

Aug. 15, 1939.

A. L. SAMUEL
SIGNAL-TRANSLATING APPARATUS

2,169,396

Filed May 8, 1936

2 Sheets-Sheet 1

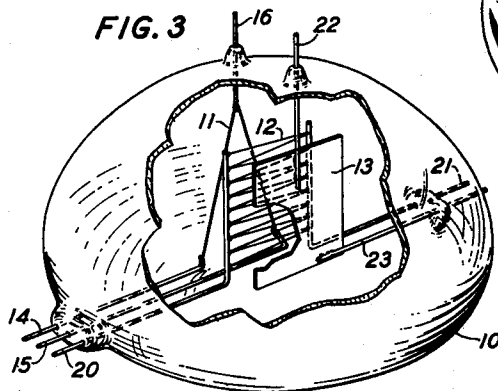
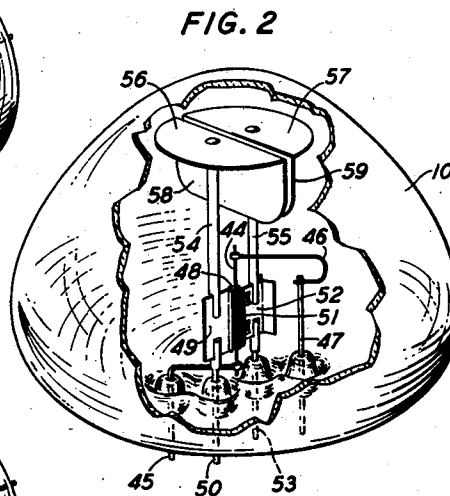
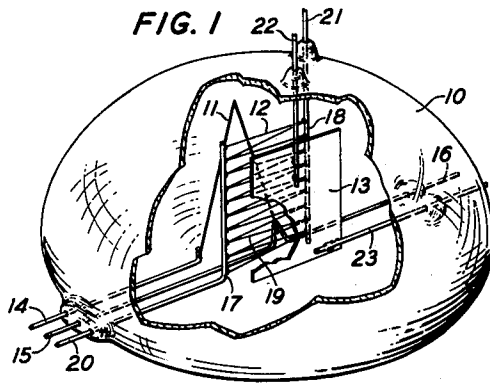
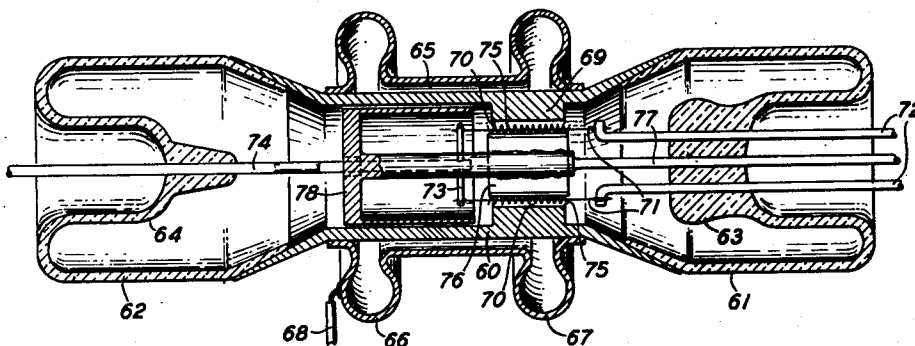


