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ELECTRON DISCHARGE DEVICE

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FIG. 1

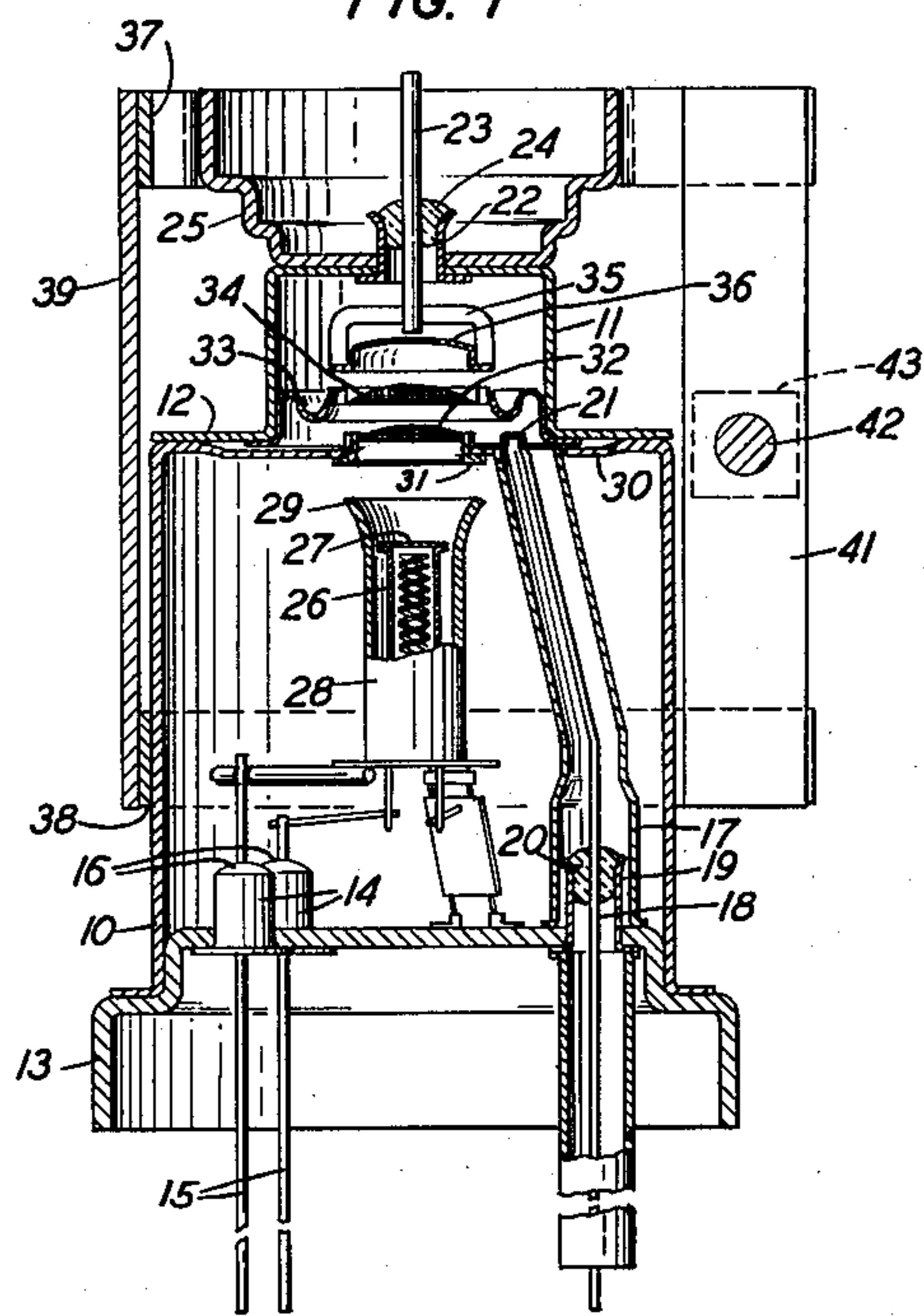
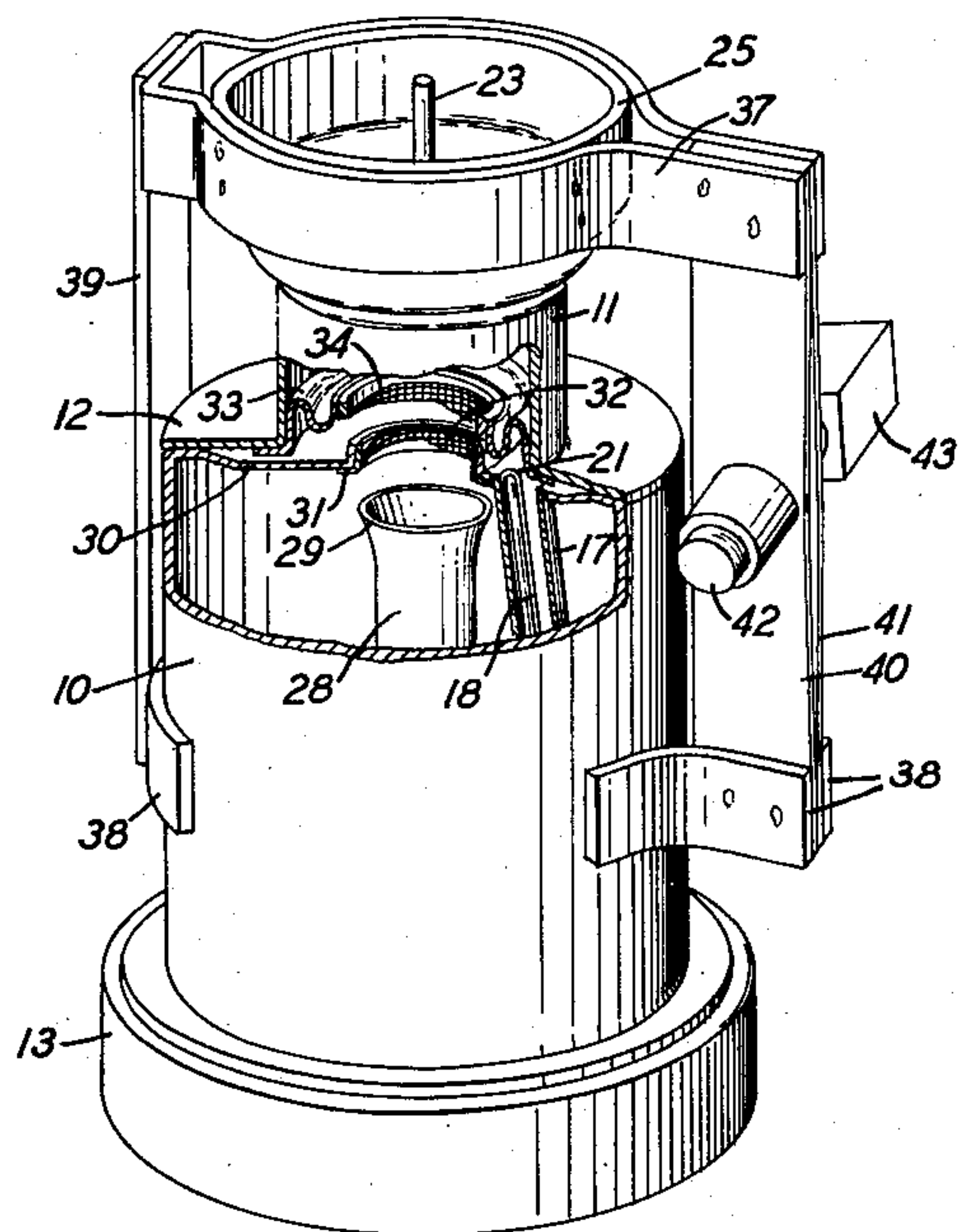


