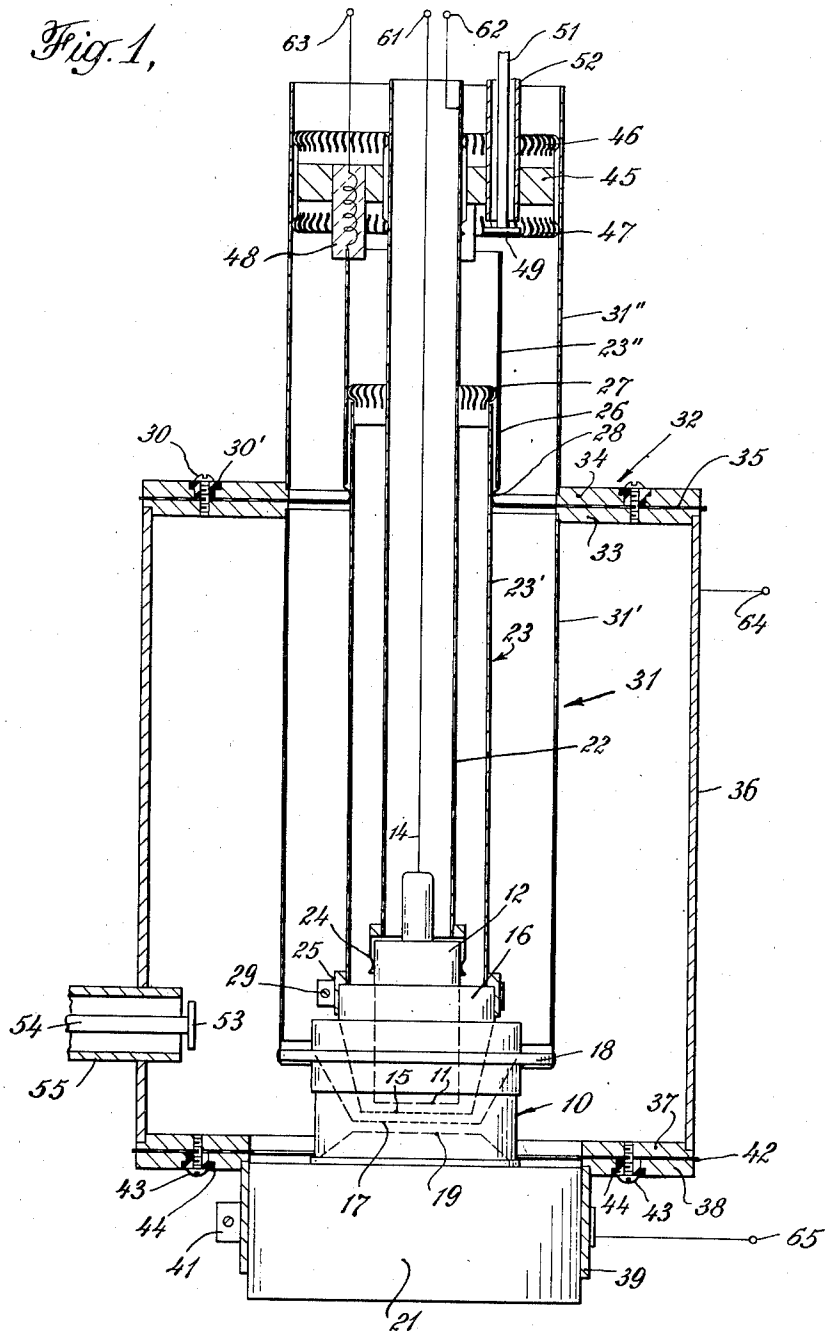
Jan. 29, 1957 H. D. DOOLITTLE 2,779,895

CAVITY RESONATOR DEVICE

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Fig. 1,



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Fig. 2,

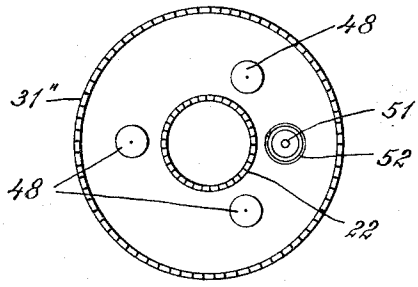


Fig. 3,

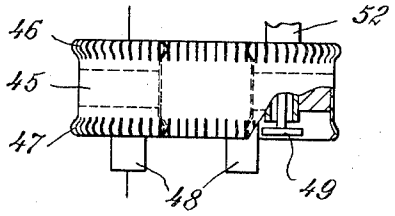


Fig. 4,

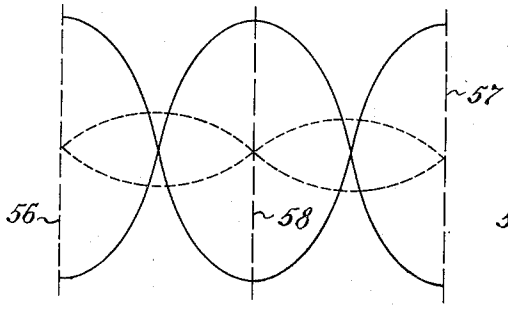
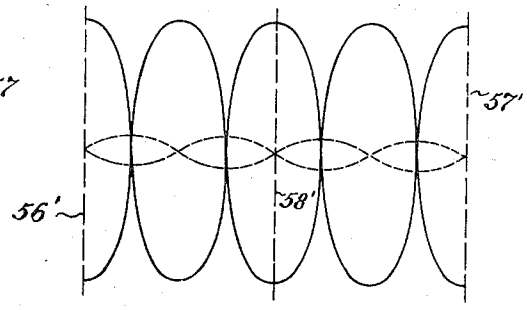


Fig. 5.



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2,779,895

CAVITY RESONATOR DEVICE

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Application April 3, 1951, Serial No. 219,080

13 Claims. (Cl. 315—43)

This invention relates to cavity circuits for high frequency use, and particularly to such circuits used in combination with electron discharge tubes of the tetrode type. It provides a cavity circuit in which the screen grid and cathode may be maintained at substantially the same radio frequency potential even at extremely high frequencies, thus realizing high gain. Furthermore, provision may be made for tuning over a considerable frequency range.

Electron discharge tubes of the triode type are limited as to gain, because of feedback due to their high grid-to-anode capacitance. The screen grid in a tetrode screens the anode from the grid, thus reducing the grid-to-anode capacitance and making higher gain possible. Also, the use of a positively biased screen grid permits tubes of much higher transconductance to be designed, thereby enabling full control of anode current with smaller grid voltage swings.

