

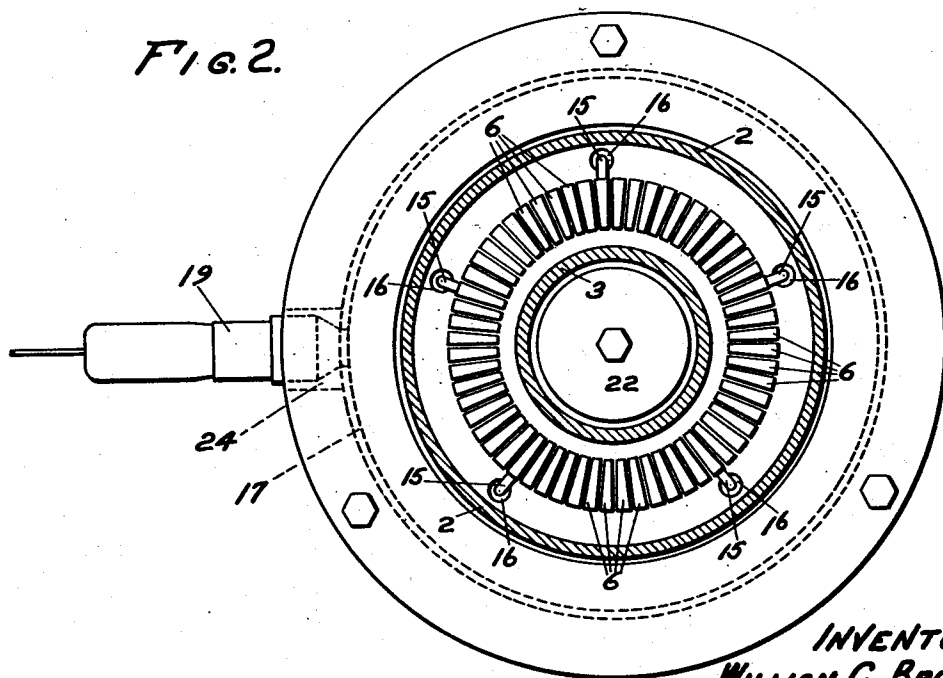
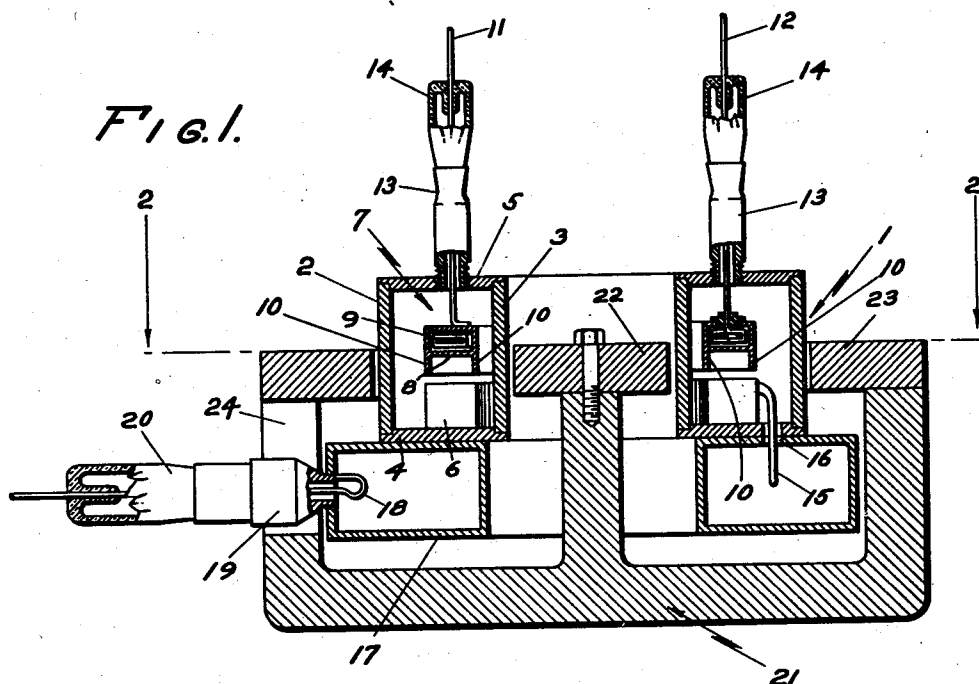
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ELECTRON DISCHARGE DEVICE OF THE MAGNETRON TYPE

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ELECTRON DISCHARGE DEVICE OF THE
MAGNETRON TYPE

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8 Claims. (Cl. 315—5)

1

This invention relates to an oscillator for the generation of ultra high frequency oscillations having wave lengths of the order of a few centimeters or less.

Where a magnetron of the multiple anode type is used as a generator in systems of the above kind, it is often desirable, particularly where large amounts of power are desired, to provide a large number of anode elements interconnected by resonant cavities. However, in such arrangements it is difficult to propagate the generated energy throughout the tube structure to the usual type of output coupling devices with the result that such devices have been relatively less effective as the anode sections have been increased to large numbers.

