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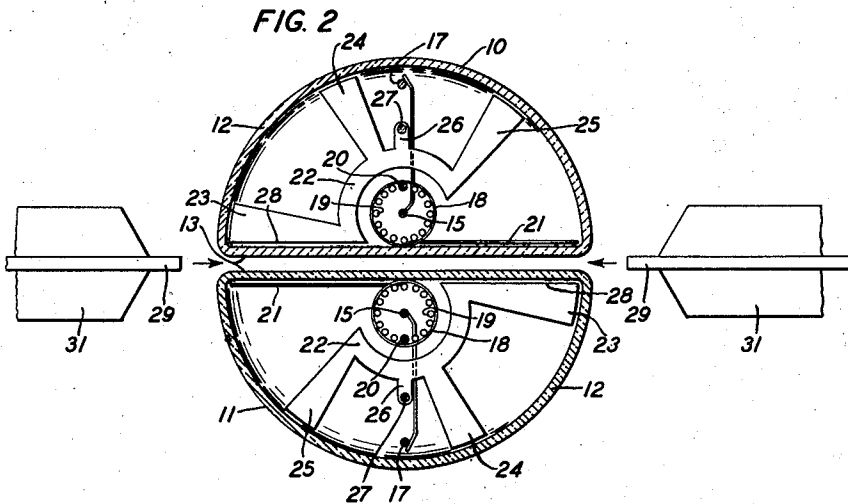
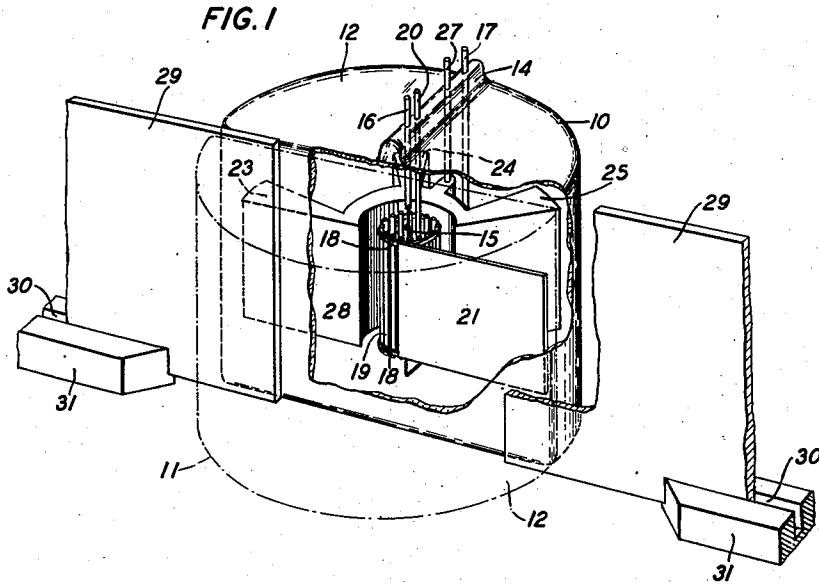
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SIGNAL TRANSLATING APPARATUS