As the frequency of operation is increased, the efficiency of tubes and their ability to generate power rapidly decreases, the more important causes being the effect of transit time, feedback from output to input circuits, and lead inductance. In the case of triodes an upper frequency limit is imposed by feedback effects when the cathode is maintained at R.-F. (radio frequency) ground potential. Grounded grid or grid separation circuits have been employed to reduce feedback, thus increasing the frequency limit. This increase, however, is attained only at a considerable sacrifice in gain.

While tetrodes have been commonly employed at low frequencies to obtain high gain, their use at extremely high frequencies (several hundred megacycles up to thousands of megacycles) has posed serious problems. One of the most important has been that of maintaining the screen grid at the proper potential. Optimum conditions for gain occur when the screen grid has a positive D.-C. (direct current) bias but is held at R.-F. cathode potential. At low frequencies this condition is easily met by capacity coupling the screen grid to the cathode. As frequency increases this expedient becomes insufficient since the R.-F. path between screen grid and cathode becomes an appreciable part of a wavelength, and lead inductance becomes troublesome.

The use of tetrodes at extremely high frequencies is additionally complicated by the fact that cavity tuning circuits are commonly employed at these frequencies. While such circuits are relatively simple when used with triodes, their design becomes much more complex when used with tetrodes. Difficult problems are encountered in providing suitable connections for properly biasing the several electrodes, maintaining the screen grid at R.-F. cathode potential, and at the same time providing suitable input and output couplings.

