

March 1, 1949.

C. A. SEGERSTROM, JR
HIGH-FREQUENCY GENERATOR

2,462,909

Filed June 26, 1944

3 Sheets-Sheet 2

Fig. 8.

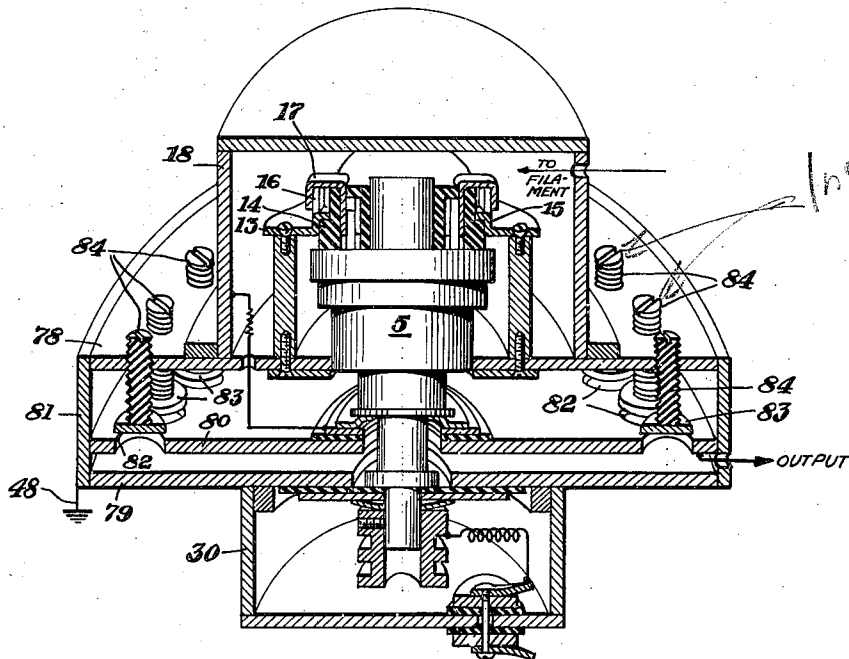
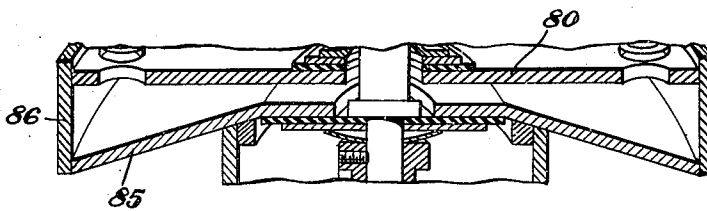


Fig. 9.



