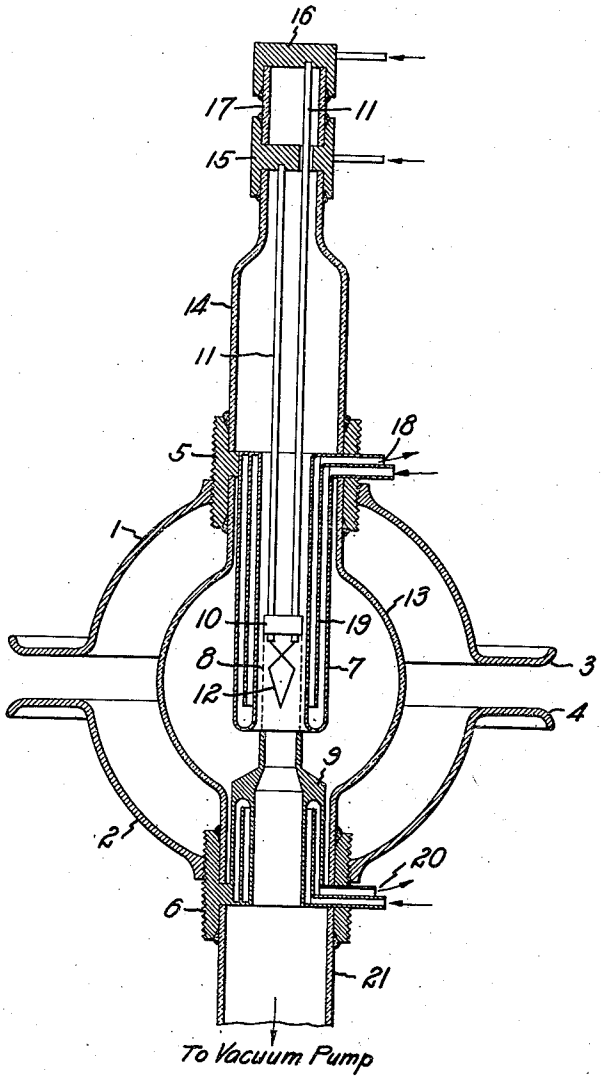
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HIGH FREQUENCY OSCILLATOR

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HIGH FREQUENCY OSCILLATOR

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13 Claims. (Cl. 250—36)

This invention relates to a high frequency oscillator, and more particularly to an ultra-high frequency oscillator of the type in which the frequency determining elements of the oscillator are built into or otherwise closely associated with the tube structure.

The so-called hollow chamber resonator has been employed in such oscillators in view of its freedom from undesired radiation from the oscillating system. The hollow chamber resonator comprises two symmetrical bowls terminating in radial flanges that are spaced from each other, the bowls being conductively or capacitively connected to an axial conductor of substantial dimensions and the spaced flanges of the bowls providing to a large extent the capacitive reactance of the resonator. It has been proposed to locate the elements of the oscillator tube within the hollow chamber resonator by covering a part of the axial conductor with an electron emitting layer to function as a cathode, the other tube elements being coaxial with the cathode section of the axial conductor. Feedback to promote oscillation was obtained by insulating the axial conductor from and capacitively coupling it to the two resonator bowls, and conductively connecting the anode and control grid of the tube to the respective bowls at points adjacent the axis of the tube and hollow chamber resonator. The normal three-point connections of an electron tube oscillator were then made to the axial conductor or cathode, and to the bowls which, as stated, were connected to the anode and control grid respectively.

The theoretically very favorable construction of these known transmitting tube arrangements results, however, in a very complicated structure when the tubes are designed for high outputs and the electrodes, or at least the anode is water cooled. It is also undesirable that the electrical oscillating system be located inside the tube bulb as it is not possible to adjust the frequency of oscillation within adequate limits.

