Feb. 15, 1938. C. A. BIELING 2,108,640

ELECTRON DISCHARGE APPARATUS

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FIG. 1

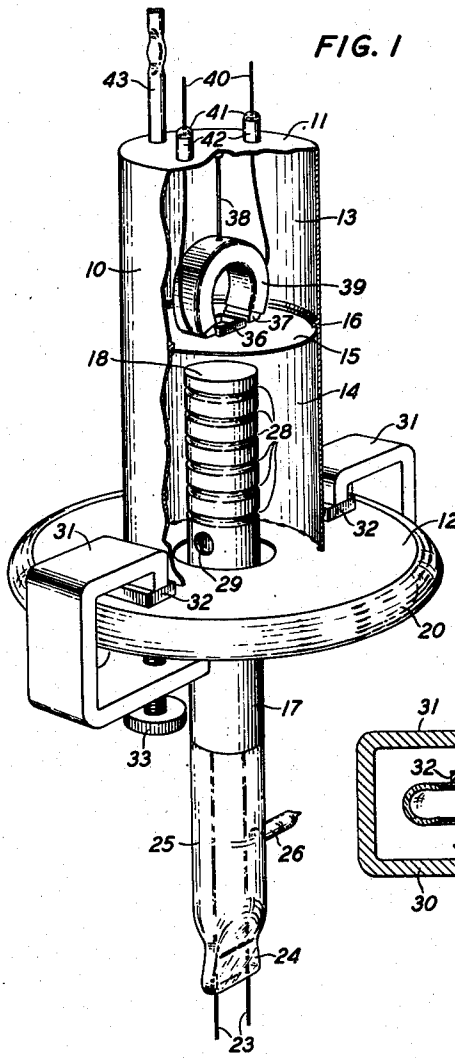
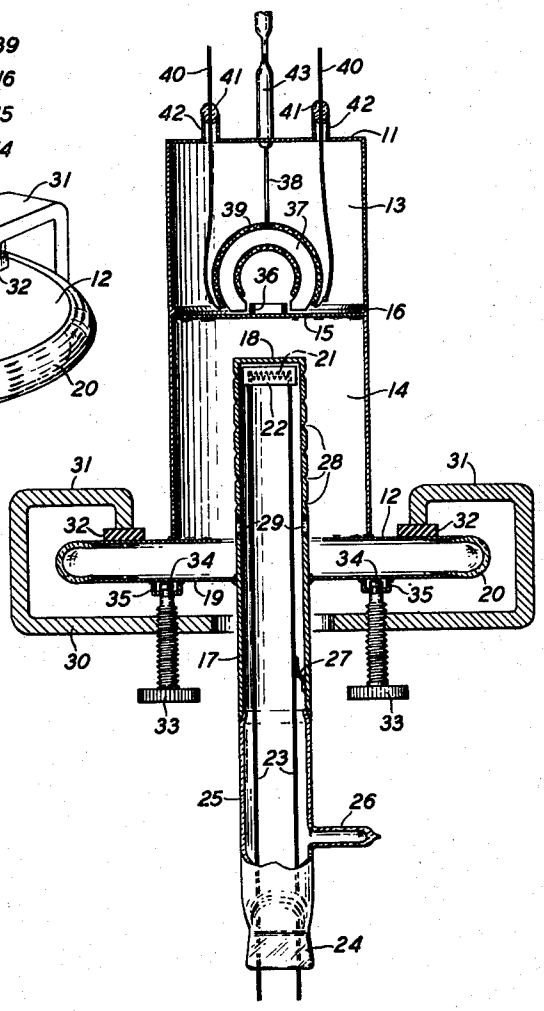


FIG. 2



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ELECTRON DISCHARGE APPARATUS

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11 Claims. (Cl. 250—27.5)

This invention relates to electron discharge apparatus and more particularly to electron discharge devices capable of generating ultra-high frequency impulses, for example impulses of frequencies of the order of 3,000 kilocycles per second.

One object of this invention is to efficiently generate ultra-high frequency oscillations.

Another object of this invention is to enable adjustment of the interelectrode impedances in electron discharge devices whereby the tuning of circuits including such devices is facilitated.

A further object of this invention is to enable and to expedite modulation of the output currents of ultra-high frequency electron discharge devices.

In one illustrative embodiment of this invention, a diode oscillator comprises a cylindrical casing or shell, which may be of metal, divided into two chambers by a flexible metallic diaphragm constituting a portion of the anode of the device. The casing or shell is provided at one end with an annular metallic flange through which an elongated metallic cathode extends into one of the chambers, the cathode including a sleeve having a flat portion adjacent the diaphragm coated with a thermionic material. The metallic sleeve is mounted upon a flexible metallic annulus disposed adjacent the annular flange and forming a condenser therewith. The metallic annulus may be flexed to vary the spacing between the juxtaposed surfaces of the cathode and the anode and also the spacing between the flange and this annulus whereby the interelectrode impedances and the tuning of the anode-cathode circuit are adjusted.