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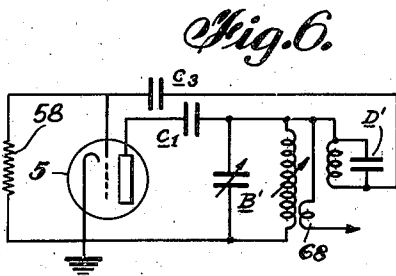
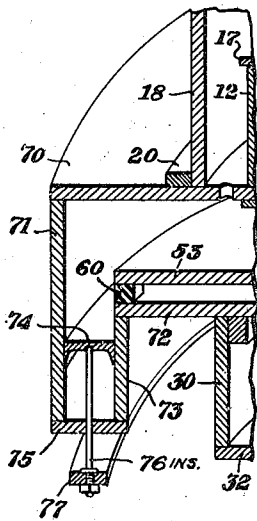
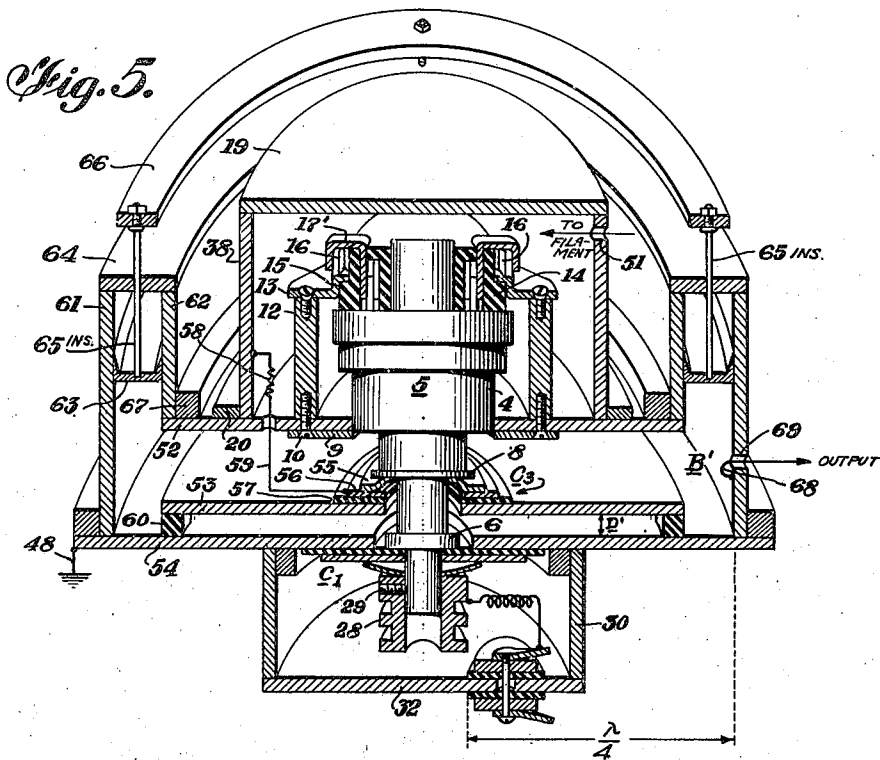
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HIGH-FREQUENCY GENERATOR

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27 Claims. (Cl. 315—5)

1

This invention relates to improvements in high frequency generators, and more particularly to such generators embodying resonant cavity structures with a vacuum tube or other electron discharge device inserted therein and forming part of the generator unit.

The primary object of this invention is directed toward providing an improved high frequency generator, by which term I intend to include at least both high frequency oscillators, i. e., self-excited generators, and high frequency amplifiers, i. e., externally excited generators.

One object of this invention is to provide a high frequency generator having a very high Q with resultant high stability at the frequencies for which it is designed.

Another object of this invention is to provide a high frequency generator having a minimum radiation.

Still another object of this invention is to provide a high frequency amplifier of extremely high gain.

A further object of this invention is the provision of a high frequency generator of maximum efficiency.

A still further object of this invention is directed toward providing a high frequency amplifier of improved selectivity.

An additional object of this invention is to provide a high frequency generator adapted to operate at higher frequencies than comparable prior art structures.

Generally speaking, it is an object of the present invention to further provide a high frequency generator which is simple in construction, employing wide tolerances, into which power may be easily injected and/or from which power may be easily withdrawn, and which permits a simple and easy changing of the enclosed tube.

I attain these objects by the constructions shown in the annexed drawings, wherein:

Fig. 1 is a vertical cross-sectional view in partial perspective of an example of a high frequency amplifier formed in accordance with the present invention;

Fig. 2 is a circuit diagram illustrating the high frequency circuit of the amplifier illustrated in Fig. 1;

Fig. 3 is a top plan view of a structural detail of the amplifier shown in Fig. 1;

Fig. 4 is a vertical cross-sectional view taken along the line 4—4 of Fig. 3;

Fig. 5 is a vertical cross-sectional view, in partial perspective of a high frequency oscillator

2

formed in accordance with the principles of the present invention;

Fig. 6 is a circuit diagram of the oscillator illustrated in Fig. 5;

Fig. 7 is a partial vertical cross-sectional view in partial perspective showing a modification of the oscillator structure of Fig. 5;

Fig. 8 is a vertical cross-sectional view in partial perspective of another, modified oscillator structure and

Fig. 9 is a partial vertical cross-section in partial perspective illustrating a modification of the oscillator shown in Fig. 8.