In magnetrons of the above type a tendency also exists for the oscillator to operate not only at the desired frequency, but at various spurious frequencies which decrease the efficiency and effectiveness of the device.

An object of this invention is to provide an oscillator of the foregoing type in which the energy from each of the oscillating anode sections is fed more effectively into the output system.

Another object is to couple the anode structure to a common cavity resonator by means of probe electrodes at a plurality of points whereby energy may be fed from each of said points directly into said common cavity resonator.

Another object is to eliminate the tendency of the oscillator to generate spurious oscillations whereby substantially all of the oscillating energy is concentrated in the desired wave length.

The foregoing and other objects of this invention will be best understood from the following description of an exemplification thereof, reference being had to the accompanying drawing wherein:

Fig. 1 is a vertical cross-section of an arrangement constructed in accordance with my invention; and

Fig. 2 is a cross-section taken along line 2—2 of Fig. 1.

The magnetron illustrated in the drawing comprises a casing 1 consisting of an outer cylinder 2, an inner cylinder 3, a bottom annular wall member 4, and a top annular wall member 5. The above members are preferably made of highly conductive material, such as copper, and are soldered together so as to form a hermetically sealed annular discharge chamber. Within the discharge chamber the upper surface of the bottom wall member 4 supports a plurality of anode elements 6, the upper faces of which are adapted

2

to receive electrons emitted from the emitting surfaces of a cathode 7. The anode elements 6 are likewise formed of highly conductive material, such as copper, and are spaced from each other to provide intervening cavity resonators each of which is resonant to the desired output frequency.

The cathode 7 may be of the indirectly heated thermionic type comprising a hollow annular cathode member 8 formed of suitable conducting material, such as nickel, and coated on its lower surface with suitable electron emitting oxides. Within the member 8 is supported a heater filament 9. Shielding members 10 may be provided extending from opposite sides of the cathode emitting surface to prevent electrons from passing into regions other than the cathode-anode discharge space. A lead-in conductor 11 is connected to the hollow member 8. One end of the heater 9 is also electrically connected to the member 8, the other end of said heater being connected to a lead-in conductor 12 which is suitably insulated from the member 8. The heater 9 may be suitably coated with insulating material so as to prevent electric contact with the member 8, except as above indicated. The lead-in conductors 11 and 12 extend through pipes 13 hermetically sealed through the top member 5. Said lead-in conductors also pass out through glass seals 14 carried at the outer ends of said pipes 13.

In order to generate a large amount of power a large number of anode elements 6 are provided. Sixty such elements are utilized in the embodiment shown in the drawing. Although such an arrangement might be capable of operating in various modes, each of which produces a different frequency of oscillation, the desired mode of oscillation is that in which alternate anode elements are of opposite voltage phase. Thus, at each instant thirty complete wave lengths of the oscillations would exist around the anode structure. In order to couple the generated energy into an output device, a plurality of coupling conductors 15 are connected to predetermined anode elements 6 and extend through openings 16 in the bottom wall member 4 into a common cavity resonator 17. The cavity resonator 17 likewise is formed of conducting material and is hermetically soldered to the bottom wall member 4. The lower end of the conductors 15 thus extend into the cavity resonator 17 and form probes which excite the same to oscillate at the desired output frequency. In order that energy may be fed from the probes 15 into the cavity resonator 17 in the proper way, said probes 15 are spaced

3

from each other by a distance equal to the length of the high frequency wave which is set up within the resonator 17. This wave length will depend upon the physical dimensions of the cavity resonator 17 and thus by proper design thereof said wave length can be adjusted to the spacing between the probes 15 within certain limits. Also in order for the probes 15 to feed energy into the cavity resonator 17 in the proper way, each said probes 15 should be of the same voltage phase. By spacing the probes 15 an even number of anode elements apart it will be seen that the above condition is satisfied particularly when the device is oscillating in the desired mode as above described. Thus in the embodiment illustrated in the drawing the probes 15 are spaced twelve anode elements apart.

The energy which is propagated through the cavity resonator 17 is led off by means of a suitable loop 18, one end of which is electrically connected to a pipe 19 hermetically sealed through a side wall of the cavity resonator 17. The other end of said coupling loop 18 extends through said pipe 19 and passes out through a glass seal 20 carried at the outer end of said pipe 19.

A magnet 21 provides the magnetic field for the magnetron. This magnet is formed with a central circular pole piece 22 and an outer annular pole piece 23 concentrically disposed with respect to the pole piece 22. In this way a radial magnetic field is created transverse to the discharge path between the cathode 7 and the anode elements 6. The magnet 21 is cut away at 24 in order to allow the pipe 19 and its seal 20 to project therethrough, while the pole pieces 22 and 23 may be attached separately to allow for ready assembly of the tube with the magnet structure.

In such an arrangement as described above, the energy which is generated within each cavity resonator between adjacent anode elements 6 is readily propagated through a relatively short distance to a probe 15 and thus is effectively and efficiently transferred into the common cavity resonator 17, and thus into the output. In addition, the presence of the common cavity resonator 17 has a frequency stabilizing effect upon the entire device and tends to cause the tube to oscillate only in the desired mode described above, other undesired modes tending to be suppressed. Thus oscillators built in accordance with my invention can deliver large amounts of power in an efficient and effective manner.

