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ELECTRODE SUPPORT

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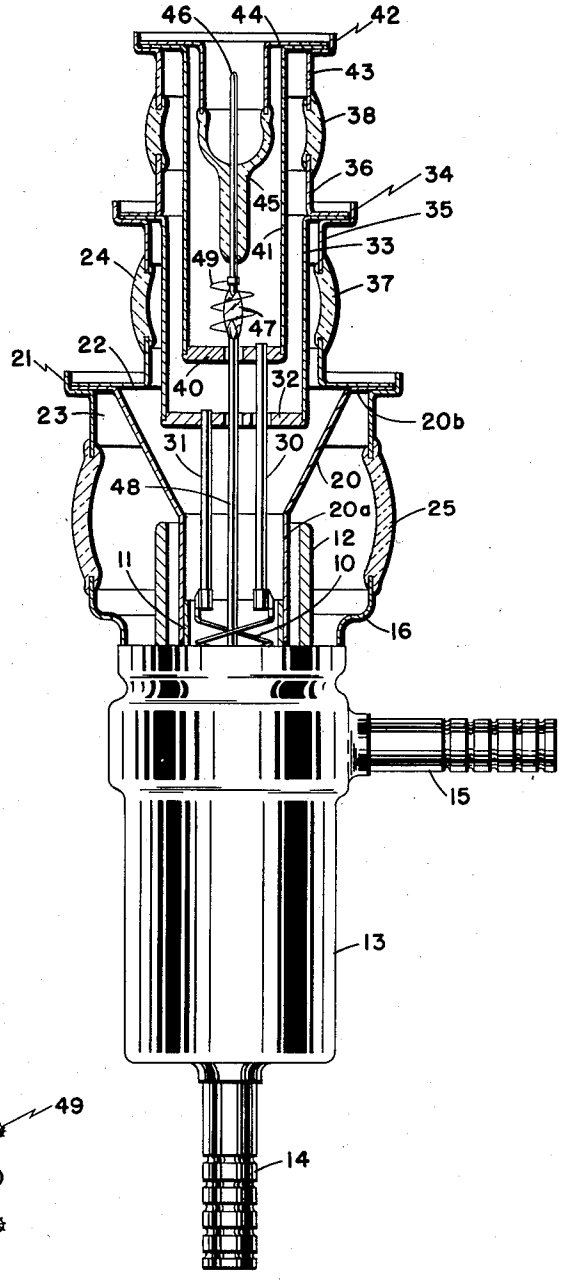


FIG. 1

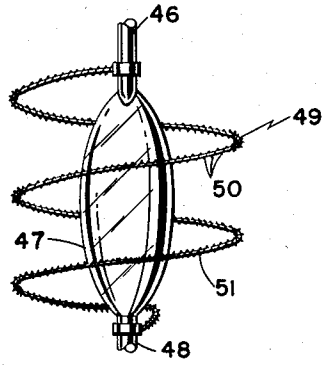


FIG. 2

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ELECTRODE SUPPORT

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This invention concerns a novel vacuum tube getter construction and in particular a getter and heater arrangement which may be incorporated as part of the structure of one of the electrode supports.

For the most part, getters employed in the vacuum tube art are independent of tube electrodes. Occasionally a getter and an electrode have been designed to share a lead in common. Then, too, getters have been supported on lead-in structures. But at no time has there been an integral getter and lead-in or support structure wherein the getter element was more than an appendage. Heretofore the mounting of the getter structure has constituted a separate operation from the mounting of the electrode supports, the getter mounting operation occurring after the electrodes have been fixed in place to their respective envelope portions. Then, in mounting the getter structure, it was frequently been necessary to take great care to place the getter in such position that its blowing will not coat the active electrode surfaces with getter material. For these and other reasons, it has been a difficult and time consuming task to mount the prior art getter in place in its tube assembly. Moreover, as tubes have become smaller and smaller and there has been less and less room for the getter structure in its appendage form, mounting problems have become more difficult.

The present invention relates to a getter structure which is easily assembled and easily maintained in place. In accordance with the present invention an electrode support is made to include at least the heater element of the getter structure as an integral part. More specifically, in the present invention the heater element of the getter is a conductor in series with conductors in the electrode support. Thus, this getter structure, which commonly comprises a gettering material and a heater, is conveniently attached to the electrode support before said support is mounted in the tube envelope. Therefore, when the electrode support is in place, the getter structure is also in place.