The amplifier structure illustrated in Fig. 1 is not only an example of an amplifier formed in accordance with the principles of the present invention, but additionally shows the general principles of my invention as applied to high frequency generators. In the specific amplifier shown by way of example, the structure is formed of two parallel plates 1 and 2, preferably in the form of circular discs which are spaced from one another and enclosed to form a hollow resonant chamber by means of a peripheral annular ring 3. The plates 1 and 2 are formed with central openings, the one in the plate 1 being adapted to receive the end of a base portion of an electron discharge device which may, for example, be a triode 5. This triode is preferably of the type known in the art as a cartridge-type tube, having a base in the form of a cathode shell 4. From the base protrudes an extension on whose end is supported an anode ring 6 and an anode lead 7, with a grid ring 8 intermediate the anode ring 6 and the cathode shell 4. The stepped-type of construction characteristic of these tubes is particularly suitable for use in the high frequency generator constructed according to the present invention because of the position of the grid and anode leads, but it is to be understood that other types of tubes having comparably positioned anode and grid leads may be used. While the cathode shell 4 fits in and is attached to the upper plate 1, the anode lead is adapted to extend through the central opening in the other plate 2.

While various means may be used for seating the tube 5 in the amplifier, and more particularly, seating the cathode shell 4 in the opening of plate 1, I have found that a simple construction for this purpose may consist of a disc 9 attached to the underside of the plate 1 by means such as screws 10, this disc being provided with a central opening about which extend spring fingers 11, as more clearly illustrated in Figs. 3 and 4. On the upper side of the plate 1 and also

3

attached thereto by the same screws 10 is a ring or cylinder 12 surrounding the base of the tube to whose upper rim is attached, by any suitable means, the radially extending lugs 13 from a vacuum tube socket 14. Such sockets are generally provided with these lugs or ears which are attached to a metal ring 15 extending about the socket insulation, while a further series of lugs 16 are attached to the ring and extend axially therefrom. Extending from the socket insulation are a series of short leads 17, 17' which in the form of the invention illustrated are attached to the respective filament and cathode connections in the socket 14. Since one of the filament connections is usually grounded, one of the filament leads 17 is bent over and secured by soldering or other means to one of the lugs 16 as shown. By reason of this construction the tube 5 together with its socket 14 is held in place by pressing the tube base portion 4 into the opening within the plate 1 and against the spring fingers 11 of the attached ring 9.

The tube base may be further surrounded by a shield in the form of a cylinder 18 provided at one end with a cover 19 and attached to the upper surface of the plate 1. To properly position the shield 18, a concentric ring 20 previously attached to the top of the plate 1 may be used, as shown. Between the plates 1 and 2 and within the cavity formed by these plates together with the ring 3, I place a second plate 21 which, in the form of invention illustrated, forms the bottom of a cup whose walls 22 are spaced within and concentric with the ring 3, and are attached to the underside of the plate 1 to support the plate 21. The plate 21 is provided with a central opening spaced from the stem of the tube 5, but makes contact with the grid ring 8 through a spring ring 23 interposed between the under face of the grid ring and the upper face of the plate 21. This spring ring 23 may if desired be similar in construction to the spring ring or disc 9 shown in Figs. 3 and 4. It will thus be seen that when the tube 5 is in position with the grid thereof connected to the plate 21, this latter plate together with a portion of the plate 1 and the walls 22 form a closed resonant grid-cathode cavity A.

Furthermore, between the walls 22 and the external ring 3 may be positioned a slidably adjustable ring 24 which controls the size and thus the tuning of the larger resonant cavity formed by the plates 1 and 2 and the ring 3, and generally indicated at B. The plate 2, in this case, is coupled to the anode lead by means forming a condenser generally indicated at C₁, so that this larger cavity is a plate cathode cavity. The condenser C₁ may be formed of an insulating washer 25 resting against the underside of the plate 2, below this insulating washer being placed a metal washer 26, the two being pressed upwardly by a spring 27 abutting against a ribbed cooling element 28 attached to the end of the anode lead 7 by means such as a set screw 29. This anode structure may, in turn, be surrounded by shielding means consisting of a hollow cylinder 30 attached to the underside of the plate 2 as through a supporting ring 31 enclosed at its other end by the plate 32. The high potential connection for the anode may be conducted through the plate 32 for which purpose a lead-in unit consisting of insulating washers 33 and 34 on opposite sides of the plate, metal washers 35 and 36 respectively covering the insulating washers and a lead through bolt 37 attached to

4

opposite connectors 38 and 39 may be used. The connector 38 will be attached to a point on the directly attached ribbed cooling member 28 as through an inductive lead wire 40.

