Dec. 14, 1948. H. J. McCARTHY 2,456,563

ULTRA HIGH FREQUENCY ELECTRONIC TUBE

Filed Oct. 21, 1944

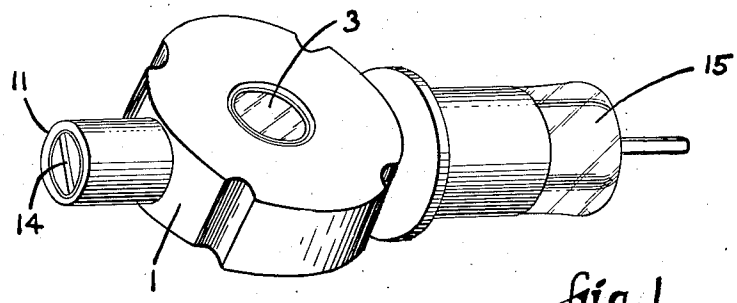


Fig. 1

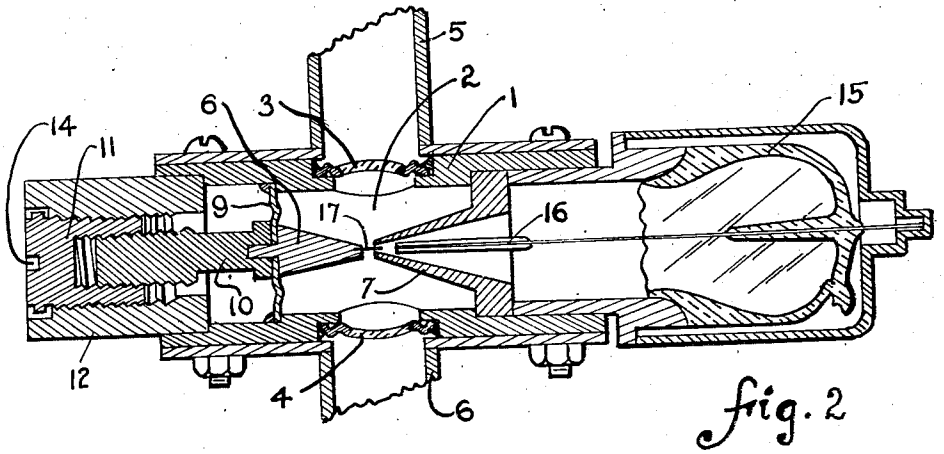


Fig. 2

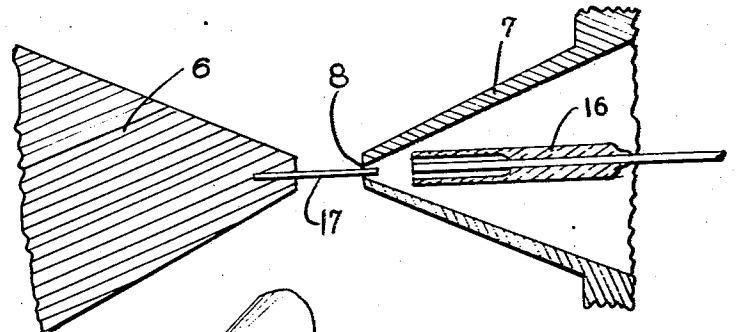


Fig. 3

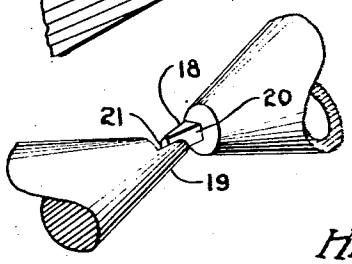


Fig. 4

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Patented Dec. 14, 1948 2,456,563

UNITED STATES PATENT OFFICE

2,456,563

ULTRA HIGH FREQUENCY ELECTRONIC TUBE

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Application October 21, 1944, Serial No. 559,727

5 Claims. (Cl. 315—5)

1

This invention relates to electronic tubes and particularly to such devices which act as resonators when supplied with an external source of high frequency current, and when applied to certain uses are known as gas switching tubes.

It is an object of the invention to provide a tube of the type indicated in which the leakage energy at its discharge may be held substantially constant over a considerable range of adjustment of its resonant frequency.

A further object of the invention is to provide an electronic tube having a discharge gap as part of its resonating system which remains invariable throughout a substantial range of frequency adjustment.

Other objects and features will more fully appear from the following description in connection with the accompanying drawing.

The invention may be applied to a number of different types of electronic tubes and is herein applied to an ultra high frequency electronic resonating device suitable for use as a gas switching tube.

The tube illustrated herein is similar to that described in a copending application filed by the present applicant on May 24, 1944, entitled "Ultra high frequency electronic tube," and bearing Serial Number 537,145 now Patent Number 2,454,741.

The tube is made of a highly conductive metal such as copper and comprises a body portion having a resonating chamber therein and at least one coupling window. The discharge element of its oscillating system is formed by a pair of cone-shaped electrodes one of which is hollow.

The cones are arranged with their slightly truncated apex ends opposed and in alignment. The hollow cone has a conical chamber terminating in a small aperture at its apex end within which is received a straight rod of uniform diameter which is anchored in the end of the other cone. The hole in the hollow cone is larger than the rod thus a gap is formed between the rod and the peripheral edge of the hole. The cone having the rod is axially adjustable to obtain a required frequency adjustment.

The tube is coupled in a wave guide system and functions in a manner to be described hereinafter.