Filed June 30, 1936

2 Sheets-Sheet 1



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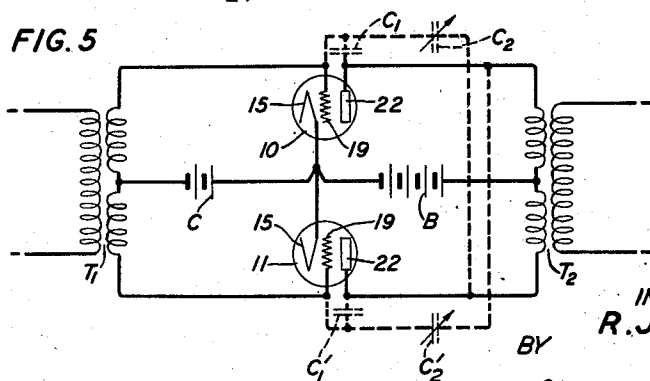
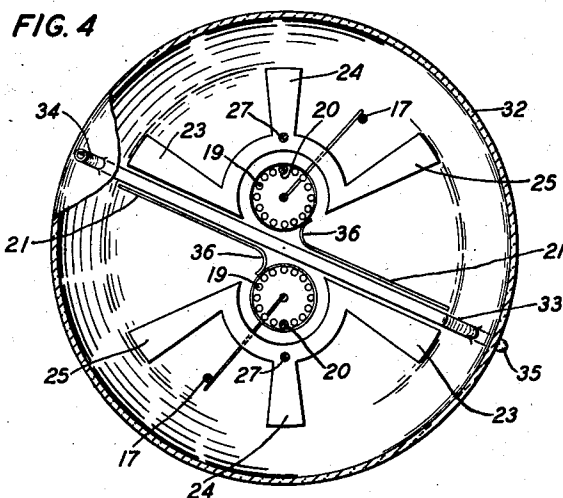
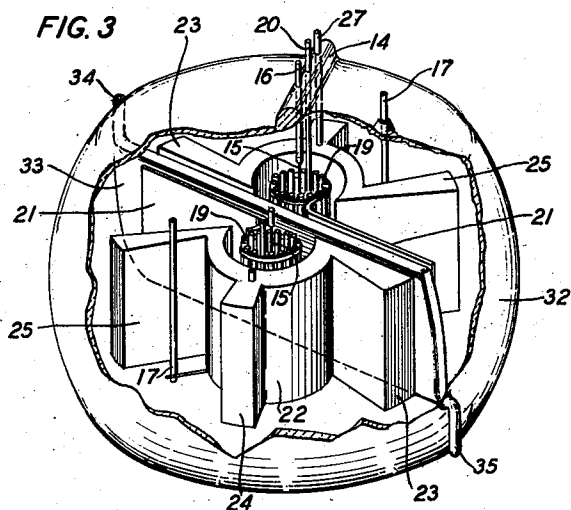
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SIGNAL TRANSLATING APPARATUS

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2 Sheets-Sheet 2



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## UNITED STATES PATENT OFFICE

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## SIGNAL TRANSLATING APPARATUS

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20 Claims. (Cl. 250—27.5)

This invention relates to signal translating apparatus and more particularly to electron discharge devices especially suitable for use as ultra-high frequency amplifiers.

One object of this invention is to reduce distortion in amplifiers including electron discharge devices.

Another object of this invention is to facilitate the adjustment of the coupling between electrodes of a plurality of electron discharge devices, specifically, for example, between the control electrodes and anodes of a pair of such devices operated in push pull.

In one illustrative embodiment of this invention, a push-pull amplifier comprises a pair of electron discharge devices each of which includes an enclosing vessel having a substantially plane wall, and housing a cathode, a control electrode or grid, and an anode. The control electrode and anode of each device are provided with relatively large area fins which may be substantially coplanar and disposed adjacent and substantially parallel to the plane wall of the enclosing vessel. The two vessels are positioned with the plane walls thereof opposite and substantially parallel whereby the fin on the control electrode of each device is opposite to the fin on the anode of the other device and forms a condenser therewith. The capacitance of the condensers thus formed may be adjusted expeditiously by dielectric or metallic plates slidably mounted between the plane walls of the enclosing vessel. For example, the condensers may be so adjusted that they are of the same capacitance as the internal grid-anode capacitance whereby the appearance of deleterious potentials upon the control electrodes is prevented and distortion in the output of the amplifier is materially reduced or substantially eliminated.

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 signal translating apparatus including electron discharge devices constructed in accordance with this invention, one of the devices being illustrated in phantom;

Fig. 2 is a top view partly in cross-section of the apparatus illustrated in Fig. 1, showing the form and relation of the electrodes of the electron discharge devices;

Fig. 3 is a view in perspective of another illustrative embodiment of this invention;

Fig. 4 is a top view partly in cross section of the apparatus shown in Fig. 3; and

Fig. 5 is a circuit diagram of a push-pull amplifier illustrative of one embodiment of this invention.

Referring now to the drawings, the apparatus shown in Figs. 1 and 2 comprises a pair of similar electron discharge devices, designated generally as 10 and 11, each of which includes an enclosing vessel having a substantially semi-cylindrical portion 12 and a substantially plane wall 13, the vessels being provided with an external press 14. Disposed within each vessel is a cathode 15 which may be a linear filament supported at its ends by wires or rods 16 and 17 sealed in the press 14, preferably at relatively widely spaced points. Although the cathode has been shown as a filament, it may be of other types, for example, of the equipotential indirectly heated type. Furthermore, if desired, the supports 16 and 17 may be sealed in the wall of the vessel opposite the press 14.

