slot between each of the connecting means, and a baffle plate lying parallel with and spaced from said spacer disc and positioned between said electrodes and said disc, said plate having an elongated slot extending transverse to the center portions of all the slots in said spacer disc, whereby conductive material thrown off said electrodes upon said spacer disc is restricted to a central portion of said disc defined by the boundaries of the edges of said elongated slot and the parallel edges of the adjacent short slots.

12. An electron discharge device comprising an enclosing vessel having a stem, a pair of supports extending from said stem, an anode attached to said supports, a spacer member at each end of said anode and attached to said supports, said spacer member having a plurality of alternate apertures and parallel slots therein, a helical grid coaxially located within said anode, supports for said grid extending through said spacer member at each end, a central cathode within said grid and extending through the center of said spacer member, and a baffle member having an elongated slot attached to the pair of supports of said anode and arranged parallel to and spaced from each spacer member intermediate the anode and spacer member, the elongated slot in said baffle member bridging the parallel slots in said spacer member and providing free passageway for said cathode and said grid supports.

JAMES O. McNALLY.