June 28, 1949. A. M. SKELLETT 2,474,335

GETTER STRUCTURE FOR ELECTRON DISCHARGE DEVICES

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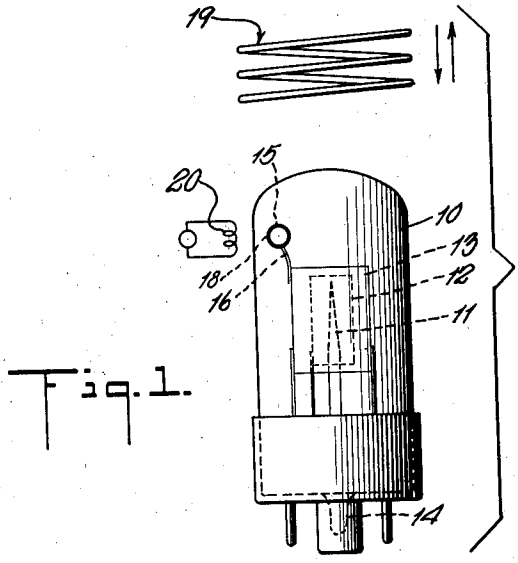


Fig. 1.

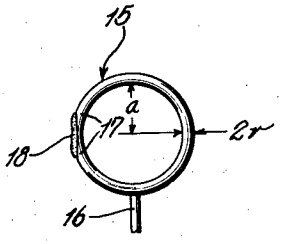


Fig. 2.

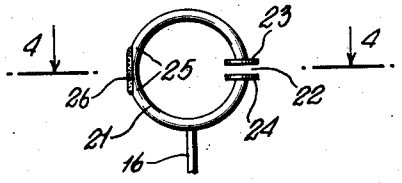


Fig. 3.

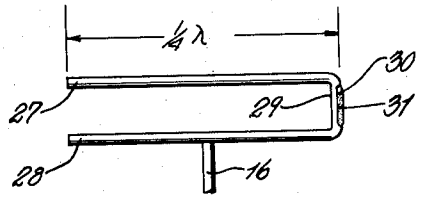


Fig. 5.

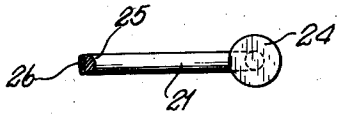


Fig. 4.

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GETTER STRUCTURE FOR ELECTRON DISCHARGE DEVICES

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10 Claims. (Cl. 250—27.5)

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This invention relates to evacuated devices such as electron tubes, electric lamps and the like, and more particularly to methods and means for effecting clean-up of residual gases in such devices.

A principal object of the invention relates to a novel gettering arrangement for evacuated devices generally.

Another principal object is to provide an improved arrangement for the selective flashing of gettering material or clean-up material such as is commonly used in the processing and final clean-up of electron tubes, electric lamps and the like.

Another object is to provide a frequency-sensitive gettering arrangement for electron tubes, electric lamps and the like.

A feature of the invention relates to a novel support for a getter or gaseous clean-up agent, which support is constructed as a resonant wave line section or as a tuned circuit, and is arranged to be selectively energized by a particular frequency at which the line is mainly resonant or tuned.

Another feature relates to a support for a getter material, which support is constructed as a wave resonant member and is arranged to be energized by alternating current energy at the resonant frequency to produce a localized current concentration or maximization.

A further feature relates to a gettering element which enables the getter material to be selectively flashed and which enables the trajectory of the flashed material to be more readily directed.

A further feature relates to an electrically tuned support for gettering material and the like.

A still further feature relates to the novel organization, arrangement and relative location and proportioning of parts which cooperate to provide a more accurately controllable gettering procedure for evacuated devices, such as electron discharge tubes, electric lamps and the like.

Other features and advantages not specifically enumerated will appear as the ensuing description progresses.

In the drawing,

Fig. 1 is a generalized view of a radio tube incorporating the novel gettering arrangement according to the invention.

Fig. 2 is a magnified view of the gettering element of Fig. 1.

Fig. 3 is a modification of the gettering element of Fig. 2.

Fig. 4 is a sectional view of Fig. 3 along line 4—4 thereof.

