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HIGH FREQUENCY ELECTRON DISCHARGE APPARATUS

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FIG. 1.

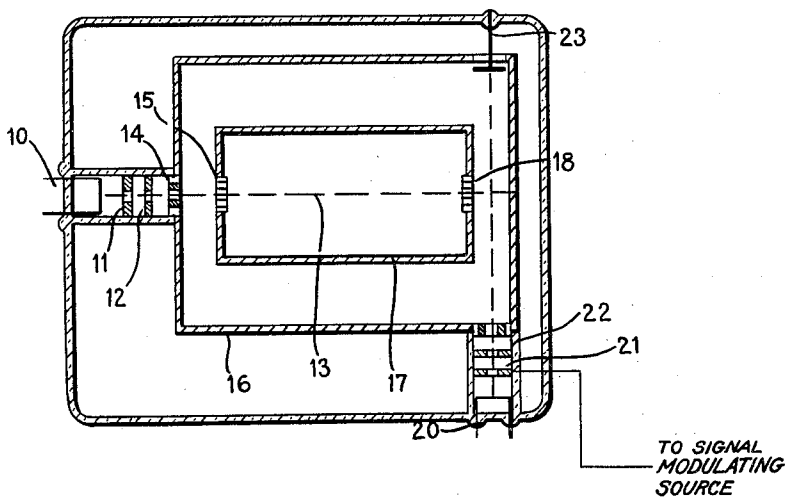
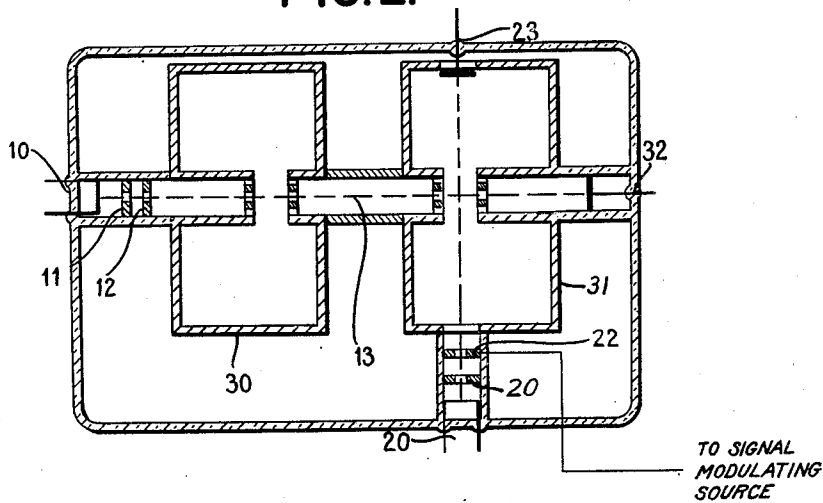


FIG. 2.



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HIGH-FREQUENCY ELECTRON DISCHARGE APPARATUS

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5 Claims. (Cl. 250—27.5)

This invention relates to ultra-high frequency apparatus comprising resonators of the cavity type.

It is proposed, in accordance with the invention, to modulate or change the frequency of a resonator of the cavity type by varying the dielectric constant within a portion of the resonator, by varying an electronic space charge or by varying the intensity or velocity of an electron beam traversing that portion.

The invention is primarily applicable to electron discharge apparatus using the principles of velocity modulation of electrons for the excitation of a resonator effective at very high frequencies.

Briefly such apparatus usually comprises a single resonator or a pair of coupled resonators of cavity type, electrons being passed through two successive gaps therein to be modulated in velocity in the first gap and to yield energy at the second gap for the maintenance of oscillations.

In either single or double resonator apparatus utilising velocity modulation of electrons, an auxiliary electron beam may be fired across some part of one of the resonators. This auxiliary beam, if of suitable velocity will change the dielectric constant and hence the natural frequency of the resonator. In the case of a single resonator, therefore, modulation of the auxiliary beam will give a frequency modulation of the high frequency output, while in a double resonator it will give an amplitude modulation (owing to the detuning of one resonator with respect to the other), probably combined with some degree of frequency modulation.