The tuning ring 24 may be adjusted outside of the amplifier as by a series of circumferentially spaced insulating rods 41 extending through the plate 2 and gripped, if desired, by suitable means such as an interconnecting metal ring 42. The structure may be strengthened by the use of an external connecting ring 43 supporting the ring 3 upon the plate 2. An opening 44 will be provided in the plate 1 for an input loop 45 to the cavity resonator A, while the ring 3 will be provided with an opening 46 for the output loop 47 coupled to the cavity resonator B. The external shell of the amplifier is grounded as indicated at 48. One or more of the cathode leads 17 is joined by a connection 49 to the grounded shell of the amplifier, through a cathode biasing resistor 50 preferably having a value of 100-200 ohms. Tube 5 is so designed that R.-F. energy is by-passed internally between the cathode and the grounded shell of the tube, this by-pass construction being diagrammatically indicated at C₂ in Fig. 2. The positive filament lead for the tube 5 may be led through an opening 51 in the wall of the shield 18.

The circuit of the amplifier described above in connection with Fig. 1 is clearly indicated with corresponding reference numerals in the circuit diagram of Fig. 2. It will be seen that this amplifier circuit is more or less conventional consisting of a tuned grid-cathode circuit formed between cavity resonator A and a tunable plate-cathode circuit formed between cavity resonator B. It will, of course, be understood that if it is not desired to make the output circuit adjustably tunable, the tuning ring 24 and its controlling structure may be eliminated. Additionally, the control elements could project outwardly through the plate 1 rather than the bottom plate 2 and the particular type of means for adjusting the position of the tuning ring 24 may be varied in various ways as will be obvious to those skilled in the art.

The oscillator construction illustrated in Fig. 5 is similar in general design and maintains the advantages of the amplifier construction illustrated in Fig. 1. In this case the position of the tube 5 and its mounting relatively to the three plates 52, 53 and 54 is similar to that described above, and like parts have been given identical reference characters. However, in the oscillator, instead of maintaining the grid of the tube at ground potential and providing a D.-C. cathode biasing resistor as is the case with the amplifier construction of Fig. 1, the cathode is grounded by bending over at least one of the cathode leads 17' and securing such bent-over lead to one of the axially projecting lugs 16. Since the latter are attached to the ring 15, the cathode will be grounded to the shell of the oscillator through the conducting support 12. This construction eliminates cathode resistor 50 and its connecting lead 49.

Between the grid ring 8 in Fig. 5 and the plate 53 is a condenser structure generally indicated at C₃. This condenser structure consists of a spring ring 55 which may be similar to the spring ring 23 of Fig. 7 bearing against the grid ring 8 and resting upon a metal washer 56 which, in turn, presses against an insulating washer 57 lying on the upper surface of the plate 53. To provide a bias for the grid of the tube, metal washer

2,462,909

5

56 is connected to the grounded shell of the oscillator through a resistor 58 by means of a lead 59, an opening in plate 110 permitting passage of lead 59 therethrough.

Furthermore, instead of providing a closed grid-cathode cavity resonator I have provided a re-entrant grid-plate cavity resonator D'. The grid plate 53 is, in this structure supported and insulated from the lower plate 54 by means such as spaced insulators 60, with a space between the periphery of the disc 53 and the outer closure ring 61. In this case, furthermore, the outer ring 61 is extended above the plane of the upper plate 52, about the periphery of the latter being placed on additional cylinder 62 whose walls are concentric with the upper portion of the ring 61. In this space is positioned the adjustable tuning ring 63, and the top of this annular space may be closed by a ring 64 through which may extend the control rods 65 operating the tuning ring 63. A ring 66 may be attached to the outer ends of the control rods 65 to provide manual adjustment. If desired, the ring 62 may be attached to the periphery of the plate 52 with the aid of a supporting ring 67. No input loop is provided, in this case, but the plate-cathode cavity B' has coupled thereto an output loop 68 which will extend through an opening 69 in the wall of ring 61. While the oscillator is adapted to operate at various frequencies, at the high frequency ranges contemplated, it can be so designed that the radius of the cavity resonator B', enclosed by the ring 61, will be approximately equal to one-fourth of the wavelength of the frequency developed.