An object of the present invention is to provide an electron tube and high frequency oscillation generator that overcomes the disadvantages of the prior devices in that the tube is arranged within the hollow chamber resonator, thereby permitting adjustment of the bowls of the resonator to alter the frequency of the generated oscillations. An object is to provide an ultra-high frequency oscillator tube or oscillator of the hollow chamber resonator type in which the usual axial conductor between the resonator bowls is omitted, and the anode and control grid of the tube are coaxial with the bowls and connected to the respective bowls, the anode-grid capacity thus constituting the feed-back coupling between the resonator bowls. A further object is to provide an oscillator tube in which the tube envelope includes externally threaded sleeves, and the resonator bowls are threaded upon the sleeves, whereby the spacing of the bowls may be varied by rotating one or both of the bowls. Another object is to provide a small oscillator tube in which the envelope includes insulating and metallic sections that may be dismantled, one insulating section being a tube or cylinder for connection to a vacuum pump.

These and other objects and advantages of the invention will be apparent from the following specification when taken with the accompanying drawing in which the single view is a longitudinal section through an embodiment of the invention.

In the drawing, the reference numerals 1 and 2 identify the two bowls or shells that form an approximately spherical hollow chamber resonator, the shells terminating at their adjacent ends in parallel flanges 3, 4, respectively. The other ends of the shells 1 and 2 are threaded upon and thereby adjustable along sleeves 5, 6, respectively, that form a part of the envelope of the oscillator tube. One end of a cylindrical anode 7 of the tube extends into and is conductively connected to the sleeve 5, and the control grid element is mounted in a similar manner on the sleeve 6. The grid element comprises a cylindrical control section 8 and a tubular extension or supporting section that is fitted into the inner bore of the sleeve 6. The upper end of the control grid 8 may be, and preferably is, supported on an insulating disk 10 on the leads 11 of the cathode 12.

The tube envelope between the sleeves 5, 6 comprises a bulb 13 that may be of glass in the case of low power oscillator tubes, but the bulb 13 should be of quartz in high power tubes to meet the high thermal and electrical stresses. A tubular member 14, preferably of quartz, is secured to and extends above the sleeve 5 to support a circumferentially flanged metal disk 15 to which one lead 11 of the cathode is connected, the disk 15 being apertured to pass the other cathode lead 11 that extends to the flanged disk 16 that is spaced from disk 15 by an insulating cylinder 17 that may be, and preferably is, of quartz. Only two leads 11 are required when the cathode 12 is directly heated, but it is

to be understood that an additional disk and spacing tubular member of insulating material may be provided in the case of an indirectly heated cathode.

It has been found that the desired feed-back conditions can be best established when, as described, both cathode leads 11 are at the anode side of the tube. It is then possible to adjust the anode-cathode impedance to a suitable value by means of additional capacities between the cathode leads 11 and the sleeve 5. It has been proved desirable to have the external capacity between the flanges of the resonator shells 1, 2 of about the same order as the grid-anode capacity.

When the anode is to be cooled, the water connections 18 extend through the sleeve 5 and the anode 7 is formed as a double-walled cylinder of annular cross-section, with an interior wall 19 that divides the space within the double walls into two communicating cylindrical chambers. The grid may be cooled in a similar manner by water connections 20 that pass through the sleeve 6 and open into cooling passages in the grid support 9.

One end of the envelope is sealed by the cathode lead disk 16, and a tube 21 is sealed into the grid sleeve 6 to provide a connection to the vacuum pump. The tube 21 may be fused off after the envelope is evacuated and gettered but, for maximum power output at ultra-high frequencies, the tube dimension may be kept to a minimum by connecting the tube 21 to a high vacuum pump (not shown) that is operated while the oscillator is in service. The insulating sections 13, 14, 17 and at least the upper end of tube 21 should be of quartz to resist the thermal and electrical stresses but it is very difficult to fuse quartz to metal and reliable joints are obtained only if glass is used between the quartz and the metal. These glass connecting sections would increase the dimensions of the tube structure and, as is well known, the power output of an ultra-high frequency oscillator tube decreases with the size of the tube. The evacuation of the tube envelope by a vacuum pump during operation of the oscillator has the further advantage that the quartz and metal parts may be connected by joints that are easily separated, thus permitting a ready replacement of any parts that need renewal. The tubular ends of the quartz members 13, 14 and 17, and the upper end of tube 21 which also is of quartz, slide into cylindrical sockets in the associated metal parts and are cemented in place to provide tight joints.