In my copending application Ser. No. 151,955, filed March 25, 1950, now Patent No. 2,646,470, I have discussed the need for high frequency tetrodes in more detail, and have described means for coupling screen grid and cathode internally of the tube, thus considerably

increasing the frequency ceiling. With the tubes there described, relatively simple cavities can be employed in which the power output may be taken from the screen grid-anode cavity. However, a frequency of operation may eventually be reached where even internal coupling may not fully suffice. Also, it is desirable to have relatively simple cavities available for use in combination with tubes which do not have internal coupling, and which will still maintain the screen grid and cathode at the same R.-F. potential.

It is accordingly a primary object of my invention to provide a tetrode cavity circuit which maintains cathode and screen grid at substantially the same R.-F. potential regardless of the frequency of operation up to limits imposed by electrode dimensions, thereby increasing the frequency at which tetrodes can be operated with adequate gain and power output.

Broadly speaking, the cathode and screen grid are maintained at the same R.-F. potential by locating them at anti-nodal points of a standing wave which is a wavelength, or an integral number of wavelengths long. This is accomplished by so constructing the cavity that the cathode and screen grid cavity walls cooperate with respective opposite sides of the control grid wall so as to form a folded cavity between cathode and screen grid. The electrical length of this folded cavity is made substantially an integral number of wavelengths long. An input coupling is inserted in the folded cavity so as to introduce energy between control grid and cathode. Output energy may be taken from the cavity in any desired manner, but it is especially contemplated that the output cavity will be coupled between screen grid and anode, thus permitting a relatively simple and convenient structure.

In a specific embodiment the cathode, control grid and screen grid walls of the cavity circuit are telescoped coaxial cylinders, one for each electrode. The control grid tubular wall is positioned between the cathode and screen grid tubular walls, and a plunger is arranged to short-circuit the cathode and screen grid walls at a point remote from the tube electrodes. The control grid cylinder is composed of two sections having a sliding joint therebetween, and the section remote from the tube electrodes is insulatedly mounted on the plunger. In this manner the cathode-control grid cavity connects with the control grid-screen grid cavity to form a folded cavity. With each cavity approximately a half wavelength long, the folded cavity is substantially a whole wavelength long so that cathode and screen grid are maintained at the same R.-F. potential. By adjusting the axial position of the plunger, the cavity may be tuned over a desired frequency range of operation.

The invention will be more fully understood by reference to the following description of a specific embodiment thereof, taken in conjunction with the drawings in which:

Fig. 1 is an axial cross section of a cavity circuit constructed in accordance with the invention, shown in combination with a suitable tetrode;

Fig. 2 is a view of the upper end of the cavity circuit;

Fig. 3 is a side elevation, partly in section, of the plunger of Fig. 1; and

Figs. 4 and 5 show standing waves illustrating two modes of operation of the cavity circuit of the invention.

Referring to Fig. 1, a tube of the tetrode type is shown at **10**. The tube has an indirectly heated cathode **11** connected to a corresponding cathode terminal **12**. One end of the heating coil (not shown) is connected to the cathode and the other to lead **14**. A control grid **15** is in close proximity to cathode **11**, and is connected to a corresponding terminal **16**. A screen grid **17** is spaced from the control grid and is connected to screen grid

terminal 18. An anode 19 is spaced from the screen grid and is connected with anode terminal 21.

It will be observed that the terminals are annular in shape, and are of progressively increasing diameter from cathode to anode. It should be understood that the cavity arrangement of the invention is not limited to use with the specific tube shown. A specific tube is shown in order that the corresponding connections to the cavity elements may be readily apparent, and the operation of the complete circuit more easily understood. With other type tubes, the cavity dimensions and arrangements may be altered accordingly.

A cathode-control grid input cavity is here shown as a pair of spaced telescoped tubular cavity walls 22 and 23 which have respective contacts 24 and 25 for making connections with respective cathode and control grid terminals. The grid cylinder 23 is here shown as formed in two sections 23′ and 23″ having a sliding joint 26 therebetween. Spring contact fingers 27 are attached to section 23′ and spring contact fingers 28 are attached to section 23″, so that adequate conductive contact is maintained between the two sections. In order to prevent section 23′ from being pulled away from the tube 10 when the length of the grid cylinder is changed, contact 25 is advantageously formed so as to clamp around the control grid terminal 16, clamping action being obtained by screw 29. The cathode contact 24 is conveniently made with spring fingers or in any other desired fashion.

