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TUNING DEVICE

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Fig. 1.

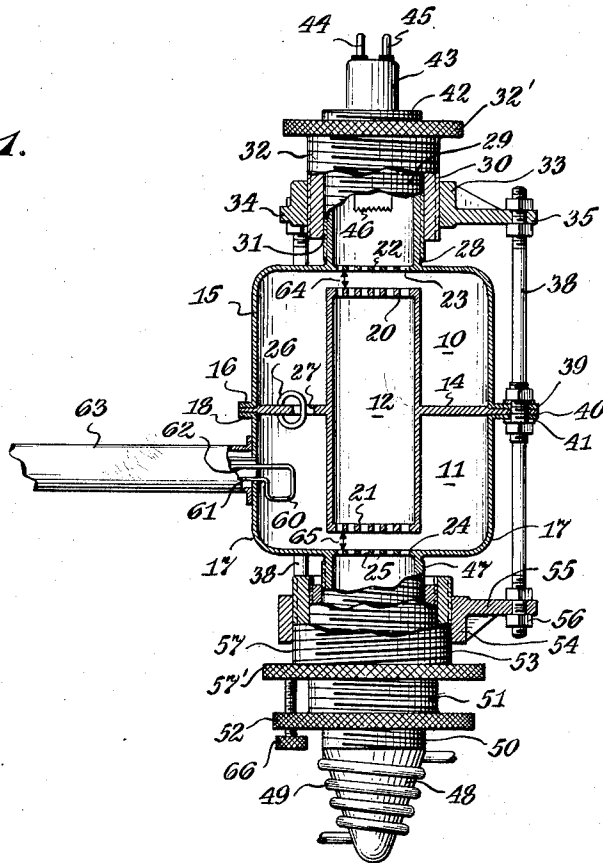
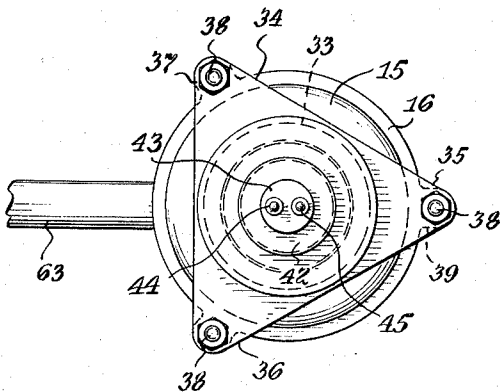


Fig. 2.



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## UNITED STATES PATENT OFFICE

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## TUNING DEVICE

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4 Claims. (Cl. 250—27.5)

Our invention relates to ultra-high frequency apparatus, and especially to apparatus incorporating hollow body resonators.

Recently high frequency generators have been developed in which hollow body resonators are interposed in the path of the charges in a discharge device. In such resonators, the frequency is dependent on the dimensions of the resonators and can be varied by changing the resonator dimensions.

For proper operation of the generator, the resonator must be tuned and, therefore, its dimensions must be varied.

It is one of the objects of our invention to provide tuning means capable of accurate adjustment for the resonator of a high frequency generator.

Another object of our invention is to provide the structure of a high frequency generator so that the resonator may be easily and accurately tuned.

Other objects and advantages of the invention will be apparent from the following description and drawing in which:

Figure 1 is a view, partly in elevation and partly in cross section of a preferred embodiment of our invention.

Figure 2 is a top elevation of Figure 1.

In Figure 1 we have disclosed a preferred embodiment of our ultra-high frequency generator, and special tuning means therefor. This ultra-high frequency generator comprises two hollow body resonators 10 and 11, with an intermediate field-free conductive shell 12. As illustrated, in Figure 1, we preferably have the field-free tube constructed as a hollow metal tube 12 supported at its mid-section by a circular plate 14 that forms an intermediate integral lateral extension of the shell or tube 15 and also a common boundary between the two hollow body resonators.

The hollow body resonator 10 is formed by a thin cup-shaped metal body 15 secured to the plate 14 at its flange 16. The hollow body 11 is securely formed by a cup-shaped metal body 17, located on the other side of the common boundary plate 14, and having its flange 18 secured thereto.

The hollow tube 12 has its ends 20 and 21 closed by perforated metal end pieces. The adjacent portion 22 of the metal cup-shaped body has similar perforations 23 therein, corresponding with the perforations in the end piece 20. Likewise, the portion 24 of the hollow body 17 has perforations 25 therein, to correspond with the perforations in the lower end piece 21 of

the intermediate hollow body. The two hollow bodies are coupled together, preferably by a metal ring 26, extending from one side of the common boundary disk 14 through an opening 27 to the other side of the disk 14.

