March 21, 1939. J. E. BEGGS ET AL 2,151,580

ELECTRIC DISCHARGE APPARATUS

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Fig. 1.

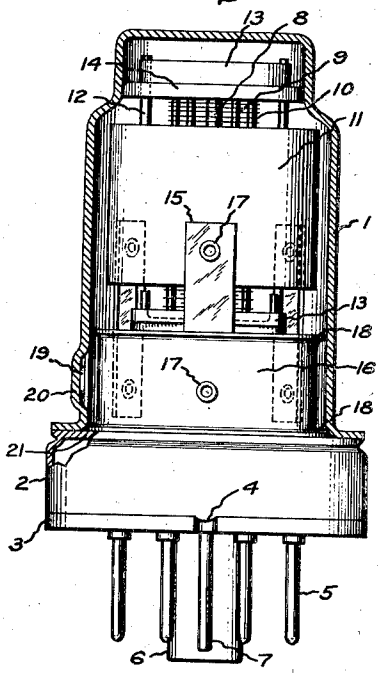
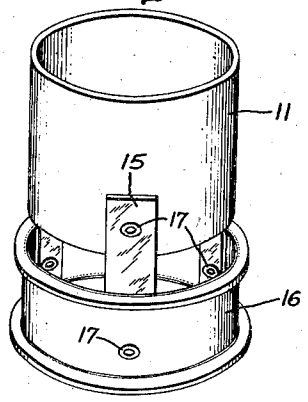


Fig. 2.



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ELECTRIC DISCHARGE APPARATUS

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9 Claims. (Cl. 250—27.5)

The present invention relates to electric discharge apparatus and more particularly, to vacuum tubes of the thermionic type which employ getters.

In tubes of this sort and particularly those of the metal envelope type in which the electrode structure is compactly arranged, the anode and control grid are usually mounted on the same frame or support by means of insulators, and the getter is positioned as close as possible to the electrodes. Under these conditions, the capacity between the control grid and anode is quite appreciable, and the electrical leakage, particularly in case the getter vapor condenses on an electrode support, may be so large as materially to reduce the translation efficiency of the tube. The deposited getter material is of a conducting character and obviously may constitute a partial short circuit along the surface of the interelectrode insulation.

An object of the present invention is to provide an improved electrode supporting structure which will involve the minimum electrostatic capacity between the electrodes, and more especially between the control member and anode. Another object is to provide a structure which will effectively prevent the deposition of getter material on the electrodes and the insulation therebetween. In carrying out these objects, we propose to mount the anode independently of the control member or the cathode. In particular, we provide a metal member which serves not only rigidly to support the anode independently of the grid support but also serves to direct the getter vapor to predetermined parts of the envelope and to shield the electrodes and supporting structure from the getter and its vapor.

The invention will be better understood when reference is made to the following description and the accompanying drawing in which Fig. 1 represents a view, partly in section, of a tube provided with the improved combined getter shield and electrode support; and Fig. 2 is a view in perspective of the anode and combined shield-support.

In Fig. 1, numeral 1 designates an envelope or shell, preferably of cylindrical configuration, and constituted of a workable and inexpensive metal such as iron or nickel. The upper end (as shown) of the envelope is drawn down to a portion of smaller diameter, the interior of which serves as a support for the upper end of an electrode structure. The opposite or lower end of the envelope is provided with a radially extending flange which may be welded to a cylindrical base member 2. The base member is closed at the end to which the flange is welded by a transverse closure member or partition 21 which is integral with the cylindrical portion of the base member.

A closure member 3 of insulating material and in the form of a disk covers the lower end (as shown) of the base member 2. This closure member may be secured to the base member in any suitable and well-known manner, for example, a small portion of the closure member may be cut out as indicated at 4 and the metal base peened over at this place and at other positions around its periphery to cause a gripping action between the base member and the closure member. The latter carries a number of metal contact pins 5 which, in case the closure member is made of a moldable material, such as a phenolic condensation product, may be molded in the base. The closure member at the center also carries a downwardly extending projection 6 of cylindrical configuration which has secured thereto a key 7 extending in the same direction as the member 6. The purpose of the projection and key is to locate the contact pins 5 in register with openings in a socket which carries connections to external circuits.