A screen grid cylindrical cavity element is shown at 31 and is provided with suitable contact means for engaging the screen grid terminal 18. The screen grid cylinder is formed in two sections 31′ and 31″ which are R.-F. coupled at 32 but D.-C. insulated from each other. Coupling 32 comprises an annular conductive ring 33 affixed to section 31′, and a cooperating annular ring 34 affixed to section 31″. A thin dielectric washer 35 is interposed between the annular rings and the coupling clamped together by bolts 30. Insulating inserts 30′ are employed to prevent the screens from short-circuiting the rings.

An anode cavity wall is provided in the form of a cylinder 36 affixed at the end remote from the tube to annular ring 33. Cylinder 36 is R.-F. coupled to the anode of the tube, but D.-C. insulated therefrom. To this end an annular conductive ring 37 is affixed to cylinder 36 and cooperates with annular ring 38 to which is affixed a contact ring 39. Ring 39 is provided with a clamp 41 so that it may be firmly secured to the anode terminal 21 of the tube. A thin dielectric washer 42 is interposed between rings 37 and 38 to provide R.-F. coupling. The rings are fastened together by bolts 43 which are insulated from ring 38 by inserts 44.

An annular plunger 45 is disposed at the end of the cavity remote from the tube with spring fingers 46 and 47 contacting the outer ends of the screen grid cavity section 31″ and the cathode cavity wall 22 to form a short circuit. The outer section 23″ of the grid cavity wall is mounted on plunger 45 but spaced therefrom by a plurality of insulating posts 48. Posts 48 are made of low-loss material and three or more posts may be provided around the circumference of grid cavity section 23″ for mechanical strength. Energy is fed into the cathode-control grid cavity by means of input coupling 49 mounted in plunger 45. The coupling terminates a coaxial input line comprising a central conductor 51 and outer conductor 52. The coupling is here shown as a voltage probe but any other suitable type of coupling may be employed as desired. With the probe arranged as shown, it is coupled by capacitance to the control grid cylinder.

An output coupling in the form of probe 53 is provided in the screen grid-anode cavity and connects with an output coaxial line comprising central conductor 54 and outer conductor 55,

The described structure provides a control grid-cathode cavity between cylindrical wall 22 and the inner surface of the grid wall 23. At the same time, a folded cavity is provided between cathode and screen grid. One wall of the folded cavity includes cylinder 22, short circuiting plunger 45 and cylinder 31. The other wall is provided by the inner and outer surfaces of cylinder 23. The space between the end of wall 23 remote from the tube and the plunger 45 allows R.-F. energy to pass between the two folds of the cavity.

In operation, the folded cavity arrangement causes a standing wave to become established between cathode and screen grid with these electrodes at voltage anti-nodal points of the wave. Hence cathode and screen grid are always maintained at substantially the same R.-F. potential. The desired frequency of operation can be selected by adjusting the position of plunger 45 so that the standing wave is an integral number of wavelengths long at the selected frequency. Ordinarily, the plunger will be adjusted so that the folded cavity is one wavelength long but it is also possible to locate it so that the cavity is two or more wavelengths long. These modes of operation are shown in Figs. 4 and 5.

Referring to Fig. 4, the full lines represent the voltage standing wave pattern which is one full wavelength long. The potentials between the cathode and control grid lie along line 56 and the potentials between screen grid and control grid lie along line 57. Therefore, the screen grid and cathode lie at voltage anti-nodal points of the standing wave and are always at the same R.-F. potential. The dotted lines show the corresponding current standing wave, and it will be observed that the cathode and screen grid are at nodal points thereof.

With a voltage input coupling, as shown in Fig. 1, it is advantageous to position the probe at a point where maximum voltage is desired. Hence in Fig. 1, the probe 49 is approximately one-half wavelength from the cathode and control grid. This position is shown by line 58 in Fig. 4. It will be understood however, that the voltage input coupling may be positioned to one side of plane 58 if desired in a particular case.