The illustration of the single cavity and double cavity tubes in accordance with this invention are shown in the drawing in which, Fig. 1 shows a single cavity arrangement, and Fig. 2 a double cavity arrangement.

In the drawing the illustrations are made diagrammatically.

In Fig. 1 an electron emitting cathode 10 emits electrons which are accelerated by accelerator electrode 11 and centered by the control electrode 12 to produce a cathode beam shown in dotted lines at 13. This beam is transmitted through a pair of grids 14, 15, located in the wall of resonant cavity 16 and tube 17, respectively, after which it is again subject to the effect of a control potential between grid 18 and the end wall of chamber 16. Such a tube is known in the prior art and energy may be extracted from the tube due to the retarding effect caused between 18 and the end wall.

In accordance with my invention modulation of the signal beam is provided by means of a second beam traversing the cavity through which the beam passes so as to change the dielectric constant effective in this area. This is accomplished by a cathode 20, an accelerating electrode 21 to which a signal modulating source is coupled, a concentrating electrode 22 to form the electrons emitted from cathode 20 into a beam, and a target electrode 23 which serves to prevent electrons from the beam from returning into the space. The signal modulations applied to electrode 21 serve to vary the concentration of the beam emitted from cathode 20 and so to vary the dielectric constant of the space traversed by beam 13 in accordance with signal modulation.

Fig. 2 corresponds substantially with Fig. 1 except that two cavities 30, 31, are provided for controlling the concentration of the beam 13. Also, a target electrode 32 is provided for beam 13 instead of terminating the beam on the chamber wall itself. In addition the signal modulating source is shown coupled to concentrating electrode 22 instead of accelerating electrode 21. It is understood, however, that the various features shown in Fig. 2 may, if desired, be applied to Fig. 1 and similarly the features of Fig. 1 which differ from Fig. 2 may be applied to this other arrangement.

What is claimed is:

1. High frequency discharge apparatus including a tube, means coaxial with and surrounding said tube, forming a hollow resonant chamber, a plurality of aligned grids, one in one end of said means, a second in one end of said tube and adjacent said first grid, and a third at the other end of said tube, a source of electrons aligned with said grids and adapted to discharge and direct electrons along a path through all of said grids, and means for varying the dielectric constant of said chamber, comprising a second source of electrons and a target positioned within said chamber, forming an electron discharge path across said chamber between said third grid and the other end of said resonant chamber forming means.

2. Modulated high frequency discharge apparatus comprising a hollow resonator having a predetermined dielectric constant, means for maintaining oscillations in the resonator including means for directing a stream of electrons along a main discharge path through the resonator, and means for modulating said oscillations including means for directing a second stream of electrons along a second discharge path through

the resonator and means for modulating said second stream.

3. Modulated high frequency discharge apparatus as set forth in claim 2, including means for velocity modulating the first stream of electrons in one part of the resonator, and means for transferring energy from said stream to the oscillating field in a second part of the resonator, and in which the second stream of electrons passes through said second part of the resonator.

4. Frequency modulated high frequency discharge apparatus comprising a hollow resonator having a predetermined dielectric constant and an oscillation frequency determined by said constant, means for maintaining oscillations in the resonator including means for directing a stream of electrons along a main discharge path through the resonator, and means for modulating the frequency of said oscillations including means for directing a second stream of electrons along a

second discharge path through the resonator and means for modulating said second stream.

5. Amplitude modulated high frequency discharge apparatus comprising a hollow resonator having a predetermined dielectric constant and formed with two resonant cavities, means for maintaining oscillations in the resonator including means for directing a stream of electrons along a main discharge path passing through both cavities of the resonator, and means for amplitude modulating the frequency of said oscillations including means for directing a second stream of electrons along a second discharge path through the second cavity of the resonator, located adjacent the discharge end of the first stream of electrons, and modulating said second stream, said detuning action of one cavity with respect to the other producing amplitude modulation.

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