Within the shell 1 there is an electrode structure of any standard design, and as illustrated, takes the form of a four-electrode device consisting of an indirectly heated cathode 8, a control grid 9 and a screen grid 10, all concentrically mounted within a cylindrical anode 11. The cathode and the grid structures are supported by means of a rectangular framework which consists of a pair of uprights 12, positioned on either side of the electrodes, these uprights being secured to an upper and lower brace member 13. The electrodes are suitably insulated from the brace members. The upper brace member 13 is provided with a flanged portion of circular configuration 14, having a diameter such that the flange fits snugly within the reduced diameter portion of the shell 1. The lower brace member 13 is supported in any suitable manner from the metal partition 21. Connections are taken from the electrodes to the contact pins 5 and insulated from the metal partition by means of glass-to-metal seals of any suitable and well-known type. For this purpose, we prefer the metal eyelet seal in which the eyelet is provided with a flange welded to the upper or lower side of the metal partition. A glass bead is formed in the eyelet and the conductor is taken through the center of the glass bead. This form of seal has been disclosed and broadly claimed in the MacKay

Patent #1,456,110, and improvements thereon have been disclosed and claimed in the Elder and Gable application, Serial No. 746,808, filed October 4, 1934, entitled "Electric discharge devices and seals therefor," and in the Beggs application, Serial No. 744,165, filed September 15, 1934, entitled "Glass-to-metal seals." The applications referred to are assigned to the same assignee as the present invention.

As pointed out in these applications, the eyelet material and the glass should preferably have the same thermal expansion characteristic over the entire temperature range between 0° C. and the softening temperature of the glass. A typical metal which may be employed for this purpose is 18% cobalt (Co), 28% nickel (Ni) and 54% iron (Fe), while the glass may have the following approximate composition: 65% silica (SiO_2), 23% boric oxide (B_2O_3), 7% sodium oxide (Na_2O) and 5% aluminum oxide (Al_2O_3). Under some conditions, the metal may consist of molybdenum, nickel or copper, and the glass made of a composition which is sold under the trade name "Corning 705 AJ." As many seals are provided as are necessary to take the various leading-in conductors through the metal partition.

As stated hereinbefore, the present invention relates to an improved structure for supporting the anode within the envelope and for gettering a tube of this sort. As shown on the drawing, the anode 11 is held in position by means of a plurality of rectangular strips 15 of insulating material, such as mica, which are secured at their upper end to the anode, and at their lower end to a metal cylindrical member 16. The mica members may be secured to the anode and to the cylindrical member 16 by any well-known stapling arrangement, such for example, as by means of circular eyelets 17. The cylindrical member 16 is provided at its upper and lower edges with radially extending lips or flanges 18, the lowermost of which may or may not fit snugly within the envelope 1, while the upper flange is of a diameter slightly less than the interior diameter of the envelope so as to leave a small annular space between the flange and the interior surface of the envelope. The cylindrical member 16 is secured, for example by welding, to the metal partition which extends across the base member 2, so that the anode is held rigidly in place within the envelope.

For gettering the tube, i. e. for improving the vacuum within the envelope, and in accordance with another feature of the invention, a getter material 19, which may be in the form of a magnesium or calcium pellet, or an alloy thereof, is positioned within the annular groove formed by the flanges 18 of the cylindrical member 16. The pellet may be contained within a pocket formed in the envelope by a pressing operation so as to leave a bulge 20 on the exterior surface of the envelope, or may be secured directly to the interior surface of the envelope. In case a pocket or depression is employed, the depth of the latter should be sufficient to accommodate the entire pellet so that the pellet is positioned entirely below the level of the interior surface of the envelope. Such an arrangement is desirable in order that the getter material shall not interfere with the ready insertion of the electrode structure and the cylindrical supporting member 16.

It will be understood that during manufacture of the tube, the cathode, the grids and their rectangular supporting frame are first secured to the partition 21 and the necessary leading-in conductors taken through the partition by means of the improved glass-to-metal seals referred to hereinbefore. The anode and its supporting cylinder 16 may then be mounted on the partition, after which the envelope 1 with the getter pellet in place is secured at its flanged end to the partition.

The interior of the envelope may be evacuated in any suitable manner but I prefer to employ a metal tubulation (not shown) for this purpose, as is described and claimed in the Fate Patent No. 1,388,248. This tubulation is conveniently secured, as by welding, to the metal partition, and the free end of the tubulation is connected to a vacuum pump of any standard design. After the envelope has been evacuated in accordance with the usual exhaust procedure, the getter 19 is flashed or vaporized by torching the bulge on the envelope. The vapor thus produced will circulate around the annular groove formed by the flanges 18 and the exterior surface of the cylinder 16, and only a small portion of the vapor will pass the space between the upper flange 18 and the envelope into the electrode chamber.

It is apparent that the vapor is for the major part confined to a region remote from the electrodes so that there is little or no opportunity for the vapor to condense on the electrodes or on their supporting structure. Obviously, if the vapor were allowed to condense either on the insulators (not shown) which support the grids and the cathode from their rectangular framework, or on the insulators 15 which insulate the anode 11 from its supporting cylinder 16, electrical leakage might be caused which would reduce the translation efficiency of the tube. The space between the upper flange 18 of the cylindrical member and the interior surface of the envelope may be so small that the vapor which actually does reach the electrode chamber causes little or no deleterious effects. On the other hand, this space is sufficiently large to permit the getter within the annular compartment effectively to improve the vacuum of the entire envelope.