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Fig. 5 is a further modification of the gettering element of Fig. 1.

Referring to Fig. 1, there is shown in generalized form, a radio tube of any well-known construction, comprising an enclosing envelope 10, which houses any well-known construction and assembly of electrodes represented, for example, by the electron-emitting cathode 11, control grid 12 and plate or anode 13. It will be understood that the showing of these electrodes is essentially schematic, and the inventive concept is not limited to any particular number or configuration of the electrodes. In the usual manner, the envelope 10 carries an exhaust tubulation 14, by means of which the envelope 10 can be connected to a suitable vacuum pump. During the pumping schedule, it is usually necessary to raise the various metal parts within the envelope 10 to a sufficiently high temperature to drive out occluded gases and the like. When the pumping schedule has been completed, it is then necessary to subject the interior of the envelope to a final gas clean-up or gettering action. It has always been a problem in this art to enable the parts to be outgassed during the pumping schedule without, at the same time, causing the usual gettering material to be heated sufficiently to vaporize it, since this gettering operaion is usually the final step before actual closing or sealing off the tubulation 14. This problem is particularly difficult when the bombarding or outgassing of the metal parts and the subsequent flashing of the getter are effected by high frequency induction heating.

Various expedients have been proposed heretofore to effect this timed or selective flashing of the getter with respect to the bombarding temperatures. The most common expedient has been to use a support for the getter material, which support is so oriented with respect to the magnetic field of the induction heating coil that, during the normal outgassing or bombarding of the parts, the getter support is substantially unaffected by the high frequency induction field. It becomes necessary with the usual arrangement either to change the orientation of the field producing coil, or bombarding coil, or even to use a separate coil for flashing the getter.

Furthermore, in the case of certain types of tubes, particularly in some of the more recent miniature tubes, the parts are so small that reliance cannot always be placed upon the difference in location of the getter with relation to the other parts within the tube to effect the selective or timed flashing of the getter material.

The above-noted, and other disadvantages, are

overcome according to the present invention, by constructing the getter support in such a way that it is highly frequency-sensitive. For this purpose, the getter support is constructed as a wave resonant element which may take any suitable form in the nature of a resonant wave transmission line section or tuned circuit organization. Thus, as shown in Figs. 1 and 2, the getter support is in the form of a relatively small metal ring **15**, which is attached by a thin metal arm **16** to any suitable part of the electrode assembly within the tube. The region **17** of this ring is reduced in thickness and carries the gettering material **18** which may be of any well-known chemical composition. While the drawing shows the ring **15** with its plane parallel to the vertical axis of envelope **10**, it will be understood that the ring **15** may be located in any other convenient plane. When it is desired to outgas the metal parts within the envelope **10**, the usual bombarding coil **19** may be lowered over the tube and the coil **19** may be excited with any suitable high frequency current sufficient to raise the parts to their outgassing temperature. However, because of the small dimensions and relative thinness of the ring **15**, insufficient heating may be generated in this ring **15** by the coil **19** to raise the material **18** to the vaporizing temperature.

After the parts have been outgassed, the coil **19** may be energized by a different high-frequency current whose frequency however is correlated with the resonant characteristics of the ring **15** considered as a wave transmission line, or tuned circuit organization. If desired, instead of using the same coil **19** for this purpose, a separate coil **20** may be employed and connected to a suitable source of ultra high-frequency energy. It is a well-known phenomenon in high-frequency wave transmission lines that by suitable proportioning of the physical parameters of the line, with respect to the excitation frequency, that current nodes and current maxima can be produced at particular points along the line. Advantage is taken of this fact to locate the thinned-out portion **17** of ring **15** at such a point that a current maxima appears in the ring **15** at this region when the ring **15** is excited by a suitable high-frequency electromagnetic wave energy as above described. In determining the frequency for this wave energy, the following formula can be followed:

$$f=\frac{3\times10^{10}}{2\pi a\left(1-\frac{0.243}{\log_e\frac{8a}{r}}\right)}$$

wherein "*a*" equals the radius of ring **15**, and "*r*" equals the radius of the wire of which ring **15** is fabricated.