With a current input coupling, it is desirable to position the coupling loop at a current maximum, which in Fig. 4 would correspond to one of the maxima in the dotted curves (one-quarter wavelength from cathode or screen grid), advantageously the maximum nearer the cathode. However, if desired in a particular case, a current input coupling may be positioned somewhat away from the plane of a current maximum.

Fig. 5 shows a mode of operation in which the folded cathode-screen grid cavity is approximately two wavelengths long. The cathode-control grid potentials lie along line 56′ and the screen grid-control grid potentials lie along line 57′. Cathode and screen grid are hence at voltage anti-nodal points of the standing wave. The probe will be positioned along line 58′ in the embodiment of Fig. 1. If desired, with this mode of operation a voltage input probe could be introduced at other voltage maxima, or slightly removed from the maxima, as discussed in connection with Fig. 4. The same considerations apply to current input couplings as discussed for Fig. 4.

The electrical length of the folded cavity between cathode and screen grid contacts will be approximately an integral number of wavelengths, but may not be exactly so due to the effect of the interelectrode capacitances which terminate opposite ends of the cavity. The length is such that the electrodes in the tube itself are at the desired anti-nodal points.

If, as in the embodiment of Fig. 1, it is desired to locate the input probe 49 at a voltage maximum, it is desired that the electrical length from the probe to the cathode-control grid, and from the probe to the control grid-screen grid, each be a half wavelength or a multiple thereof. Inasmuch as interelectrode capacitances cause an electrical foreshortening of the cavity length, the

spacings between the cathode cavity wall **22** and control grid wall **23**, and between wall **23** and screen grid wall **31**, are advantageously selected so that the electrical length of each cavity will be a half wavelength or multiple thereof when combined with the respective interelectrode capacitances. Thus the position of the probe will correspond to a voltage maximum.

In some cases, particularly in power tubes, there will be a resistive loading on the circuit due to the energy absorbed by the electron stream. This may make it difficult or impractical to maintain the cathode and screen grid at exactly the same R.-F. potential, which is the optimum condition. However, even in such cases the use of the present invention is advantageous in maintaining the electrodes at more nearly the same R.-F. potential and hence increasing the gain of the tube and associated circuit.

Where desired, refinements may be incorporated in the cavity circuit illustrated to take into account tube capacitances and resistive losses and obtain a more perfect balance between the cathode-control grid and control grid-screen grid cavities and a more symmetrical wave in the folded cavity. This may be accomplished by adding resistive loss in one cavity or the other as required, by adding inductance or capacity as required at appropriate points in the cavities, or by a suitable combination of resistance, inductance and capacity. These factors and the manner of adding the desired impedance (e. g. by the use of suitable probes) will be understood by those skilled in the art in view of the foregoing description.

Provision has been made in the arrangement of Fig. 1 for the application of proper D.-C. biasing potentials to the respective electrodes. The cathode may be maintained at a desired potential by applying it to terminal **62**. The heating current is supplied between terminals **61** and **62**. Suitable control grid bias may be applied at terminal **63**, which is connected to the control grid wall **23** through an R.-F. choke as shown. Screen grid biasing potential may be applied to **64**, it being noted that anode wall **36** is conductively connected with the screen grid wall **31'**, but D.-C. insulated from the anode and also from screen grid wall **31''** which is conductively connected to the cathode through plunger **45**. Suitable anode potential may be applied to terminal **65**.

Anode wall **36** has been shown as encircling screen grid wall **31'** and the output is taken from the anode-screen grid cavity inasmuch as the screen grid is at the same R.-F. potential as the cathode. If desired, the anode wall may extend in the opposite direction from that shown, and the screen grid wall **31** may be extended in the opposite direction. While no provision is shown for tuning the screen grid-anode cavity in Fig. 1, this may be readily accomplished by the use of a shorting plunger. When the cavity extends in the opposite direction from that shown, a shorting plunger may also be inserted at the end remote from the tube for tuning purposes.

In some cases operation at only a single frequency may be desired. In such event the tuning plunger **45** may be replaced by a fixed short-circuiting end wall, and the control grid wall **23** made in one section. Where it is desired to retain some control over the operating frequency, the control grid wall may be built with the sliding joint as shown and provision made for moving it toward and away from the fixed end wall to effect minor frequency adjustment.