The circuit for the oscillator illustrated in Fig. 5 is shown in Fig. 6, illustrating the manner in which the anode-grid cavity D' provides feedback between the output cavity B' and the grid of the enclosed tube.

It will be obvious, of course, that if it is not desired to form cavity B' tunable, the upper plate 52 may be extended directly across into contact with the ring 61 and the super structure including the cylinder 62, the tuning ring 63 and its control units may then be eliminated. Additionally, the tuning of the cavity B', if it is desired to be retained, can be varied by the reverse structural arrangement, as more clearly shown in Fig. 7. In this case the upper plate 70 extends directly across to the outer closure ring 71 which, however, is dropped below the lower cavity plate 72. A cylinder 73 extends downwardly about the periphery of the plate 72 and forms with the outer ring 71 an annular space in which the tuning ring 74 may be adjustably positioned. The bottom of this annular space may be closed by a ring 75 through which passes the insulating control rod 76, which in turn, may be attached to an outer ring 77 for the purposes of common manual adjustment. The structure shown in Fig. 7 will be otherwise identical with that illustrated in Fig. 5.

A modified form of high frequency oscillator using the principles of the reentrant cavity is illustrated in Fig. 8. In this structure which, in a sense, is a simplification of the prior structures, the plates 78 and 79 forming the outer boundaries of the main cavity resonator are of equal diameter, while the grid plate 80 is also of the same diameter as the two outer plates, the whole structure being enclosed by a simple annular ring 81 which holds the parts together and supports the metal plate. In this case, however, the plate 80 is provided with a plurality of circumferentially spaced openings 82 which permit the anode-grid

6

cavity action described above in connection with the plate 53 in the oscillator illustrated in Figs. 5 and 7. These openings may be controlled by metal discs 83 adjustably positioned above them as through threaded insulating studs 84 which may project through the upper plate 78 and may be slotted, as shown, to permit an easy turning of the same and thus vary the position of the discs 83 relatively to the openings 82. The remaining structure including the mounting of the tube, the anode and grid connections and the external shielding means may be the same as previously described. Instead of varying the position of the discs 83 by means of the insulating studs illustrated, other similar means may be used, for example, these discs may be on the ends of slidable insulated rods but will be externally movable similarly to the control of the tuning ring illustrated in connection with the remaining figures.

Where uniform impedance cavities are necessary, cones may be employed instead of the circular discs illustrated, or a combination of flat plate and cone may be used. The use of conically-shaped members will not, however, change the principles of the present invention but results solely in a few slight structural changes from the particular structures illustrated. An example of such a construction is shown in Fig. 9, which is identical with Fig. 8 except that the lower plate 85 extends conically downwardly near its outer ends, and the closure ring 86 will be made slightly longer to encompass it.

It will be noted that in all embodiments of the invention illustrated the spacing between the central plate coupled to the grid of tube 5 and the bottom plate coupled to the anode thereof is substantially closer than that between the center plate and the top plate; this spacing tends to reduce the "Q" of the grid-anode circuit relative to that of the grid-cathode circuit, thereby suppressing undesired reaction of the anode potential upon the grid potential due to the unavoidable coupling between the two circuits. A suitable voltage swing on the cathode is obtained by effectively grounding the structure at points remote from the cathode connections proper.

Additionally, while the use of circular plates results in a simplified structural arrangement, it is also clear that these plates can be of any shape consistent with one another for structural purposes. Accordingly, while I have described above the principles of my invention in connection with specific apparatus and particular modifications thereof, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of my invention as set forth in the objects and the accompanying claims.