Instead of making the getter support in the form of a complete ring, it may be constituted of composite inductive and capacitive elements. Thus, as shown in Figs. 3 and 4, the getter support consists of a discontinuous metal ring **21**, similar to ring **15**, but having a small gap **22** between the ends thereof, each gap end carrying a small metal disc or plate **23**, **24**, to form therebetween a capacitor of predetermined capacitance. This capacitance, in conjunction with the inductive reactance of the ring **21**, forms a tuned circuit which resonates at the frequency of the electromagnetic wave energy supplied by field coil **20**. Here again, the ring **21** has a thinned portion **25** to which is applied the getter material **26**.

Fig. 5 shows a further modification wherein the getter support is in the form of a one-quarter wavelength transmission line or Lecher wire comprising a pair of parallel metal wires **27**, **28**, which are approximately equal in length to one-quarter of the wavelength of the alternating current energy supplied by coil **20**. The wires **27** and **28** are short-circuited by the portion **29** which is thinned out at the region **30**, and at this region there is applied the getter material **31**.

In all the foregoing embodiments, the flashing of the getter material will be selectively responsive to the resonant frequency for which the respective supports are designed, and the flashing heat will be mainly localized at the thinned-out portions **17**, **25** and **29**, both by reason of the higher ohmic resistance at this thinned-out portion and by reason of the fact that in accordance with one transmission line theory a current maxima will occur at this thinned-out region. Furthermore, since the flashing heat is thus localized, there is provided more control over the trajectory of the flashed material as it is being vaporized, so that it can be more readily directed, for example by appropriate positioning of the getter support, towards a desired area of the envelope **10**.

While certain embodiments have been disclosed herein, various changes and modifications may be made therein without departing from the spirit and scope of the invention. Thus, instead of making the resonant member of a wire carrying a coating of getter material, the wire itself may be constituted of conductive getter material.

What is claimed is:

1. A gettering unit to be heated by high frequency wave energy, comprising a support, getter material on said support, said support being constituted of a conductive member which in itself forms a tuned electrical circuit selectively resonant at the frequency of said wave energy to convert said wave energy into heat energy for flashing the getter material.

2. A gettering unit to be heated by high frequency wave energy, comprising a support, getter material on said support, said support being constituted of a conductive member which is physically shaped to form in itself an electrical wave transmission line resonant at the frequency of said wave energy to convert said wave energy into heat energy for flashing the getter material.

3. A getter support to be heated by high-frequency wave energy, said support comprising a tuned conductive ring whose dimensions are proportioned to cause it to resonate electrically as a wave transmission line at said high frequency, said ring having a thinned-out portion supporting getter material.

4. A getter support according to claim 3 in which said thinned-out portion is located at a region of maximum current resulting from the resonating of said ring at said high frequency.

5. A getter support to be heated by high-frequency energy, said support comprising a discontinuous metal ring having a predetermined inductive reactance and with a gap between the ends, and capacitor members attached to said ends tuning said inductive reactance to resonate at said high frequency.

6. A getter support for selective heating by a particular high frequency wave, said support being in the form of a tuned conductive member forming a wave transmission line section which selectively resonates to produce at least one

region of current maximum when excited by said high frequency, and a quantity of getter material applied to said member at said region.

7. A getter support according to claim 6 in which said region of said conductive member is thinned out with respect to the remainder of said member.

8. A getter support for heating by a particular high frequency, said support being in the form of a Lecher-wire wave transmission line whose resonant frequency is correlated with the said high frequency to produce at least one current maximum at a predetermined region of the support, and a quantity of getter material applied to said support at said region.

9. A getter support in the form of a wire ring to be heated to getter flashing temperature by a high-frequency current to which said ring is selectively responsive, said frequency being substantially equal to

$$\frac{3\times10^{10}}{2\pi a\left(1-\frac{0.243}{\log_e\frac{8a}{r}}\right)}$$

where "a" is the radius of the ring and "r" is the radius of the wire from which the ring is formed, said ring having a thinned-out portion over a localized region supporting getter material.

10. A getter support according to claim 9 in which said localized region is located at a current maxima resulting from the electrical resonance of said ring at said high frequency.

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