Feb. 8, 1944. R. A. STEPHEN 2,341,483

GETTER FOR ELECTRON DISCHARGE TUBES

Filed Sept. 29, 1943

Fig. 1.

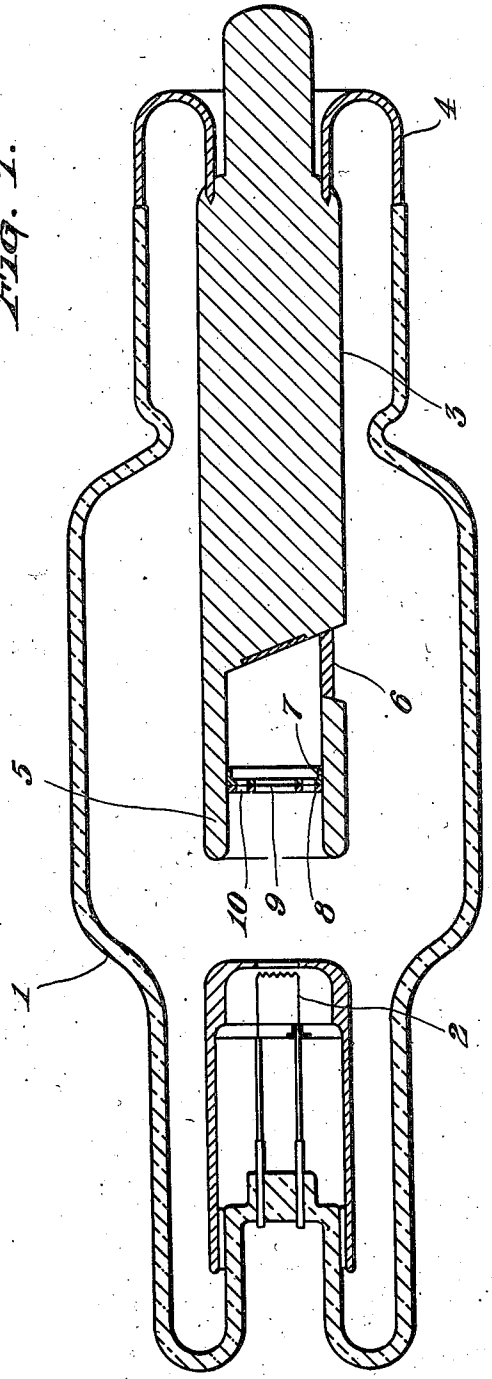


Fig. 3.

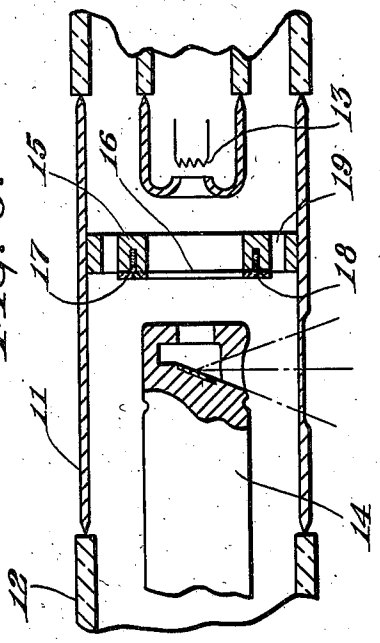
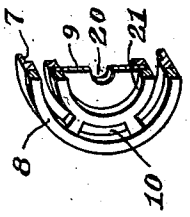


Fig. 2.



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GETTER FOR ELECTRON DISCHARGE TUBES

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8 Claims. (Cl. 250—27.5)

In the manufacture of electric discharge tubes various materials have been proposed as getters for improving or maintaining the vacuum in high-vacuum tubes. Certain of these getters, such as zirconium, tantalum and titanium, operate as getters when heated and accordingly it is known to arrange them within high-vacuum tubes in such position as to be heated to the appropriate temperature during the operation of the tube. This is permissible as they do not contaminate tungsten filaments nor do the resulting compounds which may be formed with the gas give rise to troublesome secondary emission.