I claim:

1. A high frequency generator comprising, three circular parallel coaxial metal discs each provided with a central opening, an electron discharge device having an anode, a cathode, a grid, a cathode shell, an extension from said cathode shell having an anode lead at its end, and a grid ring on said extension intermediate said anode lead and said cathode shell, means mounting the cathode shell of said electron discharge device on one of said metal discs with said extension passing through the openings in the other discs, the grid ring being adjacent the second of said metal discs and the anode lead in but spaced from the opening in the third of said metal discs, means including an annular ring joining

the one disc with the third disc and forming with them a cavity resonator enclosing said second disc, means supporting said second disc, means including said second disc and one other of said three metal discs forming a second cavity resonator, means coupling said grid ring to said second disc, means coupling said anode lead to said third disc, and means connecting the cathode to the one metal disc.

2. The generator according to claim 1, in combination with tuning means coupled to said cavities.

3. The generator according to claim 1, in combination with means attached to said one disc shielding the cathode shell of said electron discharge device, and means attached to the third disc shielding the anode lead.

4. The generator according to claim 1, in which the coupling means between said anode lead and said third disc comprises an insulating washer lying against said third disc about the opening therein, a metal washer lying against said insulating washer, a metal, ribbed cooling member attached to said lead and spring means abutting against said ribbed member; contacting said metal washer and pressing said metal and insulating washers against the third disc.

5. A high frequency amplifier comprising, a pair of spaced-apart metal plates each having a hole in its center, said holes being coaxial with one another, an electron discharge device having an anode, a cathode, a grid, a cathode shell, an extension from said cathode shell having an anode lead, and a grid lead on said extension intermediate said anode lead and said cathode shell, means mounting the cathode shell of said electron discharge device in the hole in one of said metal plates with the anode lead in but spaced from the hole in the other metal plate, metallic means connected about the peripheries of said two plates and forming with them a hollow cavity resonator, a generally cup-shaped metal member provided with a central opening in its bottom, means attaching the lip of said cup-shaped member to the one metal plate inside of said cavity resonator, with its opening about said extension and with its bottom adjacent to said grid lead, said cup-shaped member forming with one plate a second cavity resonator, means coupling said grid lead to the bottom of said cup-shaped member, means coupling said other metal plate to said anode lead, and means connecting the cathode of said electron discharge device to said one metal plate.

6. The amplifier according to claim 5, in combination with input coupling means connected to the second cavity resonator and output coupling means connected to the first cavity resonator.

7. The amplifier according to claim 5, in combination with tuning means coupled to the first cavity resonator.

8. The amplifier according to claim 5, in which the two plates are in the form of circular parallel discs and the means interconnecting their peripheries includes an annular ring, and in which the wall of said cup-shaped member is concentric with said annular ring, in combination with a slidable tuning ring mounted in the space between the walls of said cup-shaped member and said annular ring, and means attached to said tuning ring for adjusting the position thereof.

9. A high frequency oscillator comprising, a pair of parallel spaced-apart generally similar metal plates each having a central opening, the openings of both of said plates being coaxial, an elec-

tron discharge device having an anode, a cathode, a grid, a cathode shell, an extension from said cathode shell having an anode lead at its end and a grid lead on said extension intermediate said anode lead and said cathode shell, means mounting the cathode shell of said electron discharge device in the opening in one of the said metal plates, and the anode lead in but spaced from the opening in the other of said metal plates, means joining the peripheries of the two metal plates and forming with them a cavity resonator, means including a third metal plate parallel to and intermediate the pair of metal plates, forming with one of the other metal plates a second, cavity resonator inside of the first cavity resonator, said third metal plate having a central opening adjacent to said grid lead and surrounding said extension, means coupling said grid lead to said third metal plate, means coupling said anode ring to said other metal plate, and means connecting the cathode to the one metal plate.

10. The oscillator according to claim 9, in combination with output coupling means connected to the first cavity resonator.

11. The oscillator according to claim 9, in which said last means includes a metal cylinder attached at one end to said metal plate and substantially surrounding the cathode shell of said electron discharge device, and a socket for said electron discharge device having metal ears attached to the other end of said cylinder.

12. The oscillator according to claim 9, in combination with means attached to the one metal plate enclosing the cathode shell of said electron discharge device, and means attached to the other metal plate outside of the cavity resonator shielding the anode lead.