FIG. 9



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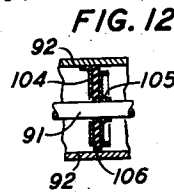
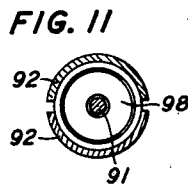
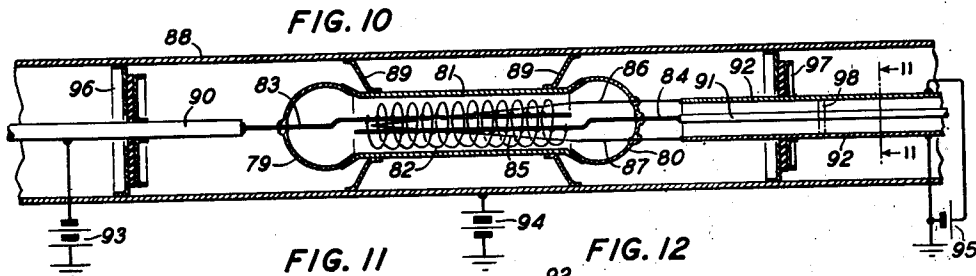
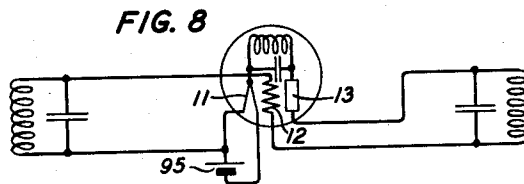
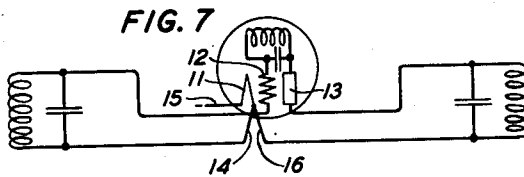
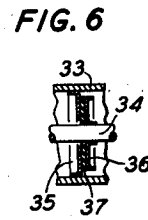
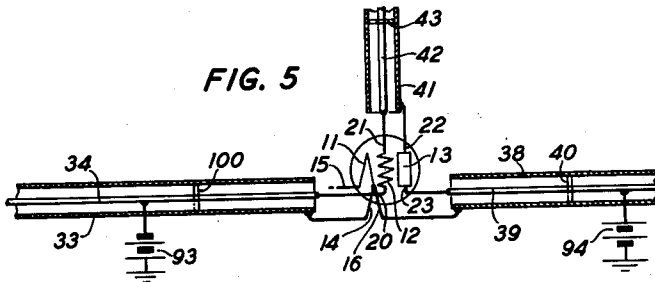
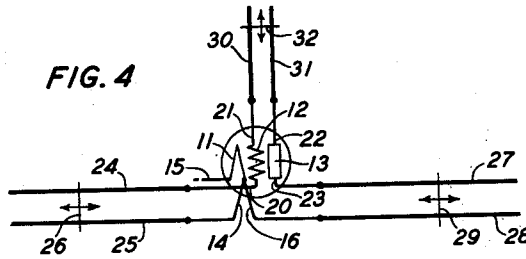
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UNITED STATES PATENT OFFICE

2,169,396

SIGNAL-TRANSLATING APPARATUS

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15 Claims. (Cl. 179—171)

This invention relates to signal translating apparatus and, more particularly, to electron discharge devices and circuits therefor especially suitable for amplifying ultra-high frequency impulses, for example, impulses of frequencies corresponding to wave-lengths of less than one meter.

In ultra-high frequency amplifying systems including electron discharge devices, the translating characteristics and the lower limit of operating wave-lengths are dependent to a material degree upon the coupling extant between the several tuned circuits connecting the electrodes of the device. One of the important factors determining such coupling and the operating characteristics at extremely high frequencies is the impedance of the leading-in conductors for the several electrodes and the coupling between two or more of the tuned circuits produced by the leading-in conductors. For example, it has been found that if, in accordance with general practice heretofore, the input and output circuits of an electron discharge device are connected to the same leading-in conductor for the cathode, this conductor provides a common impedance in the two circuits and, as a result, undesired coupling between these circuits obtains with a resultant determination of the maximum frequency at which stable translation is attainable, at a relatively high wave-length.

One general object of this invention is to increase the operating stability and power capacity of ultra-high frequency signal translating systems and also to increase the range of frequencies in which stable operation is attainable.

More specifically, objects of this invention are:

To substantially completely segregate two or more tuned circuits associated with an electron discharge device;

To eliminate common impedances in such tuned circuits whereby undesired coupling therebetween is minimized;

To remove stringent restrictions upon the parameters of leading-in conductors for the electrodes in electron discharge devices operable at extremely high frequencies;

To reduce dielectric losses in such devices whereby a high power capacity is enabled;

To enable neutralization of the impedances between the electrodes of electron discharge devices; and

To facilitate the tuning of a plurality of resonant circuits associated with an electron discharge device.