By suitably dimensioning the various elements, this being particularly easy for the semi-spherical bowls 1 and 2, it is also possible to ensure that on both sleeves 5 and 6 or at least in their vicinity, electrical zero points occur where the high frequency voltage amplitude is a minimum. The current connections for the anode and grid voltage source, although not shown in the drawing, are therefore best located on the sleeves 5 and 6.

The transmitting system or load circuit into which the oscillator works may be capacitively coupled to the flanges 3, 4 of the resonator shells. The oscillator frequency may be varied over a substantial range by rotating one or both of the shells 1 and 2 on the sleeves 5, 6, respectively, to alter the spacing of, and the capacity between, the flanges 3, 4 of the resonator shells.

The embodiment herein shown and described is particularly adapted for use as a transmitting tube as it develops a high power output at a very short wave lengths but the invention may be applied to other uses. It is to be understood that invention is not restricted to tubes for operation at a particular output level or at a particular frequency, and that various changes may be made in the several parts, their shapes and relationship without departing from the spirit of my invention as set forth in the following claims.

I claim:

1. An oscillation generator of the type comprising two semi-spherical shells, means extending axially of and coupling said shells to form a hollow chamber resonator, and an electron tube having the elements thereof within said shells, characterized by the fact that the grid element and anode element of said tube constitute said axially extending means coupling the shells.

2. An oscillation generator as claimed in claim 1, wherein each of said shells is conductively supported by a sleeve member, and said grid element and anode element include cylindrical portions fitted into the respective sleeves.

3. In an oscillation generator, a vacuum tube envelope including an insulating section extending between and mechanically connecting a pair of spaced and axially alined metallic sleeves, a pair of resonator half-shells and means supporting the same to the respective sleeves, said half-shells terminating at adjacent edges in radial flanges that provide a capacitive coupling between the half-shells, coaxial grid and anode members within said insulating section and supported by the respective shells, and a cathode cooperating with said grid and anode members.

4. In an oscillation generator, the invention as claimed in claim 3, wherein said supporting means of at least one of said resonator half-shells comprises means for adjusting that half-shell axially of its associated sleeve, whereby the capacity between said flanges is altered and the wave length of the generated oscillations thereby varied.

5. In an oscillation generator, the invention as claimed in claim 3, wherein said sleeves constitute terminals for establishing circuit connections to the grid and anode members.

6. In an oscillation generator, the invention as claimed in claim 3, wherein the leads of said cathode extend out of said insulating section of the envelope through the sleeve on which said anode member is supported.

7. In an oscillation generator, the invention as claimed in claim 3, in combination with a pair of insulating cylinders and conductive disks arranged alternately with the inner insulating cylinder secured to that sleeve which supports the anode element, and leads for said cathode connected to the respective disks, the inner disk being apertured to pass the lead of the outer disk.

8. In an oscillation generator, the invention as claimed in claim 3, in combination with a pair of insulating cylinders and conductive disks arranged alternately with the inner insulating cylinder secured to that sleeve which supports the anode element, and leads for said cathode connected to the respective disks, the inner disk being apertured to pass the lead of the outer disk, and the outer disk constituting an end closure of the envelope of the tube.

9. In an oscillation generator, the invention as claimed in claim 3, in combination with means secured to one of said sleeves to form a vacuum tight closure at the outer end of that sleeve, and

a tube secured to the other sleeve and adapted to be connected to a vacuum pump.

10. In an oscillation generator, the invention as claimed in claim 3, wherein the capacity between said resonator flanges is of the order of the capacity between said grid and anode elements.

11. In an oscillation generator, a vacuum tube envelope comprising a plurality of alternately arranged insulating sections and metallic sleeves, electrode elements within one of said insulating sections and including a cathode cooperating with a grid and anode, a hollow chamber resonator comprising shells mounted on certain of said sleeves and surrounding said electrode elements, and a tube secured to one sleeve and adapted to be connected to a high vacuum pump when the oscillation generator is in service, the insulating sections being detachably connected to the metallic sleeves.

12. In an oscillation generator, the invention as claimed in claim 3, wherein said anode member is hollow, in combination with water connections extending through the sleeve associated with said anode for cooling the same.

13. In an oscillation generator, the invention as claimed in claim 3, wherein said grid element includes a hollow supporting member, in combination with means including water connections extending through the sleeve associated with said grid member for cooling said supporting member and grid.

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