13. A high frequency oscillator comprising, a pair of parallel spaced-apart generally similar metal plates each having a central opening, the openings of both of said plates being coaxial, an electron discharge device having an anode, a grid, a cathode, a cathode shell, an extension from said cathode shell having an anode lead at its end and a grid ring on said extension intermediate said anode lead and said cathode shell, means mounting the cathode shell of said electron discharge device in the opening in one of said metal plates, and the anode lead in but spaced from the opening in the other of said metal plates, means joining the peripheries of the two metal plates and forming with them a cavity resonator, a third metal plate having a central opening, insulating means supporting said third metal ring on the other metal plate within said cavity resonator, the opening in said third metal plate surrounding said extension and the third plate being adjacent said grid ring, means coupling said grid ring to said third metal plate, means coupling said anode ring to said other metal plate and means connecting the cathode to the other metal plate.

14. The oscillator according to claim 13, in combination with tuning means coupled to the first cavity resonator.

15. The oscillator according to claim 13, in combination with means attached to the one metal plate enclosing the cathode shell of said electron discharge device, and means attached to the other metal plate outside of the cavity resonators shielding the anode lead.

16. A high frequency oscillator comprising, a pair of coaxially spaced parallel discs each having a central opening, an electron discharge device having an anode, a grid, a cathode, a cath-

2,462,909

9

ode shell, an extension from said cathode shell having an anode lead at its end, and a grid ring on said extension intermediate said anode lead and said cathode shell, means mounting the cathode shell of said electron discharge device in the opening in one of said discs, with the extension projecting through the opening in the other disc and the grid ring spaced from said other disc, a third disc parallel to and of greater diameter than the pair of discs, and having a central opening surrounding and spaced from said anode lead, a hollow cylinder attached at one end about the periphery of said third disc and enclosing said pair of discs, spaced insulating members supporting said other disc on said third disc, a second hollow cylinder attached at one end about the periphery of said one disc and extending in the same direction as the first cylinder, whereby said two cylinders form between them a hollow annulus, a ring covering the open end of said annulus, a slidable ring in said annulus, means controlling the position of said slidable ring, means coupling said grid to said other disc, means coupling said anode ring to said third disc, and means connecting the cathode to said one disc.

17. The oscillator according to claim 16, in which the means for controlling the position of said slidable ring includes insulating means attached to said ring and extending outwardly of said oscillator through said covering ring.

18. A high frequency apparatus comprising three axially spaced circular metal discs including an inner disc and two outer discs each having a hole in its center, said holes being coaxial with one another, an electron discharge device having an anode, a cathode, a grid, a cathode shell, an extension from said cathode shell having an anode lead, and a grid lead on said extension intermediate said anode lead and said cathode shell, means mounting the cathode shell of said electron discharge device on the first of said outer discs with said extension passing through the holes in the other discs, the grid lead being adjacent the said inner disc, means connecting the cathode to said first outer disc, means coupling the grid lead to the inner disc, means coupling the anode lead to the second outer disc, means including an annular metal member conductively joining the two outer discs, said member together with at least one of said outer discs forming part of a cavity resonator, means including the inner disc and one of the outer discs forming a second cavity resonator, the spacing between said inner disc and said second disc being substantially closer than that between said inner disc and said first disc, and means supporting said inner disc on the conductive structure which includes the two outer discs and the said annular member.

19. The apparatus according to claim 18 wherein said conductive structure is grounded at a point remote from said means connecting the cathode to said first outer disc.

20. A high frequency apparatus comprising a conductive envelope formed by a pair of axially spaced circular metal discs, conductive means including an annular member joining said discs, and a pair of hollow metal cylinders centrally supported on the outer surfaces of said discs; a third circular metal disc within said conductive envelope forming two cavity resonators therewith and being axially spaced from the other two discs, each of said discs having a central hole all coaxial with one another, an electron discharge device extending through said holes and projecting

10

into the spaces formed by said hollow cylinders, said device having an anode, a cathode, a grid, a cathode shell, an extension from said cathode shell having an anode lead, and a grid lead on said extension intermediate said anode lead and said cathode shell, means mounting the cathode shell of said electron discharge device on the first disc with said extension passing through the holes in the other discs, the grid lead being adjacent said third disc, means within one of said hollow cylinders connecting the cathode to said first disc, means coupling the grid lead to said third disc, means coupling the anode lead to the second disc, means supporting the third disc relative to said envelope, and means grounding said envelope.