In one illustrative embodiment of this inven-

tion, a signal amplifying system comprises an electron discharge device including a cathode, a control electrode or grid, and an anode, each of the electrodes being provided with two or more relatively widely spaced leading-in conductors. Preferably, one of the conductors for the cathode extends from the enclosing vessel in proximity to one of the conductors for the control electrode or grid and another conductor for the cathode extends in proximity to one of the conductors for the anode. Another conductor for the anode and one for the control electrode or grid extend remote from the aforementioned conductors and in proximity to each other.

A tunable input circuit, which may be of the coil and condenser type, a parallel wire or Lecher system, or a distributed constant coaxial conductor system, may be connected to the adjacent conductors for the cathode and the control electrode or grid and a tunable output circuit of any one of the types aforementioned may be connected between adjacent conductors for the cathode and the anode. A third tunable or neutralization circuit may be connected between the proximately disposed conductors for the anode and the control electrode or grid and adjusted to resonate at the frequency at which the system is to be operated.

The electrodes of the electron discharge device may be planar and arranged parallel to each other or they may be cylindrical and arranged coaxially one within another. The anode may be cylindrical and constitute a portion of the enclosing vessel.

In an illustrative system including an electron discharge device of the external anode type, two leading-in conductors are provided for the control electrode or grid and extend from opposite ends of the enclosing vessel, and the leading-in conductors for the cathode extend from one end of the vessel. The control electrode or grid conductors preferably are straight metallic rods extending coaxially with respect to the electrode system. The cathode conductors may be connected individually to the halves of a longitudinally split metallic cylinder encompassing and coaxial with one of the grid conductors. The two grid conductors and the cathode cylinder are encompassed by a tubular metallic cylinder coaxial therewith and electrically connected to the anode.

The anode cylinder and one of the grid conductors constitute a tunable distributed constant system which may be utilized as a neutralization circuit. The other grid conductor and

the cathode cylinder constitute a tunable distributed constant input circuit and the cathode and anode cylinders constitute a tunable distributed constant output circuit. The various circuits may be tuned by suitable short shunting members slidably associated with the conductors and the cylinders.

The invention and the various features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view of an electron discharge device illustrative of one embodiment of this invention;

Fig. 2 is a perspective view of another illustrative electron discharge device constructed in accordance with this invention, wherein one of the tuned circuits is mounted within the enclosing vessel of the device;

Fig. 3 is another perspective view illustrating another electron discharge device constructed in accordance with this invention particularly adapted for amplifying systems wherein a neutralization circuit is connected between the cathode and the anode.

Fig. 4 is a circuit diagram of an amplifying system illustrative of this invention wherein the tuned circuits comprise parallel wire or Lecher systems;

Fig. 5 illustrates another amplifier circuit wherein the tuned circuits comprise concentric conductor distributed constant systems;

Fig. 6 is an enlarged detail view in cross-section of the slidable tuning members included in the circuit shown in Fig. 5;

Figs. 7 and 8 are schematic diagrams illustrating amplifier circuits wherein one of the tuned circuits is mounted within the enclosing vessel of the electron discharge devices;

Fig. 9 is a view in cross-section of an external anode electron discharge device constructed in accordance with this invention;

Fig. 10 is a view partly in cross-section showing an ultra-short wave amplifier wherein the electrodes of the electron discharge device constitute portions of concentric conductor distributed constant systems and the input circuit is disposed mainly within the output circuit;

Fig. 11 is a view in cross-section along line 11-11 of Fig. 10; and

Fig. 12 is an enlarged detail view of one of the tuning members incorporated in the systems shown in Fig. 10.

Referring now to the drawings, the electron discharge device shown in Fig. 1 comprises an enclosing vessel 10 having therein a cathode 11, a control electrode or grid 12, and an anode 13, the several electrodes being disposed in parallel planes. The cathode 11 may be a V-shaped filament having leading-in conductors 14 and 15 extending from the ends thereof and sealed in a wall of the enclosing vessel 10, to which conductors a suitable source of heating current may be connected. Another leading-in conductor 16 is connected to the same end of the filament as the conductor 15 and is sealed in the vessel 10 remote from the conductor 15, for example, at a point diametrically opposite to the point of sealing of the conductor 15 to the vessel.

