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GETTER FOR ELECTRON TUBES

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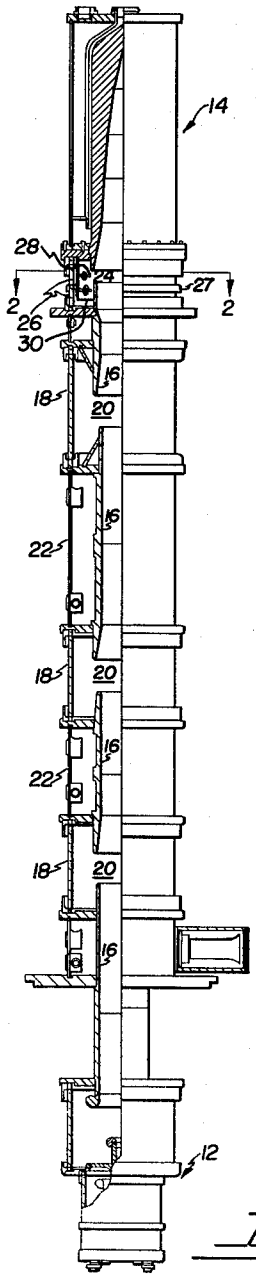


Fig. 1.

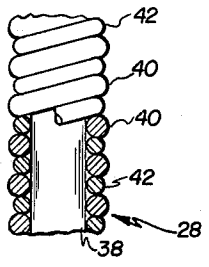


Fig. 3.

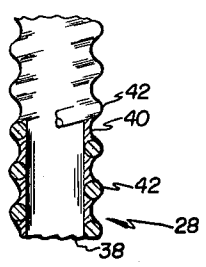
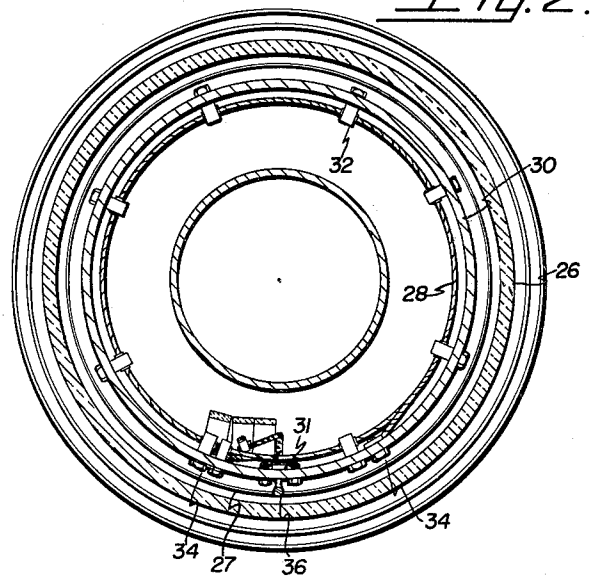


Fig. 4.

Fig. 2.



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GETTER FOR ELECTRON TUBES

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This invention relates to getters for electron tubes and more particularly to a getter construction for use during the operational life of the electron tube.

Most getters employed in vacuum tubes are either the flash type or the bulk type. In the case of the flash types, the getter material is assembled in the tube with the other tube components. The assembled tube is evacuated, processed by a standard method and sealed. The getter is then evaporated inside the tube to produce a large exposed gettering film that will rapidly getter until the film is saturated. Since all the gettering material was evaporated at one time, if elaborate means are not provided to retain the molten getter, a new gettering surface cannot be produced when the original becomes saturated.

Bulk type getters are also assembled in the tube with the other tube components. The assembled tube is evacuated, processed by a standard method, and sealed. During the operation of the tube, the bulk type getter is kept at an elevated temperature to continue its sorption properties.

It is an object of the present invention to provide a getter that can be partly evaporated and then used as a bulk getter.

Metals are usually evaporated in a vacuum by placing the metal to be evaporated on an electrical resistance type heating filament of metal having a higher melting temperature than the metal to be evaporated. The metals to be evaporated, some of which may be also used as getters, tend to flow along the filament in their molten state forming droplets on the filament. These droplets increase the cross-sectional area of the filament at their location, reducing the electrical resistance at that point. Since the resistance is lowered, the filament and droplet will cool and the droplet cannot be evaporated.

It is a further object of the present invention to keep the molten getter material uniformly coated on the filament.