21. The apparatus according to claim 20 wherein the spacing between said third disc and second disc is substantially closer than that between said first and said third disc.

22. A high frequency apparatus comprising three axially spaced circular metal discs including an inner disc and two outer discs each having a hole in its center, said holes being coaxial with one another, an electron discharge device having an anode, a cathode, a grid, a cathode shell, an extension from said cathode shell having an anode lead, and a grid lead on said extension intermediate said anode lead and said cathode shell, means mounting the cathode shell of said electron discharge device on the first of said outer discs with said extension passing through the holes in the other discs, the grid lead being adjacent the said inner disc, means connecting the cathode to said first outer disc, means coupling the grid lead to the inner disc, means coupling the anode lead to the second outer disc, means including an annular metal member conductively joining the two outer discs, said member being spaced from the periphery of the inner disc and together with said inner and one of said outer discs, forming part of a cavity resonator, means including the inner disc and the other of said outer discs forming a second cavity resonator, and means supporting the inner disc from the last-mentioned outer disc.

23. The apparatus according to claim 22 wherein said inner disc and one of said outer discs are of substantially equal diameter less than that of the other of said outer discs, further comprising a hollow metal cylinder extending axially in an outward direction from the periphery of said one outer disc, said annular member being peripherally secured to said other outer disc and extending beyond the plane of said one outer disc whereby an annular chamber is formed between said member and said cylinder, a conductive ring covering the open end of said chamber, a slidable metal ring in said chamber, and means attached to said slidable ring for controlling the position thereof.

24. A high frequency oscillator comprising three coaxially spaced circular metal discs including an inner disc and two outer discs each having a central opening, conductive closure means attached about the periphery of said outer discs forming a flat hollow box with the outer discs and supporting the inner disc between them, the spacing between the inner disc and the first outer disc being substantially greater than that between the inner disc and the second outer disc, an electron discharge device having a cathode, an anode, a grid, a cathode shell, an extension from said cathode shell having an anode lead at its end, and a grid ring on said extension inter-

11

mediate said anode lead and said cathode shell, means mounting the cathode shell of said electron discharge device in the opening of said first outer disc with said extension passing through the openings in the other discs, the grid ring being adjacent the said inner disc, means connecting the cathode to said first outer disc, means coupling the anode lead to said second outer disc, and means coupling the grid ring to said inner disc, the latter disc having a plurality of circumferentially spaced openings therethrough providing open communication between the chambers formed between said inner disc and respective ones of said outer discs.

25. The oscillator according to claim 24, further comprising means attached to one of said outer discs for controlling the degree of coupling between said chambers through said circumferentially spaced openings.

26. A high frequency oscillator comprising a conductive envelope formed by a pair of coaxially spaced circular metal discs, conductive means including an annular member joining said discs, and a pair of hollow metal cylinders centrally supported on the outer surfaces of said discs; a third circular metal disc supported on said annular member between the outer two discs in coaxially spaced relation thereto, each of said discs having a central hole, an electron discharge device extending through said holes and projecting into the spaces formed by said hollow cylinders, said device having an anode, a cathode, a grid, a cathode shell, an extension from said cathode shell having an anode lead, and a grid ring on said extension intermediate said anode lead and

12

said cathode shell, means mounting the cathode shell of said electron discharge device in the central hole of the first disc with said extension passing through the holes of the other discs, the grid being adjacent said third disc, means within one of said hollow cylinders connecting the cathode to said first disc, means coupling the anode lead to the second disc, means coupling the grid ring to said third disc, the latter disc having a plurality of circumferentially spaced openings therethrough providing open communication between the chambers formed between said third disc and respective ones of the other two discs, and means grounding said envelope.

27. The oscillator according to claim 26 wherein the spacing between said third disc and said second disc is substantially closer than that between said first and said third disc.

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