The control electrode or grid 12 may comprise a pair of parallel metallic uprights or supports 17 and 18 between which a fine wire grid 19 is wound. A leading-in conductor 20 is connected to the upright or support 17 and extends from the vessel 10 in close proximity to the leading-in

conductor 16 for the cathode 11. Another leading-in conductor 21 is connected to the upright or support 18 and extends from the vessel 10 remote from, for example at right angles to, the leading-in conductor 20.

The anode 13 may be a metallic plate as shown, provided with two leading-in conductors 22 and 23 extending remote from, for example at right angles to, each other. The leading-in conductor 22 is sealed in the enclosing vessel in proximity to the leading-in conductor 21 for the control electrode or grid 12 and preferably extends parallel to the latter conductor. The anode leading-in conductor 23 is sealed in the enclosing vessel 10 in proximity to the leading-in conductor 16 for the cathode 11 and preferably extends parallel to this conductor 16.

The electron discharge device shown in Fig. 1 may be utilized in a translating system including three tuned circuits, no two of which are coupled by a common leading-in conductor. For example, as shown in Fig. 4, an input circuit of the Lecher type including parallel wires 24 and 25 and a slidable short-circuiting member 26 may be connected to the conductors 20 and 16 for the control electrode 12 and cathode 11, respectively. An output circuit also of the Lecher type and composed of parallel wires 27 and 28 and a slidable short-circuiting member 29 may be connected between the conductors 16 and 23 for the cathode and anode, respectively. The input and output circuits may be tuned to the operating frequency desired.

A third Lecher system composed of parallel wires 30 and 31 and a short-circuiting member 32 for varying the length and tuning thereof is connected between the conductors 21 and 22 for the control electrode 12 and anode 13, respectively. This third system may be adjusted to resonate with the grid-anode interelectrode capacitance at the desired operating frequency and thereby neutralize this capacitance so that stable operation at the desired frequency will obtain.

The several Lecher systems described heretofore may all be of such length as to operate at a higher than fundamental mode with respect to the frequency of operation desired. This, it will be seen, circumvents one of the stringent restrictions in the design of electron discharge devices operable at extremely high frequencies, namely that the effective length of the portions of the various leading-in conductors within the enclosing vessel be small in comparison with the operating wave-length. The length of the portions of the various leading-in conductors between the electrodes and the points at which these conductors are sealed in the enclosing vessel then, may be so chosen that potential nodes occur at these sealing points. Consequently, dielectric losses are minimized and the construction of electron discharge devices having a relatively high power capacity at extremely high frequencies, for example, frequencies of the order of 500 megacycles, or higher, is enabled.

It will be apparent that inasmuch as no two of the several circuits are associated with the electrodes through a common leading-in conductor, no common impedance for any two circuits is extant and, as a result, undesired and deleterious coupling through such common impedance is eliminated. Specifically, it may be pointed out that undesired coupling between the neutralization circuit and the input and output circuits, such as would be due to the inductance of a grid or anode leading-in conductor common to two

circuits is eliminated. Likewise, undesired coupling between the input and output circuits such as might result from a common impedance introduced by a cathode leading-in conductor in both these circuits is eliminated. Consequently, stable operation of a system including such devices is assured and the range of frequencies wherein satisfactory operation is obtainable is extended.

As illustrated in Fig. 5, the input, output and neutralization circuits may be distributed constant concentric conductor systems. For example, the input circuit may comprise a tubular metallic member 33 connected to the leading-in conductor 14 for the cathode 11 and a linear rod 34 positioned in the longitudinal axis of the tubular member 33. The length, and hence the tuning of the circuit including the conductors 33 and 34, may be varied by a slidable member 100 which, as shown, more clearly in Fig. 6, comprises a centrally apertured metallic disc 35 contacting with the tubular member 33 but not with the rod conductor 34, another metallic disc 36 contacting the conductor 34 but not the conductor 33, and a disc 37 of dielectric material, for example mica, spacing the discs 35 and 36 and suitably affixed thereto. The several discs, it will be apparent constitute a blocking condenser between the grid 12 and cathode 11.

The output circuit may comprise a metallic cylinder 38 connected to the leading-in conductor 16 for the cathode 11, a rod conductor 39 positioned in the longitudinal axis of the cylinder 38 and connected to the leading-in conductor 23 for the anode 13, and a slidable member 40 of the construction shown in Fig. 6.