The hollow cup-shaped body 15 preferably has an integral tubular flange 28 surrounding the perforated portion 22. The outer portion of this tubular extension is preferably screw threaded at 29. Enclosing this portion is another tubular body 30 with interior threads 31 to fit into the threads 29. The exterior of this body is likewise screw threaded at 32 to fit into circular nut 33 that has outward extensions, which, as disclosed, is in the form of a triangle 34 with vertexes 35, 36 and 37 extending beyond the vertical boundary of the hollow body resonator. These vertexes have bolts 38 extending therethrough, and these bolts continue on to similar extensions 39, 40, 41 of flanges on the cup-shaped body 15, boundary plate 14 and cup-shaped body 17 respectively of the hollow resonators.

The tubular extension 28 has its upper end 42 closed vacuum tight with insulation 43, and through this insulation extension are leads 44 and 45 to the filament 46 acting as a cathode for the discharge device. If desired, a grid may also be inserted to control or concentrate the electron stream.

The bottom hollow resonator 11 likewise has a tubular extension 47 that preferably terminates in a tapered closed end 48 forming an anode. This tapered closed end 48 may have cooling coils 49 surrounding this portion. In place of these cooling coils, the casing of the high frequency generator may be cooled by a current of air, such as that from a fan.

The portion of this integral projection 47 may be screw threaded as indicated at 50, and enclosed with a tubular casing 51, screw threaded inside and out, similar to the tubular member 30 at the other end of the casing. This tubular member 51 has a knurled flange 52 for adjustment on the tubular member 50.

We also prefer to provide an additional tubular member 53 screwed around the outside of the member 51 and screwed into a circular nut 54 with extensions 55 to be fastened to the rods 38 by nuts 56. We prefer to make the threads 57 on the outer surface of the tubular member 53 in the reverse direction to those on the surfaces 50 and 51; or, we may make these threads in the same direction but of different pitch.

The output circuit comprises a loop 60 in the hollow body oscillator 11 secured to a tube 61,

extending from this resonator and having the other end of the loop secured to an axial conductor 62 of this tube to form the well-known output transmission line for the oscillator. The transmission line may be closed, if desired, by a protecting casing 63.

The distance 64 between the perforated opening 22 of the hollow resonator 10, and the perforated disk 20 of the field-free hollow tube 12, determines the frequency of oscillation of the resonator 10. Likewise the distance 65 between the perforated disk 21 of the field-free tube 12 and the perforated grid 25 of the hollow resonator 11, determines the frequency of oscillation of the hollow resonator 11.

These two distances 64 and 65 must be carefully adjusted for efficient tuning of the resonators and for a higher output. In order to regulate the distance 64 we adjust the tubular member 32 by its knurled flange 32'. The tubular member 32 is connected by its screw threads to the nut 33 which is fixedly secured to the casing by the bolts 38. On the inner side, the tubular member 32 is screw threaded to the integral front flange 28. The adjustment of 32 will force the tubular extension 28 up or down and this will adjust the position of the perforated opening 22 in relationship to the perforated disk 20 of the field-free tube 12 by flexing the flat thin plate portion 22. A similar adjustment of the tubular member 51 by its knurled flange 52 will likewise adjust the distance 65 in the lower portion of the tube.

In order to obtain a finer adjustment, however, we have inserted the additional tubular member 53 with reversed threads or with threads of different pitch on its inner and outer portion. The threads may have slightly different pitches so that one complete turn will displace the wall of the hollow resonator 11 by the sum or difference of these pitches. The inner pitch may be, for instance, fourteen threads to the inch, and the outer twenty-four threads to the inch. This difference in pitch or direction, or both, may be made on one cylindrical member such as 51 instead of providing the additional member 53. In such a case the threads on the inner nut 54 would correspond with threads on the outer wall of 51 and fit into them.

After the adjustment has been obtained, the adjustment can be locked by any suitable means, such as by the screw 66 extending through the flange 52 of the tubular member 51 and bearing against the flange 57' of the tubular member 57.

We have, accordingly, disclosed very accurate tuning means for displacing an integral flexible wall of a hollow body resonator. It is apparent, of course, that many modifications may be made in the preferred embodiment illustrated, and accordingly we desire only such limitations to be imposed on the invention as are necessitated by the spirit and scope of the following claims.