FIG. 2



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ELECTRON DISCHARGE DEVICE

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4 Claims. (Cl. 250—27.5)

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This invention relates to electron discharge devices and more particularly to such devices operable at very high frequencies, such as frequencies corresponding to wave-lengths in the centimeter range, and embodying cavity resonator type circuits associated with the electrodes.

In one form of ultra-short wave electron discharge device of the general construction disclosed in the application Serial No. 388,043, filed April 11, 1941, of John R. Pierce, a cavity resonator is provided within the enclosing vessel of the device, the resonator being defined by a pair of electrodes and a portion of the enclosing vessel. The resonant frequency of such a resonator is dependent upon the form and dimensions of the resonator, and small changes in the form and dimensions are attended by relatively large changes in the resonant frequency of the resonator.

Practical mechanical considerations and manufacturing tolerances do not allow ready design of such resonators to have the extremely accurate determination of the resonant frequency thereof necessary for optimum operation of the device in the centimeter wave-length range. Furthermore, for any given device, capability of operation at any frequency within a relatively wide band of frequencies may be desirable and realization of this desideratum entails tuning of the resonator to the desired operating frequency.

One object of this invention is to enable the accurate tuning of cavity resonators. More specifically, one object of this invention is to facilitate the accurate tuning of cavity resonators in electron discharge devices wherein the cavity resonant is within the enclosing vessel of the device.

One illustrative embodiment of this invention comprises an enclosing vessel including two hollow, for example cylindrical, sections of metal in end to end relation and joined at the juxtaposed ends by a flexible member, such as a metallic annulus which constitutes a wall portion of the enclosing vessel. A pair of electrodes are mounted within the enclosing vessel and related with the flexible member so as to define therewith a cavity resonator.

In accordance with one feature of this invention, a linkage including a toggle element is provided external to the enclosing vessel and coupling the two hollow sections, the toggle element being adjustable to effect flexure of the flexible member and thus to alter the form of the cavity resonator. In one specific form, this linkage comprises a pair of bands secured to the hollow sections and connected by a toggle element including a pair of strips mounted in face to face relation and having a micrometer screw threaded thereto whereby the strips may be bowed relative to one another and the effective length of the toggle element thereby adjusted.

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The invention and the above-noted and other features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawing in which:

Fig. 1 is a side view mainly in section of an electron discharge device illustrative of one embodiment of this invention; and

Fig. 2 is an enlarged perspective view, partly in section, of the device illustrated in Fig. 1 showing the cavity resonator defining elements and the tuning mechanism therefor.

Referring now to the drawing, the electron discharge device illustrated in Fig. 1 comprises an enclosing vessel including a metallic shell having a cylindrical portion 10 and an inverted cup-shaped portion 11 coaxial with the portion 10 and joined thereto by a flexible, metallic annular wall member 12, which may be integral with the cup-shaped portion 11 as shown. The cylindrical portion 10 is closed at one end by a base or header 13, for example of metal, having hermetically joined thereto a plurality of metal eyelets 14 through which leading-in conductors 15 extend and to which the conductors are sealed hermetically by vitreous beads 16. Also secured to the base or header is a coaxial transmission line which includes an outer tubular conductor 17 and an inner conductor 18 hermetically sealed to an eyelet 19 by a vitreous bead 20, the inner conductor 18 being looped at its inner end as shown at 21 and connected to the outer conductor 17 at the inner end thereof.

The cup-shaped portion 11 has hermetically joined thereto a metallic eyelet 22 through which a leading-in conductor 23 extends, the conductor 23 being sealed hermetically to the eyelet 22 by a vitreous bead 24. Seated upon and secured to the end wall of the cup-shaped portion 11 is a cup-shaped metallic shield or support 25.

Mounted upon the base or header 13 is an electron gun which comprises a cylindrical indirectly heated cathode 26 having an electron emissive surface 27 and a cylindrical beam-forming electrode 28 coaxial with and encompassing the cathode, the beam-forming electrode having a flared inner end 29.

As shown clearly in Fig. 2, the metallic portion 10 of the enclosing vessel is provided with an inwardly extending annular flange 30 underlying the flexible wall member 12, and having a central tubular portion 31 across which a dished grid 32 extends. The flange 30 is provided with an aperture in which the outer coaxial conductor 17 is fitted.

Mounted within the cup-shaped portion 11 is an annular metallic support 33 which carries a dished grid 34 opposite and axially aligned with the grid 32 and conforming thereto.

The leading-in conductor 23 supports a metallic bridge or yoke 35 which mounts a dished target

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or reflecting electrode 36 opposite and in alignment with the grid 34.

The grids 32 and 34 together with the supports 30, 31 and 33 therefor and the annular wall 12 define a cavity resonator which is excited during the operation of the device and from which energy may be taken by way of the coaxial transmission line 17, 18.

During operation of the device, for example, as an oscillation generator, the electrons emanating from the cathode surface 27 are concentrated into a beam which is projected through the grids 32 and 34 and toward the target or reflecting electrode 36. In traversing the gap between the grids 32 and 34, the electrons are influenced by the high frequency field between these grids and are thus velocity varied so that the beam issuing from the grid 34 is composed of accelerated and decelerated electrons. In the space between the grid 34 and the target or reflecting electrode 36, the electrons are reversed in direction and are then projected in time spaced groups back into the gap between the grids in such phase relation as to deliver energy to the field within the cavity resonator whereby oscillations are produced and sustained.