Similarly, the neutralization circuit comprises a tubular conductor 41 connected to the anode lead 22, a central rod conductor 42 connected to the grid lead 21, and a slidable member 43 of the construction shown in Fig. 6 for tuning the neutralization circuit.

Suitable potentials may be applied to the various electrodes by sources, such as batteries 93, 94 and 95 connected as shown in Fig. 5.

One or more of the tuned circuits may be enclosed within the vessel of the electron discharge device as shown, for example, in Fig. 2. The electron discharge device shown in this figure is of the general construction disclosed and claimed in my Patent 2,025,075, granted December 24, 1935 and comprises an enclosing vessel 10 housing a cathode, control electrode or grid, and anode which are coaxially arranged. The cathode may be a linear filament 44 supported at its lower end by an inverted L-shaped leading-in conductor 45 and at its upper end by a bent resilient wire 46 carried by a leading-in conductor 47. The leading-in conductors 45 and 47 are sealed in the vessel 10, for example in the base thereof, at relatively widely spaced points.

The control electrode comprises a helical grid 48 encompassing the cathode 44 and coaxial therewith, and a heat radiating fin 49 carrying the grid 48. The grid 48 and fin 49 are supported by a leading-in conductor 50 affixed to the fin and extending from the vessel 10 in immediate proximity to the leading-in conductor 45 for the cathode.

The anode may be composed of sheet metal and includes a semi-cylindrical portion 51 coaxial with the cathode and grid and a flange or fin portion 52. The anode is supported by a leading-in conductor 53 sealed in the enclosing vessel in immediate proximity to the leading-in conductor 47 for the cathode 44.

Suitable tuned input and output circuits such, for example, as shown in Figs. 4 and 5, may be connected between the conductors 45 and 50 and 47 and 53, respectively. The neutralizing circuit may be enclosed in the vessel 10 and comprises, for example, rods 54 and 55 secured to the fins 49 and 52, respectively, and sheet metal members 56 and 57 carried by the rods 54 and 55, respectively. These sheet metal members are provided with juxtaposed parallel portions 58 and 59 which form a condenser constituting, with the inductances of the rods 54 and 55 and the grid-anode capacitances, a circuit resonant to the desired operating frequency.

Inasmuch as in the device illustrated in Fig. 2, the several circuits are remotely positioned with respect to one another and no two circuits have a common lead impedance, effective segregation of the several circuits is obtained and the desirable operating characteristics set forth hereinabove in the description of the device shown in Fig. 1 are achieved.

Although the neutralization circuit has been described heretofore as connected to the grid and anode, it may be connected between the cathode and anode and the output circuit may be connected between the anode and the control electrode or grid. An electron discharge device particularly adaptable for such connections is illustrated in Fig. 3 and comprises an enclosing vessel 10 housing a cathode 11, control electrode or grid 12 and anode 13 similar in construction to the electrodes in the device shown in Fig. 1. The leading-in conductor 16 for the cathode 11 extends from the vessel 10 parallel and in proximity to the leading-in conductor 22 for the anode. The leading-in conductors 21 and 23 for the control electrode or grid and anode, respectively, extend from the vessel adjacent each other, remote from the conductors 16 and 22 and preferably at right angles thereto. Similarly, the leading-in conductors 15 and 20 for the cathode and control electrode, respectively, extend parallel and adjacent to each other and preferably at right angles to the conductors 16 and 22. A suitable input circuit, for example of the types disclosed in Figs. 4 and 5, may be connected between the conductors 15 and 20 and a similar suitable output circuit may be connected between the conductors 21 and 23. A suitable neutralization circuit, for example of the types disclosed in Figs. 4 and 5 may be connected between the conductors 16 and 22 and disposed exteriorly of the vessel 10, or, if desired, this circuit may be enclosed in the vessel 10 as shown in Fig. 2.

Typical systems wherein the neutralization circuit is contained in the vessel 10 are illustrated diagrammatically in Figs. 7 and 8. In the former figure, the neutralizing circuit is connected between the grid and anode and, in the latter figure, this circuit is connected between the cathode and anode. As shown in these figures, the several circuits may comprise suitable inductances and condensers in parallel.