Of course it is to be understood that this invention is not limited to the particular details as described above as many equivalents will suggest themselves to those skilled in the art. It is accordingly desired that the appended claims be given a broad interpretation commensurate with the scope of the invention within the art.

What is claimed is:

1. An electron-discharge device comprising: an envelope enclosing a cathode and an anode structure; said anode structure including a plurality of anode elements forming a plurality of cavity resonators each of which is adapted to resonate at a predetermined output frequency; a common cavity resonator adapted to resonate at said predetermined output frequency; and a plurality of spaced probe electrodes projecting into said common cavity resonator; said probe electrodes being connected, respectively, to anode elements which are spaced from each other by a distance equal to an integral number of wave lengths corresponding to said predetermined output frequency.

2. An electron-discharge device comprising: an

4

envelope enclosing a cathode and an anode structure; said anode structure including a plurality of anode elements forming a plurality of cavity resonators each of which is adapted to resonate at a predetermined output frequency; a common cavity resonator adapted to resonate at said predetermined output frequency; a plurality of spaced probe electrodes projecting into said common cavity resonator; said probe electrodes being connected, respectively, to anode elements which are spaced from each other by a distance equal to an integral number of wave lengths corresponding to said predetermined output frequency; and output means coupled to said common cavity resonator.

3. An electron-discharge device comprising: an envelope enclosing a cathode and an anode structure; said anode structure including a plurality of anode elements forming a plurality of cavity resonators each of which is adapted to resonate at a predetermined output frequency; a common cavity resonator adapted to resonate at said predetermined output frequency; and a plurality of spaced probe electrodes projecting into said common cavity resonator; said probe electrodes being connected, respectively, to anode elements which are spaced from each other by an even number of the same and by a distance equal to an integral number of wave lengths corresponding to said predetermined output frequency.

4. An electron-discharge device comprising: an envelope enclosing a cathode and an anode structure; said anode structure including an even number of circularly-disposed anode elements forming an even number of cavity resonators each of which is adapted to resonate at a predetermined output frequency; a common cavity resonator adapted to resonate at said predetermined output frequency; and a plurality of spaced probe electrodes projecting into said common cavity resonator; said probe electrodes being connected, respectively, to anode elements which are spaced from each other by an even number of the same and by a distance equal to an integral number of wave lengths corresponding to said predetermined output frequency.

5. A magnetron comprising: an envelope enclosing a cathode and an anode structure; said anode structure including a plurality of anode elements forming a plurality of cavity resonators each of which is adapted to resonate at a predetermined output frequency; a common cavity resonator adapted to resonate at said predetermined output frequency; a plurality of spaced probe electrodes projecting into said common cavity resonator; said probe electrodes being connected, respectively, to anode elements which are spaced from each other by a distance equal to an integral number of wave lengths corresponding to said predetermined output frequency; and means adjacent said cathode and said anode structure for producing a magnetic field transverse to the discharge path therebetween.

6. A magnetron comprising: an envelope enclosing a cathode and an anode structure; said anode structure including a plurality of anode elements forming a plurality of cavity resonators each of which is adapted to resonate at a predetermined output frequency; a common cavity resonator adapted to resonate at said predetermined output frequency; a plurality of spaced probe electrodes projecting into said common cavity resonator; said probe electrodes being connected, respectively, to anode elements which are spaced from each other by a distance equal to an integral

5

number of wave lengths corresponding to said predetermined output frequency; output means coupled to said common cavity resonator; and means adjacent said cathode and said anode structure for producing a magnetic field transverse to the discharge path therebetween.

7. A magnetron comprising: an envelope enclosing a cathode and an anode structure; said anode structure including a plurality of anode elements forming a plurality of cavity resonators each of which is adapted to resonate at a predetermined output frequency; a common cavity resonator adapted to resonate at said predetermined output frequency; a plurality of spaced probe electrodes projecting into said common cavity resonator; said probe electrodes being connected, respectively, to anode elements which are spaced from each other by an even number of the same and by a distance equal to an integral number of wave lengths corresponding to said predetermined output frequency; output means coupled to said common cavity resonator; and means adjacent said cathode and said anode structure for

6

producing a magnetic field transverse to the discharge path therebetween.

8. A magnetron comprising: an envelope enclosing a cathode and an anode structure; said anode structure including an even number of circularly-disposed anode elements forming an even number of cavity resonators each of which is adapted to resonate at a predetermined output frequency; a common cavity resonator adapted to resonate at said predetermined output frequency; a plurality of spaced probe electrodes projecting into said common cavity resonator; said probe electrodes being connected, respectively, to anode elements which are spaced from each other by an even number of the same and by a distance equal to an integral number of wave lengths corresponding to said predetermined output frequency; and means adjacent said cathode and said anode structure for producing a magnetic field transverse to the discharge path therebetween.

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