To present a better understanding of the invention a particular embodiment thereof is described and illustrated in the drawings in which:

Figure 1 is a perspective view of a preferred embodiment of the invention;

Figure 2 is a longitudinal sectional view of the device; and

2

Figure 3 is an enlarged detail view of the parts directly involving the invention.

Fig. 4 is a detailed perspective view showing a modified construction for the cone shaped electrodes.

In the type of electronc device to which the present invention is applied it is desirable that the discharge element of its resonating system be of special construction so arranged that it presents a constant gap across which the discharge takes place when the tube becomes ionized. The gap remains constant despite adjustment of the resonant frequency of the tube.

The tube to which the invention is applied has an envelope 1 of copper or other electrically conductive material enclosing a resonance chamber 2 which is provided with a pair of coupling windows 3 and 4 through which a high frequency wave may pass into and out of the tube. The windows may be coupled to suitable wave guides 5.

Within the chamber 2 a pair of cone-shaped electrodes 6 and 7 are received. The cone 7 is fixed in position and has a cone-shaped axial chamber the apex end of which opens into the slightly truncated apex end of the cone to present the aperture 8. The other cone 6 desirably is solid and is disposed with its slightly truncated apex end in alignment with the inner end of the cone 7 and is spaced a short distance therefrom. The cone 6 is adjustable axially toward and from the cone 7. This may be accomplished in any suitable manner. As shown in the drawings the cone 6 is secured to a flexible diaphragm 9 which in turn is hermetically sealed in the envelope and forms a closure for the chamber 2.

The outer face of the diaphragm 9 has secured thereto an adjusting screw 10. The screw 10 has thereon a differential nut 11 which in turn has threaded engagement with a plug 12 fixed in the envelope 1. The position of the cone 6 is finely adjusted by rotating the nut 11 as by means of a screw driver placed in the slot 14.

Desirably a glass exhausting chamber 15 is sealed to the envelope and communicates with the chamber 2 through the opening in the cone 7. The chamber 15 is provided with an exhaust tube by means of which the tube is evacuated of air and through which suitable gas may be introduced A keepalive 16 may be provided having its inner end extending into the cone 7 but spaced from the rod 17. The outer end of the keepalive 16 is extended outside of the chamber 15 for connection to a source of energy.

The tip of the cone 6 has anchored therein a metallic rod 17 of uniform and relatively small

diameter of the order of ten one thousandths of an inch. The rod is desirably axially disposed in the cone 17 and projects a short distance into the aperture 8 in the cone 7 but not into close proximity to the keepalive 16. The diameter of the aperture 8 is larger than the diameter of the rod 17 an amount sufficient to establish the desired gap between the rod and the cone 7. In operation the frequency of the tube must be adjusted to adapt it to the particular circuit to which it is coupled. To do this the cone 6 is moved by the adjusting nut 11. In so doing the resonant frequency of the tube is varied but the discharge gap remains constant.

The ends of the cones 6 and 7 may have any suitable structure. An effective variation of the structure above described is that illustrated in Figure 4 in which the apex ends of the cones are shaped as shown to present coacting discharge gap members 18 and 19 representing opposed and parallel faces 20 and 21 across which discharge takes place. The planes of the faces 20 and 21 also lie parallel to the axis of the cones along which they are moved to tune the tube. Throughout the range of tuning of the tube therefore the gap members 18 and 19 presenting opposed and

When the tube is used for certain purposes and is supplied with a substantial volume of energy its resonant system is designed to produce ionization and discharge at the point of minimum gap which exists between the rod 17 and the cone 7 in one case and between the faces 20 and 21 in the other case. It is very desirable that the amount of leakage energy passing through the discharge path should remain substantially constant throughout the range of frequencies to which the tube may be adjusted. By making the discharge path constant the energy passing through it is also held substantially constant at whatever the operating frequency of the tube may be.

What I claim is:

1. An electronic resonator tube comprising an envelope, a gas filling therein, a cavity resonator within said envelope, a pair of frequency adjusting electrodes spaced apart and forming a part of said resonator, means acting on one of said electrodes to move said electrode axially with respect to the other electrode to tune the resonator, an extension on one of said tuning electrodes and

spaced radially from the other electrode a predetermined discharge distance and having a surface parallel to the axis of said other electrode, whereby the discharge distance remains constant as the means acting on one of said electrodes moves said electrode axially to tune the resonator.

2. The combination of claim 1 in which the discharge distance between the electrodes is less than the minimum distance between the frequency determining portion of the electrodes.

3. The combination of claim 1, in which the frequency adjusting electrodes are conical, and the extension on one of said electrodes cylindrical and fitting into an opening at the apex of the other electrode.

4. The combination of claim 1, an extension on the other of said electrodes, and in which the frequency adjusting electrodes are conical, the extension on said electrodes having flat surfaces parallel to and in radial juxtaposition with each other.

5. An electronic resonator tube comprising an envelope, a gas filling therein, a pair of frequency adjusting electrodes in axial juxtaposition therein and spaced apart, one of said electrodes being axially movable, an extension on one of said electrodes and having a surface parallel to the axis of said electrode and spaced from the other electrode a predetermined discharge distance, whereby said distance remains constant with axial movement of said movable electrode.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,304,868	Franklin	May 27, 1919
2,072,993	Ulrey	Mar. 9, 1937
2,227,372	Webster et al.	Dec. 31, 1940
2,404,116	Wolowicz et al.	July 16, 1946
2,407,974	Clifford et al.	Sept. 24, 1946
2,412,659	Thomas	Dec. 7, 1946
2,412,751	Rochester	Dec. 17, 1946

FOREIGN PATENTS

Number	Country	Date
591,490	Germany	Jan. 22, 1934