The invention may be utilized to advantage also in translating systems including external anode discharge devices such, for example, as devices of the general design disclosed in my Patent 2,063,341, granted December 8, 1936. One illustrative discharge device shown in Fig. 9 comprises an enclosing vessel including a cylindrical metallic portion 60 which serves as the anode of the device, and vitreous end portions 61 and 62 having inwardly extending stems 63 and 64, respectively. The anode 60 may be encompassed

by a jacket 65 forming therewith a chamber through which a cooling medium may be circulated, the jacket 65 being provided with inlet and outlet portions 66 and 67, respectively, having inlet and outlet ports (not shown). Electrical connection to the anode may be established through a conductor 68 secured to the jacket 65.

The anode is provided with an inwardly extending annular portion 69 having diametrically opposite cylindrical longitudinal grooves 70, in each of which a cathode element and a control electrode element are disposed. Each cathode element may be a linear filament 71 supported at one end by a corresponding one of leading-in conductors 72, sealed in the stem 63, through which the requisite heating current may be supplied. The cathode elements may be connected at the other end by a resilient metallic strip 73 which is carried by a leading-in conductor 74 sealed in the stem 64.

The control electrode elements may be helical grids 75, each encircling one of the cathode elements 71, carried by a plate or fin 76 which is supported by a leading-in conductor 77 sealed in the stem 63. The conductor 77 may support also a cup-shaped metallic member 78 which forms a substantially cylindrical inductance with the inwardly extending portion 69 of the anode and forms also a blocking condenser with the cylindrical shell portion 60 of the anode. The inductance thus formed may be chosen so that it forms with the interelectrode capacitances a circuit resonant to the frequency at which the device is to be operated, this circuit corresponding to the neutralizing circuit in the systems described hereinabove.

An output circuit which may be, for example, of any of the types heretofore mentioned, may be connected between the conductors 68 and 74 and a suitable similar input circuit may be connected between the conductor 77 for the control electrode and one of the supply conductors 72 for the cathode.

It will be clear that no two of the input, output and neutralizing circuits associated with the device shown in Fig. 9 include a common lead impedance and, therefore, undesired coupling between these circuits through such a common impedance is eliminated. Furthermore, inasmuch as the conductors included in the input circuit are remote from those included in the output circuit and these circuits are materially displaced from the neutralizing circuit, the several circuits are effectively segregated from one another whereby stable operation is assured.

In another illustrative embodiment of this invention illustrated in Fig. 10, the electron discharge device comprises an enclosing vessel including vitreous end portions 79 and 80 and an intermediate cylindrical metallic portion 81 which serves as the anode of the device. Disposed coaxially within the anode 81 is a helical control electrode or grid 82 provided with oppositely extending leading-in conductors 83 and 84 sealed in the vitreous end portions 79 and 80, respectively. Preferably, the grid 82 and conductors 83 and 84 are coaxial with the anode 81. The grid 82 encompasses a cathode 85, which may be a filament, provided with leading-in conductors 86 and 87, sealed in the vitreous end portion 80, through which the heating current for the cathode may be supplied.

The electron discharge device may be disposed within a cylindrical metallic tube 88 and mounted coaxially therein by metallic webs 89 which con-

nect the anode 81 and tube 88 electrically. Mounted coaxially within the tube 88 and electrically connected to the leading-in conductor 83 is a metallic rod or cylinder 90. Another metallic rod or cylinder 91 is electrically connected to the other leading-in conductor 84 for the control electrode or grid 82 and also is mounted coaxially within the cylinder 88. The rod or cylinder 91 is encircled also by a longitudinally divided metallic cylinder 92, as shown in Fig. 11, the two halves of which are coaxial with the cylinder 88 and connected to the cathode leads 86 and 87. Suitable potentials may be applied to the several electrodes by sources, such as batteries 93, 94 and 95, connected as shown.