Disposed within the other chamber of the casing or shell is an actuating means for vibrating the metallic diaphragm in accordance with a desired signal whereby the spacing between the juxtaposed surfaces of the anode and cathode is varied and modulation of the output current of the device in accordance with the signal results.

The invention and the various 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 an elevational view in perspective of an electron discharge device constructed in accordance with this invention, a portion of the casing or shell being broken away to show the internal elements more clearly; and

Fig. 2 is an elevational view in cross-section of the electron discharge device shown in Fig. 1.

Referring now to the drawing, the electron discharge device therein shown comprises a cylindrical metallic shell or casing 10 closed at one end by an integral metallic disc 11 and having at the other end an annular metallic flange 12, which may be suitably secured to the casing or shell 10 and extends at right angles to the longitudinal axis thereof. The shell or casing 10 is divided into two chambers 13 and 14 by a flexible metallic disc or diaphragm 15 seated upon and secured to an annular seat 16, the diaphragm serving as the principal electron receiving element of the device.

Extending through the annular flange 12 and into the chamber 14 is a metallic cylindrical member 17 having a disc end portion 18 disposed parallel to the diaphragm 15 and coated on its surface toward the diaphragm with an efficient electron emitting material, such as alkaline earth metal oxides. The cylindrical member 17 preferably is coaxial with the casing 10 and is mounted upon and hermetically sealed to a flexible metallic disc or diaphragm 19 substantially coextensive with and parallel to the annular flange 12. The diaphragm 19 and the flange 12 are sealed hermetically at their peripheries to an annulus 20 of vitreous material and form a condenser with each other coupling the anode or diaphragm 15 and the disc portion 18 of the cathode.

A heater filament 21 encased in insulating material 22 is disposed within the cylindrical member 17 and in immediate proximity to the emitting portion 18. The heater filament may be supported by rigid leading-in conductors 23 embedded in and extending through an external press 24 on an insulating sleeve 25, which is hermetically sealed to the metallic cylinder 17 and is provided with an exhaust tubulature 26. The cylinder 17 may be connected electrically to one of the leading-in conductors 23 by a tie wire 27. This tie wire 27 may be omitted and electrical connection to the cathode made by a suitable conductor affixed externally to the sleeve 17. In order to provide a sharp temperature gradient along the cylindrical member 17 and thereby to assure concentration of heat at the emitting portion 18, the cylindrical member 17 may be provided with a series of annular grooves 28 in its outer surface. It may be provided also with apertures 29 to allow evacuation of the chamber 14 through the tubulature 26.

Preferably the sleeve or cylinder 17 extends below the diaphragm 19 for a relatively large distance so that it shields the heater 21 and the leads 23 therefor from the high frequency

fields extant in the device and thereby minimizes high frequency losses in the heater element and the leading-in conductor therefor.

The electron discharge device may be mounted on a yoke-shaped member having a base 30 and arms 31 which bear against insulating spacers or blocks 32 upon the flange 12. A plurality of thumb screws 33 are threaded through the base 30 and have head portions 34 rotatably fitted in socket members 35 secured to the flexible disc or diaphragm 19.

The anode 15 and cathode 18 may be suitably connected as known in the art to generate oscillations of very high frequencies, for example of the order of 3,000 kilocycles per second. The oscillating frequency is dependent upon, among other factors, the interelectrode impedances. These may be adjusted readily in accordance with this invention, and hence the oscillating frequency varied throughout a relatively wide range. Specifically, rotation of the thumb screws 33 will flex the diaphragm 19 so that the capacitance of the condenser formed by the diaphragm 19 and the flange 12 will be varied. Such manipulation of the thumb screws enables also adjustment of the spacing between the electrodes 15 and 18 and a corresponding adjustment in the interelectrode impedances.

The high frequency field between the anode and the cathode of the device may be modulated in accordance with a suitable signal by vibrating the anode diaphragm 15 by an electrodynamic, electrostatic or electromagnetic mechanism whereby the spacing between this diaphragm and the cathode member 18 is varied. For example, the diaphragm 15 may be vibrated through an electrodynamic drive including a substantially rectangular armature 36 of magnetic material affixed to the diaphragm, which is disposed between the poles of a horseshoe magnet 37. The magnet 37 is supported within the chamber 13 by a strut 38 extending from the end closure member 11, and has wound thereon a suitable field or energizing coil 39. The coil 39 may be associated with an external circuit through leading-in conductors 40 sealed in insulating beads 41 which are hermetically sealed in tubulations or sockets 42 on the disc 11.