The specific structure of the present invention consists of a pair of support conductors separated by an insulator. The insulator contributes to the overall rigidity of the support so that mechanically the support functions as a single piece. A heater element of higher resistance than the conductor-support members bypasses the insulator and electrically connects together the conductors in the support. This heater element may itself be composed of a gettering substance, but, in the preferred embodiments of the invention, the heater element is composed of refractory metal and gettering substances are placed in position to be activated by the heater filament. Separate conductive paths from the respective conductors are provided to the outside of the tube envelope so that current may be supplied through the conductive paths to the heater element.

It is possible for a support a employing this getter structure to also function as a conductor in connection with the electrode supported. In such cases the heater element is selected such that current normally carried by the support-conductor will not heat the heater to such a temperature that it will blow or activate the getter. Then, when it is desired to blow the getter, a heavier current may be passed through the heater element.

For a better understanding of the present invention reference is made to the accompanying drawing:

Fig. 1 illustrates in partial section an electron tube employing the present invention.

Fig. 2 is a detailed elevational view of the region in which the heater element and getter material are located.

Referring now to the structure of Fig. 1 there is illustrated a high power vacuum tube commonly used in communications work. This tube is a triode employing a cathode **10**, a grid **11** and anode **12**, which electrodes are arranged in a cylindrical geometry, extending from innermost to outermost member in the order recited. The anode is actually a cup-shaped structure having heavy side and bottom walls of copper or other highly conductive material. A large part of this anode is external of the vacuum envelope. Anode cup **12** is, in turn, surrounded by larger cup **13** which serves as a water jacket for cooling the external anode **12**. Water or other fluid coolant may be introduced betweeen anode **12** and jacket **13** through tubular conduit member **14** and removed through tubular conduit member **15**, or vice versa, using suitable hose connections. The outer cylindrical surface of anode **12** is sealed vacuum-tight to collar **16**, preferably somewhere between the middle of the anode cylinder and the lip of the open end of the anode cup. Collar **16** which extends toward the open end of the anode forms part of the vacuum envelope and also provides convenient means to which water jacket **13** may be sealed in a water tight joint.

The grid **11** which has a tubular metallic end piece, as shown, consists of a plurality of rods circularly arranged in a pattern concentric with the tube's axis and a helical winding wrapped thereabout. The grid support **20** is primarily frusto-conical in shape with a tubular portion **20***a* which actually supports the grid and a planar annular portion **20***b* which is joined to the terminal. The grid terminal **21** is advantageously coaxial with the anode and with the filament terminals hereafter described. Terminal **21** is composed of two metallic envelope portions **22** and **23** each of which has both tubular and planar portions. Both of these members are sealed to essentially cylindrical insulator rings and, accordingly, should be composed of glass-sealing metal, or other appropriate material. Member **22** is sealed to insulator ring **24** which joins the grid terminal to the filament terminal. Member **23** is sealed to insulator ring **25** which is also sealed to collar **16**. Members **22** and **23** are advantageously arranged to cooperate with one another and with the grid support **20** so that, when melted a solder ring placed between the outer edge of member **22** and the cylindrical upturned portion at the outer edge of member **23** will make a vacuum tight joint, sealing together all three members.

The filament structure **10** is a bifilar helical winding preferably composed of a single strand of refractory filament wire which has its ends arranged to terminate adjacent the lip of anode cup **12**. These ends are, in turn, affixed to support members **30** and **31**. Support members **31** and **30** are metallic rods preferably composed of some refractory metal. Rod **31** is terminated in a planar deck **32** which is, in turn, affixed to a tubular support member **33**. At the end of tubular support member, remote from planar deck **32**, there is an out-turned, radially extending planar flange. This radial flange of member **33** is supported by engagement between the members forming terminal **34**. Filament terminal **34** is composed of metallic

envelope members 35 and 36 corresponding to member 23 and 22 of the grid terminal in general shape in relation to each other and to the filament support. Members 35 and 36 are sealed together in a manner similar to the manner in which the grid terminal members are sealed together. Both members 35 and 36 are composed of glass-sealing metals so that member 35 may be sealed to ring insulator 37 and member 36 may be sealed to ring insulator 38.