As will be understood by those skilled in the art, the cavities described hereinbefore function as resonant circuit elements and may be termed "cavity resonators." Similarly, the cavity circuits may be termed "cavity resonator circuits."

It will be apparent from the foregoing that the present invention provides a considerably improved high-frequency circuit with screen grid tubes. While specifically described in connection with tetrodes, the invention can also be applied to tubes having a greater number of electrodes. Many mechanical details may be altered as desired, and the location of the D.-C. insulating couplings may be chosen as desired. These and other modifications may be made by those skilled in the art within the spirit and scope of the invention.

I claim:

1. In combination with a high frequency tube having at least cathode, control grid, screen grid and anode electrodes, a pair of spaced telescoped tubular cathode and screen grid cavity resonator walls connected to corresponding tube electrodes, an annular plunger slidably arranged between said walls remote from said electrodes to establish a radio frequency connection therebetween, a tubular control grid cavity resonator wall telescoped between said cathode and screen grid walls and connected at one end thereof to said control grid electrode, insulating means mounting the other end of said control grid wall on said plunger and spaced therefrom, said control grid wall comprising a pair of electrically connected wall sections joined to permit variation in the wall length with movement of the plunger, said cathode and screen grid walls cooperating with respective opposite sides of said control grid wall to form a folded cavity resonator between cathode and screen grid electrodes, the electrical length of said folded cavity resonator being substantially an integral number of wavelengths long, and an input coupling positioned to introduce energy into said folded cavity resonator.

2. In combination with a high frequency tube having at least cathode, control grid, screen grid and anode electrodes, a pair of spaced telescoped tubular cathode and screen grid cavity resonator walls connected to corresponding tube electrodes, an annular short-circuiting plunger slidably mounted between said walls remote from said electrodes, a direct current insulating but radio frequency conductive coupling in the outer of said walls between said plunger and the respective electrode, a tubular control grid cavity resonator wall telescoped between said cathode and screen grid walls and connected at one end thereof to said control grid electrode, insulating means mounting the other end of said control grid wall on said plunger and spaced therefrom, said control grid wall comprising a pair of electrically connected wall sections joined to permit variation in the wall length with movement of the plunger, said cathode and screen grid walls cooperating with respective opposite sides of said control grid wall to form a folded cavity resonator between cathode and screen grid electrodes, the electrical length of said folded cavity resonator being substantially an integral number of wavelengths long, and an input coupling positioned to introduce energy into said folded cavity resonator.

3. In combination with a high frequency tube having at least cathode, control grid, screen grid and anode electrodes with respective concentric annular terminals increasing in diameter in the order named, telescoped cathode, control grid and screen grid coaxial cylindrical cavity resonator walls of increasing diameter in the order named and connected at one end thereof to respective tube terminals, an annular short-circuiting plunger slidably mounted between the other ends of said cathode and screen grid walls, insulating means mounting the other end of said control grid wall on said plunger but spaced therefrom, said control grid wall comprising a pair of electrically connected wall sections joined to permit variation in the wall length with movement of the plunger, said cathode and screen grid walls cooperating with respective opposite sides of said control grid wall to form a folded cavity resonator between cathode and screen grid electrodes, the electrical length of said folded cavity resonator being substantially an integral number of wavelengths long, and an input coupling mounted in said plunger for introducing energy into said folded cavity resonator.

4. In combination with a high frequency tube having at least cathode, control grid, screen grid and anode

electrodes with respective concentric annular terminals increasing in diameter in the order named, telescoped cathode, control grid and screen grid coaxial cylindrical cavity resonator walls of increasing diameter in the order named and connected at one end thereof to respective tube terminals, an annular short-circuiting plunger slidably mounted between the other ends of said cathode and screen grid walls, insulating means mounting the other end of said control grid wall on said plunger but spaced therefrom, said control grid wall comprising a pair of electrically connected telescoped wall sections to permit variation in the wall length with movement of the plunger, said cathode and screen grid walls cooperating with respective opposite sides of said control grid wall to form a folded cavity resonator between cathode and screen grid electrodes, the electrical length of said folded cavity resonator being substantially an integral number of wavelengths long, an input coupling positioned to introduce energy into said folded cavity resonator, telescoped screen grid and anode cavity resonator walls forming an output cavity resonator, and an output coupling positioned to derive energy from said output cavity resonator.