The chamber 13 may be evacuated through an exhaust tubulature 43 extending from the disc 11. Preferably the chambers 13 and 14 are exhausted to the same degree so that the static pressures upon opposite sides of the diaphragm are substantially in equilibrium.

Although a specific embodiment of this invention has been shown and described, it will be understood, of course, that this embodiment is merely illustrative and 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 means forming a chamber, including a metallic diaphragm constituting the anode of the device, a cathode in cooperative relation with said anode, flexible means mounting said cathode in said chamber, means for flexing said mounting means to vary the spacing between said cathode and said anode, and means for vibrating said diaphragm.

2. An electron discharge device comprising a cup-shaped metallic member constituting an electrode of the device, a flange at the open end of said cup-shaped metallic member and electrically connected thereto, an electrode assembly including a portion within said cup-shaped metallic member and a flexible metallic member adjacent said flange and forming a condenser therewith, and means for flexing said flexible member to vary the capacitance of said condenser.

3. An electron discharge device comprising a cylindrical metallic shell constituting an electrode, an annular metallic flange mounted on said shell, another electrode within said shell having a tubular portion coaxial therewith, a metallic disc electrically connected to said second electrode and disposed adjacent to and coaxial with said flange, said flange and said disc forming a condenser, and means for varying the capacitance of said condenser.

4. An electron discharge device comprising a metallic enclosing vessel having a cylindrical portion and a substantially plane portion on said cylindrical portion, a flange on said cylindrical portion remote from said plane portion, a flexible disc member insulatingly joined to said flange and forming a condenser therewith, and an electrode mounted on said disc member and electrically connected thereto including a cylindrical portion coaxial with said first cylindrical portion and a substantially plane portion parallel to said first plane portion.

5. An electron discharge device comprising a metallic shell constituting the anode of the device and having a rigid metallic flange adjacent one end thereof, a flexible metallic disc adjacent said flange and parallel thereto, insulating means spacing said flange and said disc and sealed to the peripheries thereof, an electrode mounted on said disc and having a portion within said shell, yoke means engaging said flange and having a portion adjacent said disc, and adjustable means mounted on said yoke means and engaging said disc.

6. An electron discharge device comprising a cylindrical shell, means closing the ends of said shell, a metallic diaphragm dividing said shell into two closed chambers, said diaphragm constituting an electron receiving member, an electron emitting member in one of said chambers and in cooperative relation with said diaphragm, and electro-mechanical energy converting means in the other of said chambers for vibrating said diaphragm.

7. An electron discharge device in accordance with the next preceding claim wherein said chambers are evacuated to substantially the same degree.

8. An electron discharge device comprising a cylindrical shell closed at its ends, a metallic diaphragm mounted within said shell and dividing it into two chambers, said diaphragm constituting an electron receiving member, an electron emitting electrode in one of said chambers having a disc portion parallel and in juxtaposition to said diaphragm, an armature within the other of said chambers and connected to said diaphragm, and an electromagnet within said other chamber and in cooperative relation with said armature.

9. An electron discharge device comprising a cylindrical shell, a pair of diaphragms mounted on said shell in spaced substantially parallel relation, one of said diaphragms constituting an electrode, another electrode mounted on the other of said diaphragms and having a portion in juxtaposition to said one diaphragm, means for vibrating said one diaphragm, and means for flexing said other diaphragm to vary the space relation of said electrodes.

10. An electron discharge device comprising a cylindrical metallic member having an annular metallic flange, a metallic diaphragm electrode mounted on said cylindrical metallic member in spaced relation to said flange and substantially parallel thereto, a metallic diaphragm adjacent said flange and forming a condenser therewith, an electrode mounted on said diaphragm and having a portion in juxtaposition to said diaphragm electrode, means for flexing said diaphragm to vary the capacitance of said condenser, and means for vibrating said diaphragm electrode.

11. An electron discharge device comprising a cylindrical metallic enclosing vessel having an annular metallic flange at one end, a metallic diaphragm within said vessel and dividing it into two chambers, an annular flexible metallic member adjacent and substantially parallel to said flange and forming a condenser therewith, insulating means sealed to said flange and to said flexible member at the peripheries thereof, an electrode mounted on said flexible member and having an electron emitting portion within one of said chambers and in juxtaposition to said diaphragm, means for adjusting the spacing between said flange and said flexible member, and means within the other of said chambers for vibrating said diaphragm.

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