We claim:

1. An ultra-high frequency discharge device comprising a hollow conductive shell having a perforated end, said shell having an extension lateral to said perforated end; a cup-shaped member enclosing the perforated end of said conductive shell and having its edge secured to the said lateral extension of said shell, the bottom portion of the cup-shaped member being flat, flexible and having a perforated portion adjacent the perforated end of the hollow conductive shell, an integrally secured circular flange surrounding the perforated portion of said cup-shaped mem-

ber and extending outwardly, insulation closing the end of said circular flange, a cathode within said circular flange, said circular flange having exterior screw threads, an adjusting member screwed on said threads and having threads on its exterior, a supporting member receiving said exterior threads on said adjusting member, said supporting member being secured to the said lateral extension of said shell.

2. An ultra-high frequency discharge device comprising a hollow tube conductive shell having a perforated end, said shell having an extension lateral to said perforated end; a cup-shaped member enclosing the perforated end of said conductive shell and having its edge secured to the said lateral extension of said shell, the bottom portion of the cup-shaped member being flat, flexible and having a perforated portion adjacent the perforated end of the hollow conductive shell, an integrally secured circular flange surrounding the perforated portion of said cup-shaped member and extending outwardly, insulation closing the end of said circular flange, a cathode within said circular flange, said circular flange having exterior screw threads, an adjusting member screwed on said threads and having threads on its exterior, a supporting member receiving said exterior threads on said adjusting member, said supporting member being secured to the said lateral extension of said shell, said conductive shell having a second perforated end, a second cup-shaped member enclosing said second perforated end and secured to said lateral extension of said shell, said second cup-shaped member also having a flat, flexible bottom, having a perforated portion adjacent said second perforated end of the hollow conductive shell, an integrally secured circular flange surrounding the perforated portion of the bottom of said second cup-shaped member and extending outwardly, a closed end for said last mentioned circular flange adapted to act as an anode, and means for adjusting the spacing between the perforations in said second cup-shaped member and the second perforated end of said first mentioned hollow tube.

3. An ultra-high frequency discharge device comprising a hollow conductive shell having a perforated end, said shell having an extension lateral to said perforated end; a cup-shaped member enclosing the perforated end of said conductive shell and having its edge secured to said lateral extension of said shell, the bottom portion of the cup-shaped member being flat, flexible and having a perforated portion adjacent the perforated end of the hollow conductive shell, an integrally secured circular flange surrounding the perforated portion of said cup-shaped member and extending outwardly, insulation closing the end of said circular flange, a cathode within said circular flange, said circular flange having exterior screw threads, an adjusting member screwed on said threads and having threads on its exterior, a supporting member receiving said exterior threads on said adjusting member, said supporting member being secured to the said lateral extension of said shell, said conductive shell having a second perforated end, a second cup-shaped member enclosing said second perforated end and secured to said lateral extension of said shell, said second cup-shaped member also having a flat, flexible bottom, having a perforated portion adjacent said second perforated end of the hollow conductive shell, an integrally secured circular flange surrounding the perfo-

rated portion of the bottom of said second cup-shaped member and extending outwardly, a closed end for said last mentioned circular flange adapted to act as an anode, and means for adjusting the spacing between the perforations in said second cup-shaped member and the second perforated end of said first mentioned hollow tube, said last mentioned means including a cylindrical member having screw threads on its inner surface of different pitch than the screw threads on its outer surface.

4. An ultra-high frequency discharge device comprising a hollow conductive shell having a perforated end, said shell having an extension lateral to said perforated end; a cup-shaped member enclosing the perforated end of said conductive shell and having its edge secured to said lateral extension of said shell, the bottom portion of the cup-shaped member being flat, flexible and having a perforated portion adjacent the perforated end of the hollow conductive shell, an integrally secured circular flange surrounding the perforated portion of said cup-shaped member and extending outwardly, insulation closing the end of said circular flange, a cathode within said circular flange, said circular flange having exterior screw threads,

an adjusting member screwed on said threads and having threads on its exterior, a supporting member receiving said exterior threads on said adjusting member, said supporting member being secured to the said lateral extension of said shell, said hollow tube having a second perforated end, a second cup-shaped member enclosing said second perforated end and secured to said lateral extension of said shell, said second cup-shaped member also having a flat, flexible bottom, having a perforated portion adjacent said second perforated end of the hollow tube, an integrally secured circular flange surrounding the perforated portion of the bottom of said second cup-shaped member and extending outwardly, a closed end for said last mentioned circular flange adapted to act as an anode, and means for adjusting the spacing between the perforations in said second cup-shaped member and the second perforated end of said first mentioned hollow tube, said last mentioned means including a cylindrical member having screw threads on its inner surface of different direction than the screw threads on its outer surface.

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