Filament support rod 39 is affixed to planar deck 40. Planar deck 40 is, in turn, affixed to cylindrical support 41 which is terminated at its other end in a radially outwardly extending flange similar to that terminating the end of member 33. This flange is engaged by the members forming the terminal 42. Filament terminal 42 is composed of members 43 and 44. The junction of members 43 and 44 is similar to the junctions at terminals 21 and 34. Members 43 and 44 are preferably composed of glass-sealing metals. Member 43 is sealed to ring insulator 38.

The shape of member 44 differs considerably from the shape of corresponding members at the other terminal junctions. Member 44 is generally planar with a tubular flange which is made to lie coaxially within support member 41. Thus member 44 forms a reentrant portion of the vacuum envelope. This reentrant portion is closed by dielectric press member 45.

Through dielectric press member 45 extends rod conductor 46. Within the vacuum envelope and within the cup formed by support member 41 and deck member 40 lies bead 47. Support rod 46 is sealed to the bead 47 which is composed of glass or other dielectric material. At the opposite end of bead 47, and maintaining the general axial alignment established by rod 46, is sealed support rod 48. Support rod 48 extends axially through filament 10 into the midst of the ends of the filament strands, the electrical mid-point of the filament, adjacent the bottom of the anode cup. Thus, the structure provided by rods 46 and 48 and dielectric member 47 provides a mechanical support for a portion of the filament.

A center-tap or electrical path from the filament's midpoint to the outside of the vacuum envelope is also provided by connecting together rods 46 and 48 through conductive link 49. This link is advantageously composed of material of relatively high resistance compared to the resistance of rods 46 and 48. As is shown in Fig. 2 the high resistance wire 50, which is advantageously tungsten or some other refractory material, may be wrapped around wire of gettering material 51 such as titanium or zirconium or a getter containing wire such as nickel coated barium wire. This getter or getter containing wire 50 may be blown or activated by passing sufficient current through the heater wire 49 to cause it to reach incandescence.

In the tube structure illustrated a certain amount of current will be drawn through the center tap during normal operation of the tube. Current will, however, be essentially limited to the plate current impressed across the tube. Consequently, it is possible to design the heater wire 49 so that it will carry this current without heating excessively. Then, when it is desirable to blow the getter, it will be necessary to increase the current through the wire 49 in order to raise its temperature to a point sufficiently high to blow the getter. In one actual case, involving the tube illustrated, a plate current of 1.5 amperes was drawn through the center tap. In order to blow the getter in this particular tube, 6 amperes of current was required through the heater wire 49.

Many modifications of the getter structure will occur to those skilled in the art. As previously mentioned it is possible to make the heater wire and the getter one and the same. This has the advantage of simplicity in structure but the disadvantage of more readily burning out or breaking than the preferred structure previously described. It is also possible to put the getter material on the walls of the cup formed by members 41 and 40. In any event, it should be noted that these walls will probably receive a coating of gettering material after the getter is blown. Thus, the partial enclosure of the getter amounts to a considerable advantage inasmuch as it is quite difficult to spray the getter material onto the filament or other active electrodes of the tube.

It is posisble to use a support structure of the general type described with high resistance wire in series with the conductors and by-passing the dielectric member without the getter material. Such a structure has certain advantages. In particular, it has the advantage of enabling the positioning of a stem press closer to the active parts of the tube, inasmuch as the low heat flow impedance path is broken by the introduction of dielectric material. High resistance wire 49 also has high heat flow impedance so that the transfer of heat by conduction through wire 49 from rod 48 to rod 46 will be negligible. Accordingly, the danger of cracking the glass-to-metal seal at press 45 is relatively small. It is true that the glass bead 47 may be cracked but the damage to this bead will probably not be sufficient to seriously effect the mechanical support which it gives so that it is of no consequence since it is not a part of the vacuum envelope. Furthermore, if cracking of the glass is deleterious, it is possible to substitute a suitable ceramic for the glass, joining the ceramic to the conductors by known ceramic-to-metal brazing techniques.