The arrangement shown in Fig. 10, it will be noted, provides three distributed constant concentric conductor systems, each of which includes two electrodes. Specifically, the cylinders 88 and 90 together with the anode 81 and grid 82 constitute an output or neutralization circuit; the cylinders 88 and 92 together with the anode 81 and cathode 85 constitute a neutralization or output circuit; and the cylinders 91 and 92 constitute an input circuit. The length, and hence the tuning of these several circuits may be varied by the slidable members 96, 97 and 98. The slidable member 96 may be of the construction shown in Fig. 6. The slidable member 97 may be similar to that disclosed in Fig. 6 with the difference that one disc contacts with the cylinder 88 and the other disc contacts with only one of the halves of the cylinder 92. Similarly, the slidable member 98 may be similar to that shown in Fig. 6 except that, as shown in Fig. 12, one of the discs 104 contacts with only one of the halves of the cylinder 92, while the other disc 105 contacts the rod or cylinder 91, the discs being spaced by an insulator 106. The cylinders 88 and 92 may be provided with suitable slots or apertures (not shown) allowing manipulation of the slidable members 96, 97 and 98.

Inasmuch as the grid conductor 83, 90 is remote from the grid conductor 84, 91 and the cathode conductors, it will be clear that coupling of the circuit including the conductor 83, 90 with the input circuit and with the circuit including the cathode conductors and the cylinder 88 is prevented except through the electrodes of the device. Although the input circuit conductors are within the cylinder 88, undesired coupling between the input circuit and between the output or neutralization circuit including the cylinders 88 and 92 will not obtain at ultra-high frequencies because of skin effects. That is, the currents in the circuit including the cylinders 88 and 92 will be confined mainly to the outer surface of the cylinder 92. Currents in the input circuit will be confined mainly to the inner surface of the cylinder 92. In order to enhance these effects and thereby assure substantially complete segregation of the circuits mentioned, the cylinder 92 preferably should be made of relatively thick material, for example $\frac{1}{8}$ inch copper.

Although specific embodiments of the invention have been shown and described, it will be understood, of course, that various modifications may be made therein without departing from the scope and spirit of this invention as defined in the appended claims.

What is claimed is:

1. Signal translating apparatus comprising an electron discharge device including a cathode, an input electrode, and an output electrode, a pair of widely spaced leading-in conductors for said 75

input electrode, and a plurality of leading-in conductors for said cathode, one of which is disposed in proximity to one of the leading-in conductors for said input electrode and remote from the other of said leading-in conductors for said input electrode, a resonant circuit connected to said one input electrode leading-in conductor and the cathode leading-in conductor in proximity thereto, a resonant circuit connected to said anode and said other leading-in conductor for said input electrode, and a third resonant circuit connected to said cathode and said anode.

2. An electron discharge device comprising a cathode, an input electrode, an output electrode, two leading-in conductors one for said input electrode and the other for said output electrode, and three leading-in conductors for said cathode, two of said cathode leading-in conductors being disposed in proximity to one of said first conductors and the other of said cathode leading-in conductors being disposed in proximity to the other of said first conductors.

3. A signal translating device comprising a cathode, an anode, a control electrode, a pair of spaced leading-in conductors for said control electrode, a leading-in conductor for said anode angularly displaced from both of said first leading-in conductors, and a plurality of leading-in conductors for said cathode disposed one in proximity to one of said first leading-in conductors and the other in proximity to said anode leading-in conductor.

4. A signal translating device comprising a cathode, a grid, an anode, and pairs of leading-in conductors for each of at least two of said cathode, grid and anode, one conductor of each of said pairs extending in proximity to one conductor of another of said pairs, and the other conductors of said pairs extending at substantially right angles to said conductors in proximity.

5. An electron discharge device comprising a cathode, an input electrode, an output electrode, a pair of widely spaced leading-in conductors for said input electrode, a pair of leading-in conductors for said output electrode, one of which is in proximity to one of said first conductors and the other of which is widely spaced from the other of said first conductors, and a pair of leading-in conductors for said cathode disposed one in proximity to one of the leading-in conductors for said input electrode and the other in proximity to one of the leading-in conductors for said output electrode.

6. An electron discharge device comprising a cathode, a control electrode, an anode, a pair of widely spaced leading-in conductors for said cathode, a pair of leading-in conductors for said control electrode, one disposed in proximity to one of said cathode leading-in conductors and the other disposed remote from both of said cathode leading-in conductors, and a pair of leading-in conductors for said anode disposed one in proximity to the other of said cathode leading-in conductors and the other in proximity to said other leading-in conductor for said control electrode.