The frequency of these oscillations will be dependent upon, among other factors, the resonant frequency of the cavity resonator. Efficient operation requires that this resonator be tuned accurately to the desired operating frequency. This invention enables the realization not only of such accurate tuning but also thereof in an expeditious manner.

The metallic portions 10 and 11 are coupled by a linkage of adjustable length whereby relative axial movement between the portions 10 and 11 of the enclosing vessel may be effected and, due to the flexure of the annular wall 12 and attendant relative movement between the grids 32 and 34, the configuration of the cavity resonator may be altered with a consequent change in the resonant frequency of the resonator. As shown particularly clearly in Fig. 2, this coupling linkage includes a metallic band 37 and 3 metal strips 38 secured to the shield 25 and the portion 10 of the enclosing vessel respectively. The band and strips are joined by a metallic strip 39 affixed thereto and by a toggle element including a pair of metallic strips 40 and 41 mounted in face to face relation and having a right-hand left-hand micrometer screw 42, extending therethrough and threaded to nuts 43 affixed, as by welding, to the strips 40 and 41.

Rotation of the screw 42 results in relative movement of the strips 40 and 41 to bow the strips either toward or away from one another. Such bowing of the strips results in a change in the effective length of the toggle element with a corresponding relative movement between the portions 10 and 11 of the enclosing vessel and flexure of the annular wall 12, and an attendant change in the resonant frequency of the cavity resonator.

It will be appreciated that very fine and accurate tuning of the resonator is thus enabled inasmuch as extremely small increments of displacement or movement may be imparted to the flexible wall member 12 by means of the great mechanical advantage provided by the toggle element. It will be appreciated further that such a toggle system, rigidly connected as it is to portions 10 and 11 of the enclosing vessel, admits of no appreciable or effective play or slack to be translated to the flexible wall member 12, and this obtains without the introduction of locking devices.

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Although a specific embodiment of the invention has been shown and described, it will be understood that various modifications may be made therein without departing from the scope and spirit of this invention as defined in the appended claims.

What is claimed is:

1. An electron discharge device comprising an enclosing vessel including a pair of spaced portions mounted in end to end relation and a flexible member connecting said portions, means including said flexible member defining a cavity resonator within said vessel, said cavity resonator having an aperture therein, electrode means adjacent thereto for exciting said resonator, and means for tuning said resonator, said tuning means including a pair of adjacent flexible members extending between said spaced portions and affixed thereto and means coupled thereto for adjustably flexing said adjacent flexible members.

2. An electron discharge device comprising an enclosing vessel including a pair of hollow portions mounted in end to end relation and a flexible member connecting the opposed ends of said portions, means bounding a cavity resonator within said vessel, said means including an electrode supported from one of said hollow portions and a second electrode supported from the other of said hollow portions, electrode means adjacent thereto for energizing said resonator and means for tuning said resonator, said tuning means comprising a pair of adjacent strip members extending between and having their ends secured to said hollow portions and means coupled thereto for adjustably bowing said strip members.

3. An electron discharge device comprising a pair of members having juxtaposed electrode portions, means including said members and a flexible wall member defining a cavity resonator, said flexible wall member extending between and connecting said pair of members, electrode means adjacent thereto for energizing said cavity resonator, and means for tuning said resonator, said tuning means comprising a pair of strip members mounted adjacent one another and in face to face relation, means rigidly connecting said strip members at opposite ends to said pair of members, and a micrometer means coupling said strip members to one another and effective to bow said strip members normal to the faces thereof.

4. An electron discharge device comprising an enclosing vessel including a pair of hollow members in end to end relation and a flexible wall connecting the opposed ends of said hollow members, means bounding a cavity resonator within said vessel, said means including said flexible wall, an electrode mounted from one of said hollow members and a second electrode in juxtaposition to said first electrode and mounted from the other of said hollow members, one of said electrodes having an apertured portion, means within said vessel for projecting an electron stream into said resonator through said apertured portion, and means for tuning said resonator, said tuning means comprising a pair of bands each secured to a corresponding one of said hollow members, a pair of adjacent strip members mounted in face to face relation and secured at their ends to said bands, and a micrometer screw threadably coupled to both of said strip members and effective to flex said strip members relative to one another.

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