It is, of course, possible to use this getter construction in connection with electrode supports for electrodes other than the filament, but its use with the filament, and particularly the center tap of the filament, is particularly advantageous.

Other modifications of the structure described in the terms of the claims are intended to be within the scope and spirit of the present invention.

I claim:

1. An electron tube getter construction comprising a pair of elongated conductors in coaxial spaced end-to-end relation and having their adjacent ends connected by an insulator, which insulator contributes to the overall rigidity of the support, a gettering substance adjacent the insulator, a heater element of high resistance relative to the conductors electrically connecting the conductors, and conductive paths from the respective conductors through which electric current may be supplied to the heater element.

2. A structure as defined in claim 1 in which the heater element is also the gettering material in wire form.

3. A structure as defined in claim 1 in which the heater element supports the getter which is in wire form and about which the heater element is wound.

4. A structure as defined in claim 1 in which the getter material is deposited on cylindrical walls surrounding the heater element.

5. An electron tube comprising an envelope containing a cathode and an anode in predetermined spaced relation, a filament adjacent the cathode and electrically connected at its ends to respective filament terminals having portions external of the envelope, a support rod having one end portion thereof connected to and supporting an intermediate portion of the filament and having its other end portion penetrating the envelope, the support rod being provided intermediate its end portions with an insulator electrically separating the end portions, a heater element electrically connecting together the end portions of the support rod, and gettering material adjacent the insulator and adapted to be head by the heater element upon application of sufficient voltage across one of the filament terminals and the end portion of the support rod which penetrates the envelope.

6. An electron tube comprising an envelope containing a cathode and an anode in predetermined spaced relation, a filament adjacent the cathode and electrically connected at its ends to respective filament terminals having

portions external of the envelope, a support rod having one end portion thereof connected to and supporting an intermediate portion of the filament and having its other end portion penetrating the envelope, the support rod being provided intermediate its end portions with an insulator electrically separating the end portions, a heater element electrically connecting together the end portions of the support rod and helically encircling the insulator, and gettering material adjacent the insulator and adapted to be heated by the heater element upon application of sufficient voltage across one of the filament terminals and the end portion of the support rod which penetrates the envelope.

7. An electron tube comprising an envelope containing a cathode and an anode in predetermined spaced relation, a filament adjacent the cathode and electrically connected at its ends to respective filament terminals having portions external of the envelope, a support rod having one end portion thereof connected to and supporting an intermediate portion of the filament and having its other end portion penetrating the envelope, the support rod being provided intermediate its end portions with an insulator electrically separating the end portions, a heater wire electrically connecting together the end portions of the support rod, and a getter wire interwound with the heater wire and adapted to be heated thereby upon application of sufficient voltage across one of the filament terminals and the end portion of the support rod which penetrates the envelope.

8. An electron tube comprising an envelope having a reentrant end portion and containing a cathode and an anode in predetermined coaxial spaced relation, a filament adjacent and coaxial with the cathode and electrically connected at its ends to respective filament terminals having portions external of the envelope, a support rod extending substantially along the axis of the tube and having one end portion thereof disposed entirely within the envelope and connected to and supporting an intermediate portion of the filament and having its other end portion penetrating the reentrant end portion of the envelope, the support rod being provided intermediate its end portions with an insulator electrically separating the end portions, a heater element electrically connecting together the end portions of the support rod, and gettering material adjacent the insulator and adapted to be heated by the heater element upon application of sufficient voltage across one of the filament terminals and the end portion of the support rod which penetrates the envelope.

9. An electron tube comprising an envelope containing a cathode and an anode in predetermined coaxial spaced relation, a filament adjacent and coaxial with the cathode and electrically connected at its ends to respective filament terminals having portions external of the envelope, a support rod extending substantially along the axis of the tube and having two portions in spaced end-to-end relation, one of the portions being disposed entirely within the envelope and connected to and supporting an intermediate portion of the filament and the other portion penetrating the envelope, the support rod being provided intermediate its two portions with an insulator electrically separating the portions, a heater element electrically connecting together the portions of the support rod, and gettering material adjacent the insulator and adapted to be heated by the heater element upon application of sufficient voltage across one of the filament terminals and the portion of the support rod which penetrates the envelope.

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