Each cathode 15 is encompassed by a control electrode or grid, which may be of the cage type, comprising a pair of metallic annular end members 18 and a plurality of wires 19 affixed to the end members 18 and mounted parallel to each other and to the cathode 15. Preferably the wires 19 are disposed within a cylindrical or elliptical boundary coaxial with the cathode 15. The control electrode or grid may be supported by a single metallic rod or wire 20 affixed to one of the annular members 18 and sealed in the press 14, preferably in proximity to the leading-in conductor 16 for the cathode 15. Each control electrode is provided with a relatively large area metallic or graphitic plate or fin 21 which is positioned closely adjacent and substantially parallel to the plane wall 13 of the corresponding enclosing vessel.

An anode is cooperatively associated with each cathode and control electrode and may be, for example, a single piece metallic or graphitic casting including an arcuate portion 22, coaxial with the corresponding cathode and control electrode, radially extending relatively large area heat radiating fins 23, 24 and 25, and a flange 26. The anode may be supported by a single metallic rod or wire 27 secured to the flange 26 and sealed in the press 14, preferably in proximity to the leading-in conductor 17 for the cathode 15. The fin 23 is provided with a plane surface 28 disposed immediately adjacent and substantially parallel to the plane wall 13 of the corresponding enclosing vessel, and preferably coplanar with

the outer surface of the plate member or fin 21 on the grid.

The cathode, control electrode and anode of each of the electron discharge devices preferably are spaced as closely together as may be dictated by the desired characteristics of the device and by the mechanical feasibility and the allowances for the necessary insulation requirements.

As shown more clearly in Fig. 2, the two electron discharge devices 10 and 11 are mounted with the plane walls 13 thereof opposite, closely adjacent and substantially parallel. Hence, the fin 21 on the control electrode or grid of each device is opposite and parallel to the fin 23 of the anode of the other device and forms a condenser therewith, whereby the control electrode or grid of each device is capacitively coupled to the anode of the other device. The capacitance of the condensers thus formed, and hence the coupling between the control electrodes and anodes, may be adjusted by dielectric or metallic plates 29 each of which is slidably mounted in a groove 30 in a base or support 31 and is insertable between the plane walls 13 of the enclosing vessels.

In signal translating apparatus, such, for example, as push-pull amplifiers, by virtue of the grid-anode capacitances, some energy feedback occurs from the anode to the grid as a result of which an undesired variable potential appears upon the grid so that distortion obtains and when sufficiently augmented, oscillations occur. Such undesired variable potentials causing regeneration and oscillation are eliminated in accordance with this invention by neutralizing externally the internal energy feedback paths. To this end, the capacitances between the grid and anode fins are adjusted by the plates 29 so that each is equal to the total capacitance between the control electrode and anode of each of the devices 10 and 11. Hence, each control electrode will receive an identical amount of energy feedback from both of the anodes, but the voltage appearing upon the control electrode by virtue of its capacitance to one anode is 180 degrees out of phase with the potential appearing thereon by virtue of its capacitance to the other anode. The net potential, therefore, induced upon each control electrode is zero so that distortion is minimized and substantially eliminated as are the regeneration and oscillation propensities.

When the slidable plates 29 are of metal, the bases or supports 31 should be of a good dielectric or insulating material so that the capacity of the plates 29 to ground will be small.

In the fabrication of the devices shown in Figs. 1 and 2 the several electrodes may be accurately positioned within the semi-cylindrical portion 12 of the corresponding enclosing vessel and the leading-in conductors therefor sealed in the press 14. Subsequently the vessels may be sealed by fusing the plane walls 13 to the semi-cylindrical portion of the vessels. A suitable outlet, not shown, may be provided for allowing evacuation of the enclosing vessel.

In another illustrative embodiment of this invention, shown in Figs. 3 and 4, the two electrode units may be mounted in a single enclosing vessel 32, the several electrodes being substantially identical in construction to those illustrated in Figs. 1 and 2 and supported solely by the leading-in conductors therefor. Preferably the grid fins 21 are provided with curved portions 36 adjacent their attachment to the grids so that the area of opposed portions of these fins is very small and

the input capacity is maintained relatively low. As shown clearly in Fig. 4, the plate member or fin 21 associated with the control electrode of each electrode unit is disposed opposite and substantially parallel to the fin or plate member 23 on the anode of the other electrode unit and forms a condenser therewith. The fins may assume whatever structural properties that may be desirable for the fullest realization of all functions which they perform.