5. In combination with a high frequency tube having at least cathode, control grid, screen grid and anode electrodes with respective concentric annular terminals increasing in diameter in the order named, telescoped cathode, control grid and screen grid coaxial cylindrical cavity resonator walls of increasing diameter in the order named and connected at one end thereof to respective tube terminals, an annular short-circuiting plunger slidably mounted between the other ends of said cathode and screen grid walls, insulating means mounting the other end of said control grid wall on said plunger but spaced therefrom, said control grid wall comprising a pair of electrically connected telescoped wall sections to permit variation in the wall length with movement of the plunger, said cathode and screen grid walls cooperating with respective opposite sides of said control grid wall to form a folded cavity resonator between cathode and screen grid electrodes, the electrical length of said folded cavity resonator being substantially an integral number of wavelengths long, an input coupling mounted in said plunger for introducing energy into said folded cavity resonator, an anode cylindrical cavity resonator wall telescoped with at least a portion of said screen grid wall to form an output cavity resonator, and an output coupling mounted in said output cavity resonator.

6. A cavity resonator circuit for a high frequency tube having at least cathode, control grid, screen grid and anode electrodes with respective terminals therefor which comprises a pair of spaced cathode and screen grid cavity resonator walls having respective contacts for respective tube terminals, a radio frequency connection between said walls remote from said contacts, a control grid cavity resonator wall positioned between the cathode and screen grid walls and having a contact for the control grid tube terminal, said control grid wall extending adjacent said connection but spaced and insulated therefrom, whereby said cathode and screen grid walls cooperate with respective opposite sides of said control grid wall to form a folded cavity resonator between cathode and screen grid contacts, and input coupling means positioned to introduce energy into said folded cavity resonator.

7. A cavity resonator circuit for a high frequency tube having at least cathode, control grid, screen grid and anode electrodes with respective terminals therefor which comprises a pair of spaced telescoped tubular cathode and screen grid cavity resonator walls having contacts at end end thereof respectively for respective tube terminals, a radio frequency connection between said walls remote from said contacts, a tubular control grid cavity resonator wall telescoped between said cathode and screen grid walls and having a contact at one end thereof for the control grid tube terminal, the other end of said control grid wall extending adjacent said connection but spaced and insulated therefrom, whereby said cathode and screen grid walls cooperate with respective opposite sides of said control grid wall to form a folded cavity resonator between cathode and screen grid contacts, and an input coupling positioned to introduce energy into said folded cavity resonator.

8. A cavity resonator circuit for a high frequency tube having at least cathode, control grid, screen grid and anode electrodes with respective terminals therefor which comprises a pair of spaced telescoped tubular cathode and screen grid cavity resonator walls having contacts at one end thereof respectively for respective tube terminals, an annular plunger slidably arranged between said walls remote from said contacts to establish a radio frequency connection therebetween, a tubular control grid cavity resonator wall telescoped between the cathode and screen grid walls and having a contact at one end thereof for the control grid tube terminal, insulating means mounting the other end of said control grid wall on said plunger and spaced therefrom, whereby said cathode and screen grid walls cooperate with respective opposite sides of said control grid wall to form a folded cavity resonator between cathode and screen grid contacts, a joint in said control grid wall allowing extension thereof with said plunger, and an input coupling positioned to introduce energy into said folded cavity resonator.

9. A cavity resonator circuit for a high frequency tube having at least cathode, control grid, screen grid and anode electrodes with respective terminals therefor which comprises telescoped cathode, control grid and screen grid coaxial cylindrical cavity resonator walls of increasing diameter in the order named, said walls having contacts at one end thereof respectively for respective tube terminals, an annular short-circuiting plunger slidably mounted between the other ends of said cathode and screen grid walls, insulating means mounting the other end of said control grid wall on said plunger but spaced therefrom, said control grid wall comprising a pair of electrically connected wall sections joined to permit variation in the wall length with movement of the plunger, said cathode and screen grid walls cooperating with respective opposite sides of said control grid wall to form a folded cavity resonator between cathode and screen grid contacts, and an input coupling mounted in said plunger for introducing energy into said folded cavity resonator.