According to the present invention a foil of a getter which becomes operative when heated is disposed in the path of the discharge and is apertured to permit the passage of the discharge. Advantageously a continuous foil of the heat-responsive getter is mounted in the path of the discharge and during manufacture of the discharge tube is apertured by cathode bombardment. Preferably the foil is first degassed by raising it to the desired temperature by bombardment from the cathode during pumping, the emission of the cathode being adjusted to a suitable low level appropriate to the degassing temperature. Thereafter the bombardment is increased to evaporate that part of the foil which is in the direct line of the discharge, the evaporated getter being deposited on the adjacent portions of the discharge chamber in the form of a mirror, whereas the apertured foil remains in the original position where it is heated during the operation of the tube and is enabled also to contribute to the absorbtion of gas which may be released in the discharge chamber.

Naturally two or more getter foils of the same or different materials may be arranged in the path of the discharge instead of the single foil above referred to. Degassing and partial disintegration by cathode bombardment can be carried out in an equivalent manner.

If desired, the getter foils arranged in the discharge space may be utilised in conjunction with alkaline earth or other getters which have to be kept remote from the discharge space and be in communication therewith only through long winding channels owing to the contaminating effect they exercise on hot tungsten filaments and the large secondary emission which may be produced from the compounds formed with the gas taken up. Such combination of getters is particularly desirable when it is necessary to deal with a gas such as hydrogen which may be freed at comparatively low temperatures and should be held in a cool place in the tube.

The present invention is particularly applicable to X-ray tubes, where in general, owing to considerations of efficiency in X-ray production and/or quality of radiation, the getter materials constituting the foils in the discharge space cannot be utilised as the anode.

In order that the invention may be more readily understood, reference will now be had to the accompanying drawing, which is semi-diagrammatic in character and shows only those parts of existing apparatus which are necessary for describing the present invention.

In the drawing:

Fig. 1 is substantially a longitudinal section through a glass envelope X-ray tube with a hooded anode,

Fig. 2 is a cross-sectional view in perspective showing the getter assembly of the X-ray tube of Fig. 1.

Fig. 3 is a fragmentary sectional view of another X-ray tube in which the central part of the tube envelope is of metal and a metal partition is provided in the space between anode and cathode.

Referring first to Fig. 1, the glass envelope 1 accommodates the cathode 2 and the anode 3. The heating wires to the cathode are sealed in the envelope in the usual way. The seal for the anode 3 is provided by a chrome-iron envelope portion 4 which is welded or otherwise secured to the anode 3, a fused-joint being provided between glass 1 and chrome-iron 4. The anode 3 is provided with a hood 5 which surrounds the discharge path adjacent the target surface. Adjoining the target surface, the hood 5 is provided with a window 6 for the unimpeded emergence of the X-ray beam. The construction as hereinbefore described with reference to Fig. 1 is of conventional character and accordingly the details are not fully illustrated or described. In accordance with the present invention, a foil of heat-responsive getter material, preferably zirconium is interposed in the path of the discharge between cathode 2 and anode 3. The foil 9 is mounted to cover the central aperture 21 of an apertured spider or ring 7 against which it is clamped by a similar ring 8. The rings 7 and 8 are welded or otherwise secured together so as to hold the foil 9 immovably between them. The rings 7 and 8 fit within the hood 5 of the anode 3 to support the foil in the desired position. Preferably the ring 7 is provided with a flange to give an enlarged seating surface within the hood 5

as shown. As best seen from Fig. 2 both rings 7 and 8 are provided with peripheral openings 10 beyond the foil so that the space within the hood 5 between the foil 9 and the target surface is in free communication with the rest of the interior of the envelope 1.