Mounted within the vessel 32 is a narrow flat envelope 33 which is disposed between the two electrode units and has opposite walls substantially parallel to the plate members or fins 21 and 23. The envelope 33 is provided with inlet and outlet ports 34 and 35 respectively sealed in walls of the enclosing vessel 32.

A fluid, liquid or gas, may be introduced into and removed from the envelope 33 for varying and adjusting the capacitance of the condensers formed by the plate members or fins 21 and 23. The fluid may be a conductive material, for example mercury, or a non-conductive material having a high dielectric constant, such for example as oil. The level of the fluid within the envelope 33 may be such that the capacitance between each fin 21 and the opposite fin 23 is equal to the capacitance between each control electrode and the anode corresponding thereto, whereby, as pointed out hereinabove the appearance of undesired potentials upon the control electrodes is prevented.

Alternatively, the envelope 33 may have therein a quantity of a suitable gas under pressure, the dielectric constant being determined by the nature of the gas and the pressure. For example, the gas and the pressure at non-operating temperatures may be so chosen that at the temperatures extant in the device during operation the dielectric constant of the gas is increased in amount such as to counteract and offset any positive increment in the capacity between the plate members or fins on the grids and anodes.

The electron discharge devices heretofore described may be utilized in a push-pull amplifier as illustrated, for example, in Fig. 5. As shown in this figure, the grids or control electrodes 19 may be connected to opposite ends of the secondary winding of an input transformer  $T_1$ , a source, such as a battery C being provided to apply a suitable biasing potential to the grids. Similarly, the anodes 22 may be connected to opposite ends of the primary of an output transformer  $T_2$  and have a suitable potential applied thereto from a source such as a battery B.

The capacitances between each grid and the corresponding anode are indicated by the condensers  $C_1$  and  $C_1'$ . The capacitances between the grid of each device and the anode of the other device are indicated by the condensers  $C_2$  and  $C_2'$ . The latter capacitances are adjusted as described hereinabove so that the resultant energy feedback to each grid is substantially zero in accord with the capacity bridge type of neutralization.

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 a pair of enclosing vessels having juxtaposed walls and each housing a plurality of electrodes, and means including plate members immediately ad-

jacent said walls and within said vessels forming a condenser capacitively coupling an electrode within one vessel to an electrode within the other vessel.

2. Signal translating apparatus in accordance with claim 1 comprising means exterior to said vessels and between said walls for varying the coupling between the coupled electrodes.

3. Signal translating apparatus comprising a pair of enclosing vessels, a plurality of electrodes within each of said vessels, leading-in conductors for said electrodes, and juxtaposed plate members separate from said leading-in conductors and within said vessels forming condensers coupling two of the electrodes within one vessel to two of electrodes within the other vessel.

4. Signal translating apparatus in accordance with claim 3 comprising means exterior to said vessels and insertable between said plate members for varying the capacitance of said condensers.

5. An electron discharge device comprising an enclosing vessel having a substantially plane wall, a cathode, a control electrode and an anode within said vessel, means electrically connected to said control electrode consisting of a plate member extending substantially parallel to and immediately adjacent said wall, and means electrically integral with said anode consisting of a plate member substantially coplanar with said first plate member and also immediately adjacent said wall.

6. An electron discharge device comprising an enclosing vessel having a substantially plane wall, a cathode, a cylindrical control electrode encompassing said cathode, an arcuate anode cooperatively associated with said cathode, metallic fins extending individually from said control electrode and said anode and electrically connected thereto, said fins being disposed immediately adjacent said plane wall and substantially parallel thereto, and means outside of said vessel forming condensers with said fins.

7. An electron discharge device comprising a pair of electrode units each including a cathode, a control electrode and an anode, the control electrode of one of said units having a fin portion, the anode of the other of said units having a fin portion adjacent said first fin portion and forming a condenser therewith, and means between said fin portions for adjusting the capacitance of said condenser.

8. An electron discharge device comprising a pair of electrode units each including a cathode, a control electrode having a fin portion, and an anode having a fin portion, the fin portion of the control electrode of each of said units being opposite the fin portion of the anode of the other unit, whereby the control electrode of each unit is coupled to the anode of the other unit, and means between opposite of said fin portions and substantially parallel thereto for varying the coupling between said control electrodes and said anodes.