According to this invention the getter material (e.g. titanium) is coated over an electric heating filament (e.g. thoriated tungsten) by having the getter material in the form of a wire helically wound around the filament and having a refractory metal, (e.g. molybdenum) also in the form of a wire, helically wound around the filament and disposed between the turns of the getter helix.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth in the following description of the invention. The invention is not limited to the disclosed embodiment, as variant embodiments thereof are contemplated and may be adopted within the scope of the claims.

Referring to the drawings,

Figure 1 is a side elevational view, partly in section, of a klystron embodying a getter in accordance with this invention;

Figure 2 is an enlarged sectional view taken on line 2—2 of Figure 1 and showing the getter and getter construction.

Figure 3 is an enlarged fragmentary view of the getter

showing the helical wires wound around the filament; and

Figure 4 is an enlarged fragmentary view of the getter similar to Figure 3 showing the getter material evenly spread on the filament during or after its molten state.

Referring to the drawings in greater detail, Figure 1 shows a klystron comprising an electron gun assembly **12**, a collector **14**, drift tube sections **16**, and insulating ceramic cylinders **18** disposed around interaction gaps **20** formed between the drift tube sections **16**. The klystron is a water cooled variety, and water jackets **22** are placed around drift tube section **16**. The collector **14** is insulated from the drift tube section **16** by the space **24** and two stacked coaxial ceramic cylinders **26**. A metallic terminal ring **27** is bonded between the adjacent ends of the two stacked cylinders **26**. Inside the ceramic cylinders **26** is placed a getter **28**, according to the invention, and in this embodiment the getter is wound twice around the klystron axis.

Referring to Figure 2 showing a cross-section of the klystron, the getter **28** is disposed internally of the ceramic cylinders **26**. The getter **28** is mounted by supports **32** on a metallic shield cylinder **30** extending from the collector **14**. Electricity is conducted to the getter **28** by leads **34** and **36**. Lead **34** is connected to cylinder **30** and therefore to the collector **14**. Lead **36** passes through cylinder **30**, insulated therefrom by an insulating bushing **31**, and is attached to terminal ring **27**.

The construction of getter **28** is shown more clearly in Figure 3. A heating filament **38** in this embodiment was made of thoriated tungsten because it is more ductile than pure tungsten and is a good refractory metal for filament construction. But other suitable conducting refractory materials can be substituted for the thoriated tungsten. A getter wire **40** is helically wound around the filament **38**, and a refractory metal wire **42** of slightly smaller diameter than the getter wire **40** is also helically wound around the filament **38**, as shown. The getter wire **40** and refractory metal wire **42**, which are wound around the filament **38**, are disposed side by side, touching each other and with the turns of the getter wire **40** lying between the turns of the refractory metal wire **42**. In this embodiment the getter wire **40** is made of titanium and the refractory metal wire **42** is made of molybdenum, since molten titanium adheres well to the molybdenum and since molybdenum has a higher melting point than titanium.

Figure 4 shows a getter assembly after heating current has been passed through the filament **38**. The titanium wire **40** is shown melted and filling up the spaces between the molybdenum wire **42**. Since titanium wets the molybdenum wire, the titanium does not form droplets on the filament wire. The formation of droplets of titanium is objectionable because droplets lower the electrical resistance at the droplets. Therefore, since the resistance is lower, the electrical heating of this part of the filament will be reduced and the getter will solidify and cannot be remelted.

In the operation of a klystron, after the klystron has been assembled and evacuated to a low pressure, the getter **28** is heated by an electric current. The titanium melts and is partly evaporated. The titanium will be deposited on nearby surfaces, such as the interior surface of shield cylinder **30**, which prevents a continuous conductive layer from being deposited on the interior surface of the ceramics **26**. In being deposited on the shield **30** the titanium will capture residual atoms or molecules. Also, the thin film of titanium will continually act as a getter, capturing residual atoms or molecules until the titanium film becomes saturated. In large klystron tubes such as shown in Figure 1 which may be eight feet long, the amount of gas which may be evolved from its parts

during subsequent operation is large. Therefore, a getter film which can be regenerated again and again during the lifetime of the tube is required. The getter construction according to this invention can be used a number of times to reflash and evaporate the getter onto the adjacent surfaces, covering the old getter film with a new film. Since the getter is regenerated, the vacuum pressure in the envelope is lowered and the klystron becomes an efficient tube in relatively short order. The more times the getter can be flashed, the longer would be the total life of the klystron. Since the novel getter construction provides an even coat of molten getter metal on the electrical heating filament **38**, the getter metal can be remelted and partly evaporated at the will of the operator of the klystron. Also, the getter may be continuously heated and used as a bulk type getter even after the getter is partly evaporated.