It is evident that if desired, the space between the flange 18 and the envelope may be so constructed as to constitute a nozzle for projecting an annular stream of getter vapor to the upper part of the envelope in such a direction as to miss the anode or other electrode structure. The projected vapor may be readily condensed at predetermined positions on the envelope by local cooling effects and the getter pattern readily controlled in this manner. As stated hereinbefore, the cylinder 16 in addition, may also serve the important function of providing a rigid support for the anode, entirely independent of the framework which supports the grids and the cathode. This latter feature is shown more clearly in Fig. 2 which demonstrates the fact that the supporting structure is extremely simple and inexpensive and yet the anode, which is usually the heaviest electrode of all of the elements in the tube, is rigidly supported in an insulating manner from the remainder of the device.

The improved anode supporting structure introduces no deleterious interelectrode capacity effects because there is no physical connection between the anode and control member except at the metal partition which is already at ground potential or in any case, is at the same potential as the metal envelope.

After the tube has been evacuated and gettered in the manner described hereinbefore, the insulating closure member 3 which carries the contact

pins 5 and the locating pin 6 are secured to the metal base member 2, and the leading-in conductors from the various electrodes connected to the contact pins in the usual manner.

While we have described the strips 15 as being constituted of mica for insulation purposes, it will be understood that under some circumstances the anode 11 may be maintained at the same potential as the metal envelope 1, in which case the mica members would be replaced by metal supports. Indeed, the anode and the cylindrical member 16 could in this case, be made in one piece, if desired. The envelope 1 may also be used as an anode in which case the anode element 11 would be discarded and the flanged cylinder 16 used for its improved getter shielding or directing effects and not as an anode support. Moreover, if desired, the anode 11 could be supported independently of the cylinder 16 so that the latter may again be used solely as a getter shield.

What we claim as new and desire to secure by Letters Patent of the United States, is:

1. An electric discharge device comprising an envelope, an electrode structure and vaporizable getter material therein, and means including a nozzle member having a configuration which substantially conforms to that of the envelope for directing the vapor obtained from said getter through the envelope and away from said electrode structure.

2. An electric discharge device comprising a metal envelope closed at one end by an integral portion of the envelope and at the other end by a metal closure member, an electrode structure including an anode and control member in said envelope, and means for supporting said anode and control member from said envelope, the anode support being separate from the control member support, said anode support being constituted of a metal ring secured to said closure member, and insulating members between said ring and the anode.

3. An electric discharge device comprising an envelope containing an electrode structure and vaporizable getter material, a common means for shielding said structure from vaporized getter material and for supporting a portion of said structure in the envelope, said means including a ring provided with flanges to form an annular compartment, said getter material being positioned in said compartment.

4. An electric discharge device comprising a cylindrical envelope containing an electrode structure and vaporizable getter material, and means for shielding said structure from vaporized getter material, said means including a ring member of smaller diameter than the envelope, said ring member terminating in outwardly extending annular flanges, the flange nearer the electrode structure being of a size smaller than the envelope thereby leaving an annular space between the flange and the envelope, said getter material being positioned between said flanges.

5. An electric discharge device comprising an envelope, an electrode structure and vaporizable getter material therein, means for supporting a portion of said electrode structure in said envelope, said means including a ring provided with outwardly extending flanges to form a compartment within the envelope, said getter material being positioned in said compartment.

6. An electric discharge device comprising a cylindrical envelope, an electrode structure and vaporizable getter material therein, and a common means for shielding said structure from vaporized getter material and for supporting the structure within said envelope, said means including a ring of circular configuration provided with radially extending flanges to provide an annular compartment, said getter material being positioned in said compartment.

7. An electric discharge device comprising a cylindrical envelope, an electrode structure and vaporizable getter material therein, and a common means for shielding said structure from vaporized getter material and for supporting the structure within said envelope, said means including a ring of circular configuration provided with radially extending flanges to provide an annular compartment, said getter material being contained in a pocket in the envelope opposite said compartment.

8. An electric discharge device comprising a hollow cylindrical envelope closed at one end by an integral portion of the envelope and at the other end by a closure member, an electrode structure and vaporizable getter material in said envelope, means for supporting the electrode structure from said closure member, and means including a portion of said supporting means for confining vaporized getter material to a position in the envelope remote from the electrode structure.

9. An electric discharge device comprising a cylindrical envelope containing electrode structure, vaporizable getter material, and means for shielding the said electrode structure from vaporized getter material, said means including an annular member interfitting within the envelope and forming in cooperation with the cylindrical wall thereof a substantially closed annular space, the said getter material being positioned within said space and one of the peripheral edges of the said annular member being slightly spaced from the envelope wall to provide a narrow crack extending peripherally of the envelope and through which the said space communicates with the interior of the envelope.

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