7. Signal translating apparatus comprising an electron discharge device including an enclosing vessel having vitreous end portions and an intermediate metallic portion serving as the anode of the device, a plurality of electrodes within said vessel mounted in cooperative relation with said anode, and a pair of leading-in conductors for one of said electrodes, one extending from one of said end portions and the other extending from the

other of said end portions, a tuned circuit connected to said anode and one of said leading-in conductors, and another tuned circuit connected to the other of said electrodes and the other of said conductors.

8. Signal translating apparatus comprising an electron discharge device including an enclosing vessel having insulating end portions and an intermediate metallic portion serving as the anode of the device, a cathode and a control electrode in said vessel, a pair of leading-in conductors for said cathode, one of said conductors extending from one of the ends of said vessel, and a leading-in conductor for said control electrode extending in proximity to said one of said cathode leading-in conductors, and separate resonant circuits connected between said leading-in conductor for said control electrode and said one cathode leading-in conductor and between said anode and the other of said cathode leading-in conductors.

9. Signal translating apparatus comprising an electron discharge device including an enclosing vessel having vitreous end portions and an intermediate metallic portion serving as the anode of the device, a cathode and a grid within said vessel, leading-in conductors for said grid extending from opposite ends of said vessel, leading-in conductors for said cathode extending from one end of said vessel, a resonant circuit connected to one of said grid leading-in conductors and said anode, a resonant circuit connected to said other grid leading-in conductor and said cathode, and a third resonant circuit connected to said cathode and said anode.

10. An ultra-high frequency amplifier comprising an electron discharge device including a cathode, a grid, an anode, a pair of divergent conductors extending from each of said cathode, grid and anode, each conductor of each pair being in proximity to only one conductor of each of the other pairs, an input circuit connected to proximate leading-in conductors for said cathode and grid, and separate resonant circuits connected to proximate conductors for said cathode and anode and for said grid and anode.

11. An ultra-high frequency amplifier comprising an electron discharge device including a cathode, a grid, an anode and a pair of divergent conductors extending from each of said cathode, grid and anode, each conductor of each of said pairs being in proximity to but one conductor of another of said pairs, and a plurality of distributed constant circuits connected one between each two conductors in proximity.

12. A translating system comprising an electron discharge device including an enclosing vessel, a cathode, an input electrode, an output electrode, leading-in conductors for said input electrode extending from opposite ends of said vessel, and a leading-in conductor for said cathode extending from one end of said vessel, a tubular conductor encompassing the leading-in conductors for said input electrode and electrically connected to said anode, a conductive member slidably contacting said tubular conductor and one of the leading-in conductors for said input electrode, a tubular conductor within said first tubular conductor encompassing the other of said leading-in conductors for said input electrode and electrically connected to said cathode, and a tuning member slidably contacting said tubular conductors.

13. Signal translating apparatus comprising an electron discharge device including an enclosing

vessel having a metallic portion serving as the anode of the device, a cathode and a grid within said vessel, leading-in conductors for said grid extending from opposite ends of said vessel, and
5 leading-in conductors for said cathode extending from one end of said vessel, a metallic member connected to one of said cathode leading-in conductors mounted adjacent one of the grid leading-in
10 conductors and forming a distributed constant system therewith, and a hollow metallic member surrounding said first metallic member and the other of said grid conductors and forming distributed constant systems therewith.

14. Signal translating apparatus comprising an
15 electron discharge device including an enclosing vessel having a cylindrical metallic portion serving as the anode of the device, a grid and a cathode within said anode and coaxial therewith, leading-in conductors for said grid extending
20 from opposite ends of said vessel and coaxial with said anode, leading-in conductors, for said

cathode extending from one end of said vessel, a metallic cylinder encompassing one of said grid leading-in conductors and coaxial therewith, said cylinder being connected to said cathode and
5 forming a concentric conductor system with said one grid leading-in conductor, a metallic cylinder encompassing said first cylinder and the other of said grid leading-in conductors and forming
10 concentric conductor systems therewith, and means for varying the effective length of each of said systems.

15. An ultra-high frequency amplifier comprising an electron discharge device including a cathode, grid and anode coaxially mounted, and a plurality of concentric conductor systems including
15 said electrodes and coaxial therewith, said systems being connected one to said cathode and grid, one to said cathode and anode, and one to said grid and anode, and one of said systems being
20 disposed within another of said systems.

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