This invention is not limited to the embodiments shown, but other suitable structures can be used. Furthermore, various other materials having suitable properties can be substituted for those described. For example, zirconium may be substituted for titanium as the getter material; similarly, tantalum can be substituted for molybdenum as the refractory metal to prevent formation of droplets. One should preferably choose metals which do not form alloys and the molten getter must wet the solid refractory metal wire helix. Obviously, the getter material must melt and evaporate at a lower temperature than the refractory metal wire helix and filament.

What is claimed is:

1. An electron tube comprising an evacuated envelope and a getter structure within said envelope, said getter structure comprising an electrical heating filament, a wire of getter material disposed about said filament, and a wire of refractory metal disposed about said filament, said refractory metal wire being of a metal which has a low alloying rate with said getter material and said filament, turns of said wire of refractory metal lying between turns of said wire of getter material, said getter material having a lower melting point than both said filament and said refractory metal, said refractory metal being wetted by said getter material when said getter material is molten.

2. An electron tube comprising an evacuated envelope and a getter structure within said envelope, said getter structure comprising a thoriated tungsten heating filament, titanium wire disposed around said filament, and molybdenum wire disposed around said filament, said titanium wire lying adjacent said molybdenum wire.

3. An electron tube, comprising an evacuated envelope and a getter structure within said envelope, said getter structure comprising a thoriated tungsten heating filament, a molybdenum wire disposed about said heating filament, and titanium metal disposed adjacent said molybdenum wire.

4. A getter structure comprising a thoriated tungsten heating filament, a titanium wire disposed helically around said filament, and a molybdenum wire lying between turns of said titanium wire.

5. A getter structure comprising a thoriated tungsten heating filament, titanium wire wound around and contacting said heating filament, and molybdenum wire wound around and contacting said heating filament, said titanium wire lying between turns of said molybdenum wire and contacting said molybdenum wire.

6. A getter structure comprising a thoriated tungsten heating filament, a molybdenum wire disposed helically around said filament, and titanium metal disposed between turns of said molybdenum wire.

7. In an electron tube having an evacuated envelope including a tubular ceramic section, the subcombination comprising an electrical heating element arranged within said ceramic section, means conductively connected to said heating element and extending out of the envelope through said ceramic section and constituting an external terminal for energizing said heating element, a getter carried by said element in heat exchanging relation therewith to effect vaporization of at least a portion of said getter when said heating element is energized, and means on the heating element cooperating with said gettering material to effect distribution of said gettering material in a layer of substantially uniform thickness.

8. The combination according to claim 7, in which shield means are provided within the envelope and interposed between said ceramic section and said getter.

9. The combination according to claim 8, in which said shield means constitutes a metal cylinder concentrically arranged within said ceramic section, and said heating element and getter are concentrically arranged within said metal cylinder.

10. In an electron tube having an evacuated envelope including a tubular ceramic section, the subcombination comprising an electrical heating element arranged within said ceramic section, a wire of getter material helically wound about said heating element in spaced coils, a wire of refractory material helically wound about said heating element, the coils of said refractory material being interposed between the coils of said getter material, and means conductively connected to said heating element and extending out of the envelope and constituting an external terminal for energizing said heating element to effect partial vaporization of the gettering material and formation of a substantially uniform layer of getter material between the coils of said refractory material.

11. The combination according to claim 10, in which shield means are provided interposed between said ceramic section and said heating element to shield said ceramic section against the deposit of vaporized getter material thereon.

12. The method of forming a reflashable getter assembly for vacuum tubes comprising helically winding a wire of getter material about a peripheral surface of a heating element, helically winding a wire of refractory material about said peripheral surface of the heating element, and heating said windings and said heating element to melt said gettering wire to form a uniform layer of gettering material between adjacent windings of said refractory wire.

13. The method according to claim 12, in which said gettering material is bonded to said refractory windings and to said heating element.

14. The method according to claim 12, in which said wire of gettering material comprises titanium, and said heating is effected by passing an electric current through said heating element.

15. The method according to claim 12, in which said wire of gettering material comprises titanium, said wire of refractory material comprises molybdenum, said heating element comprises a wire of thoriated tungsten, and said getter assembly is heated to the melting point of titanium by passing an electric current through said heating element.

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