The foil 9 may be pre-fabricated with a central opening 20 to permit the passage of the discharge between cathode 2 and anode 3 during normal running of the X-ray tube. Preferably however, a continuous, i. e., non-perforated foil is originally mounted as shown in Fig. 1 and the desired discharge opening 20 produced during the manufacture of the tube prior to sealing-off from the pump. For this purpose the foil is first degassed by bombardment from the cathode during pumping, utilising the well known cathode bombardment de-gassing technique. Thereafter the bombardment is increased to evaporate that part of the foil 9 which lies in the direct path of the discharge. The evaporated getter material is deposited as a mirror predominantly on the inner surface of the hood 5. The tube is then sealed-off from the pump and has the appearance of Fig. 1 except that the foil 9 has a central opening which is just the size required for the passage of the discharge as shown at 20 in Fig. 2. In the subsequent use of the tube, the discharge passes close to and heats the remaining foil 9 which consequently exercises its getter action and contributes to the maintenance of the requisite high vacuum.

In the modification of Fig. 3, the X-ray tube is of the known type in which a central portion 11 of the envelope is made of metal and is attached by fused joints to glass end-pieces 12. The central metal portion 11 carries a partition 15 with a central opening of considerably greater diameter than is requisite for the passage of the discharge. The metal portion 11 with the partition 15 is usually connected to earth, whereas the anode 14 and cathode 13 are supplied with equal positive and negative voltages. In the foregoing respects, the construction of Fig. 3 is well known. According to the present invention, the partition 15 carries a foil 16 of zirconium or other heat-responsive getter material. This foil 16 can conveniently be secured in position by a clamping ring 17 fastened to the partition 15 by screws 18. To permit free communication between the two ends of the X-ray tube on either side of the partition 15, the latter is provided with at least two apertures 19. These apertures 19 are preferably adjacent the outer edge of the partition 15 and are distributed symmetrically about the axis of the tube.

The foil 16 may be provided with a central opening before being mounted or it may be apertured by cathode bombardment in precisely the same manner as hereinbefore described for the foil 9, Fig. 1.

Although only two specific examples have been described and illustrated, each involving the use of a single foil, it will be aparent that two or more foils may be mounted in parallel relationship by means identical with or equivalent to those described with reference to the drawing. Consequently the invention is not to be interpreted as confined to the preferred embodiments or otherwise limited except by the appended claims.

I claim:

1. An electron discharge tube comprising an anode, a cathode, and a foil of heat-responsive getter material arranged transversely to the discharge path between said cathode and anode, said foil having an aperture to permit the passage of the discharge.

2. An electron discharge tube comprising an anode, a cathode, and a foil of heat-responsive getter material arranged transversely to the discharge path between said cathode and anode, said foil being so constituted that an aperture may be formed therein by electron bombardment.

3. In the manufacture of an electron discharge tube the steps of mounting a foil of heat-responsive getter material in the path of the discharge between cathode and anode, degassing said foil, and subsequently bombarding said foil with electrons and evaporating that part of the foil which lies in the direct line of the discharge.

4. An X-ray tube comprising an evacuated envelope, a cathode, an anode, and a foil of heat responsive getter material arranged within said envelope transversely to the discharge path, said foil having an aperture to permit the passage of the discharge.

5. An X-ray tube comprising an evacuated envelope, a cathode, an anode, a hood extending from said anode towards the cathode so as to surround the path of discharge adjacent the anode, and a foil of heat-responsive getter material carried by said hood and disposed transversely to the path of discharge, said foil having an aperture to permit the passage of the discharge.

6. An X-ray tube comprising an evacuated envelope, a cathode, an anode, a hood extending from said anode towards the cathode so as to surround the path of discharge adjacent the anode, and a foil of heat-responsive getter material mounted transversely across said hood at a point spaced from the anode surface, said foil having an aperture for the passage of the discharge.

7. An X-ray tube comprising a cathode, an anode, an evacuated envelope having a metallic portion surrounding the discharge path between said cathode and anode, a wall integral with said metal portion and extending inwardly therefrom towards the discharge path in a plane normal to said path and between said cathode and anode and having an opening therein greater than the cross-section of the discharge, and a foil of heat-responsive getter material carried by said wall and extending across the opening therein, said foil having an aperture for the passage of the discharge.

8. In the manufacture of an X-ray tube the steps of mounting a foil of heat-responsive getter material between anode and cathode in a plane at right angles to the discharge path, degassing said foil by electron bombardment and thereafter increasing the electron bombardment to produce an aperture in the foil in the direct line of the discharge.

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