9. Signal translating apparatus comprising a pair of enclosing vessels each housing a cathode, a control electrode and an anode, means including members within said vessels capacitively coupling the control electrode within each vessel to the anode within the other vessel, and means for varying the capacitive coupling between the control electrode in each vessel and the anode in the other vessel.

10. Signal translating apparatus comprising a pair of enclosing vessels each housing a cathode,

a control electrode and an anode, plate members within said vessels forming condensers coupling the control electrode in each vessel to the anode in the other vessel, each plate member being electrically connected to one of said control electrodes or anodes and each member in one vessel being opposite one member in the other vessel, and means exterior to said vessels and insertable between opposite plate members for varying the capacitance of said condensers.

11. Electron discharge apparatus comprising a pair of enclosing vessels having opposed walls, a cathode, an anode, and a control electrode within each of said vessels, means coupling the control electrode in each vessel to the anode in the other vessel including conductive members adjacent said walls, and coupling adjusting means between said walls.

12. Electron discharge apparatus comprising a pair of enclosing vessels each having a substantially plane wall, said vessels being disposed with said plane walls substantially parallel, an electrode unit in each of said vessels including a cathode, a control electrode having an extended portion substantially parallel to said walls, and an anode having an extended portion substantially parallel to said walls, the extended portion of each control electrode being opposite the extended portion of the anode of the other unit whereby each control electrode is capacitively coupled to the anode of the other unit, and a slidable member extending between said opposite extended portions.

13. Signal translating apparatus comprising a pair of enclosing vessels having opposed walls, an electrode unit within each of said vessels including a cathode, a control electrode and an anode, condensers coupling each control electrode to the anode of the other unit, including plate members within said vessels and adjacent said walls, and means between said walls for varying the capacitance of said condensers.

14. Signal translating apparatus comprising a pair of enclosing vessels having juxtaposed plane parallel walls, an electrode unit within each of said vessels including a cathode, a grid encompassing said cathode, and an arcuate anode, each grid and anode having a large surface plane fin adjacent said walls and substantially parallel thereto, the fin of each control electrode being opposite the fin of the anode of the other unit and forming a condenser therewith, and slidable plate members between said walls for varying the capacitance of said condensers.

15. An electron discharge device comprising an enclosing vessel, an envelope in said vessel, a plurality of electrodes within said vessel having portions adjacent said envelope and forming a condenser therewith, and means for introducing a fluid into said envelope for varying the capacitance of said condenser.

16. An electron discharge device comprising an enclosing vessel, a plurality of electrodes within said vessel, means defining a chamber between two of said electrodes, and inlet means for said chamber whereby a fluid may be introduced into said chamber for varying the capacitance between said two electrodes.

17. An electron discharge device comprising an enclosing vessel, an envelope within said vessel, a plurality of electrode units within said vessel each including a pair of electrodes having portions adjacent said envelope and forming condensers coupling the pair of electrodes of one unit to the pair of electrodes of the other unit,

and means for introducing a fluid into said envelope whereby the capacitance of said condensers may be adjusted.

18. An electron discharge device comprising an enclosing vessel, a pair of electrode units within said vessel each including a cathode, a grid and an anode, the grids and anodes having fins and the fin on the grid of each unit being opposite the fin on the anode of the other unit and forming a condenser therewith, and an envelope extending between said opposite fins and adapted to have a fluid introduced therein for varying the capacitance of said condensers.

19. A push-pull amplifier comprising a pair of similar electrode units each including a cathode, a grid and an anode, the grid of each of said units having a portion in proximity to the anode of the other of said units and forming a condenser therewith, and means between said portions of the grids and anodes which are in prox-

imity for adjusting the capacitance of each of said condensers to a value commensurate with the grid-anode capacitance of each of said electrode units.

20. An electron discharge device comprising a pair of similar electrode units each including a cathode, a grid encompassing the cathode, and an arcuate anode coaxial with the grid, each grid having a plate member electrically integral therewith and each anode having an integral fin substantially coplanar with the plate member of the corresponding grid, each anode fin being opposite and substantially parallel to the plate member of the grid of the other electrode unit and forming a condenser therewith, and means removably insertable between each of said plate members and the opposite fin for varying the capacitance of the condenser formed thereby.

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