10. A cavity resonator circuit for a high frequency tube having at least cathode, control grid, screen grid and anode electrodes with respective terminals therefor which comprises telescoped cathode, control grid and screen grid coaxial cyindrical cavity resonator walls of increasing diameter in the order named, said walls having contacts at one end thereof respectively for respective tube terminals, an annular short-circuiting plunger slidably mounted between the other ends of said cathode and screen grid walls, insulating means mounting the other end of said control grid wall on said plunger but spaced therefrom, said control grid wall comprising a pair of electrically connected telescoped wall sections to permit variations in the wall length with movement of the plunger, said cathode and screen grid walls cooperating with respective opposite sides of said control grid wall to form a folded cavity resonator between cathode and screen grid contacts, an input coupling mounted in said plunger for introducing energy into said folded cavity resonator, an anode cylindrical cavity resonator wall telescoped with at least a portion of said screen grid wall to form an output cavity resonator and having a contact at one end thereof for said anode tube terminal, and an output coupling mounted in said output cavity resonator.

11. A cavity resonator circuit for a high frequency tube having at least cathode, control grid, screen grid and anode electrodes with respective terminals therefor

which comprises a pair of spaced cathode and screen grid cavity resonator walls having respective contacts for respective tube terminals, a radio frequency connection between said walls remote from said contacts, a control grid cavity resonator wall positioned between the cathode and screen grid walls and having a contact for the control grid tube terminal, said control grid wall extending adjacent said connection but spaced and insulated therefrom, whereby said cathode and screen grid walls cooperate with respective opposite sides of said control grid wall to form a folded cavity resonator between cathode and screen grid contacts, the electrical length of said folded cavity resonator being substantially an integral number of wavelengths long, and input coupling means positioned to introduce energy into said folded cavity resonator.

12. A cavity resonator circuit for a high frequency tube having at least cathode, control grid, screen grid and anode electrodes with respective terminals therefor which comprises a pair of spaced telescoped tubular cathode and screen grid cavity resonator walls having contacts at one end thereof respectively for respective tube terminals, an annular plunger slidably arranged between said walls remote from said contacts to establish a radio frequency connection therebetween, a tubular control grid cavity resonator wall telescoped between the cathode and screen grid walls and having a contact at one end thereof for the control grid tube terminal, insulating means mounting the other end of said control grid wall on said plunger and spaced therefrom, said control grid wall comprising a pair of electrically connected wall sections joined to permit variation in the wall length with movement of the plunger, said cathode and screen grid walls cooperating with respective opposite sides of said control grid wall to form a folded cavity resonator between cathode and screen grid contacts, the electrical length of said folded cavity resonator being substantially an integral number of wavelengths long, and an input coupling positioned to introduce energy into said folded cavity resonator.

13. A cavity resonator circuit for a high frequency tube having at least cathode, control grid, screen grid and anode electrodes with respective terminals therefor which comprises telescoped cathode, control grid and screen grid coaxial cylindrical cavity resonator walls of increasing diameter in the order named, said walls having contacts at one end thereof respectively for respective tube terminals, an annular short-circuiting plunger slidably mounted between the other ends of said cathode and screen grid walls, insulating means mounting the other end of said control grid wall on said plunger but spaced therefrom, said control grid wall comprising a pair of electrically connected telescoped wall sections to permit variations in the wall length with movement of the plunger, said cathode and screen grid walls cooperating with respective opposite sides of said control grid wall to form a folded cavity resonator between cathode and screen grid contacts, the electrical length of said folded cavity resonator being substantially an integral number of wavelengths long, an input coupling mounted in said plunger for introducing energy into said folded cavity resonator, an anode cylindrical cavity resonator wall telescoped with at least a portion of said screen grid wall to form an output cavity resonator and having a contact at one end thereof for said anode tube terminal, and an output coupling mounted in said output cavity resonator.

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