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ELECTRIC WAVE AMPLIFYING SYSTEM

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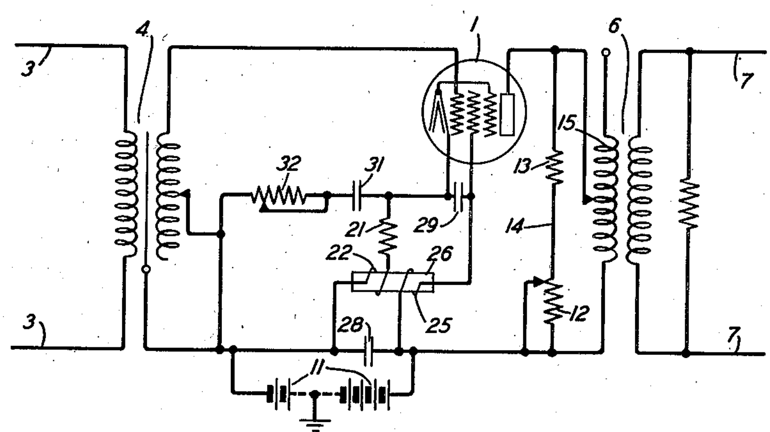

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ELECTRIC WAVE AMPLIFYING SYSTEM

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7 Claims. (Cl. 179—171)

This invention relates to systems involving electric space discharge devices, as for example electric wave amplifying systems.

An object of the invention is control of transmission properties of such devices or systems, as for example, their gain or transmission efficiency, load carrying capacity, and modulation or distortion.

In one specific aspect the invention is an amplifier with anode and grid circuits comprising a common impedance having two parallel branches, one branch having its direct current impedance high compared to the other and having a variable resistance for providing variable negative feedback of the waves to be amplified and the other branch having resistance traversed by the anode direct current for providing grid biasing voltage and having inductance of high reactance for the waves to be amplified. For instance, the one branch may have, in series with the variable resistance therein, a condenser of low reactance for the waves to be amplified, for preventing passage of direct current through that branch; and the other branch may have, in series with the resistor for providing grid biasing voltage, an inductance coil for substantially preventing passage of the waves to be amplified through that branch. By varying the resistance in the one branch, the amount of the negative or gain-reducing feedback can be varied to vary or adjust the amplifier gain, for example through a range of several times ten decibels, without causing the grid biasing voltage to vary, and therefore without deleteriously affecting the power output capacity of the amplifier.

Other objects and features of the invention will be apparent from the following description and claims.

The single figure of the drawing shows an amplifier embodying the specific form of the invention referred to above.

The amplifier comprises a pentode tube 1 for amplifying speech or other signal waves supplied to tube 1 from incoming line or circuit 3 through input transformer 4 and transmits the amplified waves through output transformer 6 to outgoing line or circuit 7.

Plate voltage for the tube is supplied from battery 11. Plate current for the tube passes from the positive terminal of the battery through two branch circuits to the plate. One of these branch circuits includes resistors 12 and 13 in series and is designated 14, and the other includes the primary winding 15 of transformer 6. This current passes from the plate through the tube to the cathode, and then through resistance 21 and choke coil 22 to the negative pole of the battery.

Screen grid potential for the tube is supplied from the battery through choke coil 25 which may have the same magnetic core 26 as coil 22. Condensers 28 and 29 are by-pass condensers of low reactance for alternating current.

The voltage across resistance 21 and choke coil 22 due to flow of plate and screen direct currents therethrough supplies grid biasing potential for the control grid of the tube.

The alternating current output circuit of the tube extends from the cathode through condenser 31, resistance 32, condenser 28, and branch circuits 14 and 15, to the plate. The voltage across condenser 31 and resistance 32 due to flow of alternating current therethrough produces negative or gain-reducing feedback in the tube. Negative feedback is advantageous for example for reducing the modulation and noise in the amplifier and increasing its gain stability, as pointed out in the paper by H. S. Black on Stabilized Feed-back Amplifiers, Electrical Engineering, January 1934, pages 114 to 120, and the voltage amplification for propagation once around the feedback loop may be of a larger order of magnitude than unity, for obtaining large modulation reduction or gain stability, as pointed out in that paper.

Resistance 32 is adjustable, for varying the amount of the negative feedback to vary or adjust the amplifier gain, for example through a range of several times ten decibels, without causing the grid biasing voltage to vary, and therefore without deleteriously affecting the power output capacity of the amplifier or reducing the undistorted power that the amplifier is capable of delivering to the load.

For signaling frequencies or alternating current, the reactance of condenser 31 may be negligibly low and the admittance of coil 22 may be negligibly low. The ratio of the impedance of the path through resistance 21 and coil 22 to the impedance of the path through condenser 31 and resistance 32, may be low for direct current and high for signal frequencies or alternating current.

For signal frequencies or alternating current, the impedance of coil 25 may be sufficiently high to substantially prevent shunting of current from the path through condenser 31 and resistance 32 by the path through condenser 29 and coil 25.

By way of example, with the tube 1 a Western Electric Company's 310A or 311A type of tube: condenser 31 may have a capacity of 4 microfarads; condenser **28** a capacity of 4 microfarads; condenser **29** a capacity of 2 microfarads; resistance **32** in its maximum setting a value of 3,140 ohms when its desired range of gain variation is for instance 20 decibels, or a value of approximately 100,000 ohms when its desired range of gain is for instance approximately 45 decibels; resistance **21** a value of 150 ohms; coil **22** a direct current resistance of 350 ohms; and coil **25** a direct current resistance of 350 ohms. Coils **22** and **25** may be wound on core **26** as shown, so that current flowing to the left through coil **22** acts cumulatively with current flowing to the left through coil **25**.

With the 311A tube, resistance **12** may be short-circuited and a portion of the winding **15** omitted from circuit, as indicated in the drawing. When the 310A tube is used, the entire resistance **12** and the entire winding **15** may be included in circuit. By way of example, when the circuit is to be used with these two types of tubes, the resistance **12** and **13** may have values of 86,500 ohms and 13,500 ohms, respectively.

What is claimed is:

1. A system for translating signaling waves comprising an electric space discharge device having anode and grid circuits and gain control means for said device comprising an impedance common to said circuits having two electrically separate branches in parallel relation, one of said branches comprising in series a capacity and a resistance traversed by said signaling waves for providing negative feedback of the waves to be translated and the other of said branches comprising inductance and effectively in series therewith resistance traversed by anode direct current for providing grid biasing voltage, and means for varying said first-mentioned resistance sufficiently to vary said negative feedback through a substantial range.

2. A system for translating signaling waves comprising an electric space discharge device having anode and grid circuits and gain control means for said device comprising a two-terminal network common to said circuits, said network having two branches electrically separated throughout their lengths, one having its direct current impedance high compared to the other, a condenser in said one branch and in series therewith a resistance in said one branch traversed by said signaling waves for producing gain-reducing feedback of the waves to be translated, means for varying said resistance sufficiently to produce substantial gain variation of said device for said waves to be translated, and in said other branch a resistance traversed by the anode direct current for providing grid biasing voltage and an inductance effectively in series therewith for substantially preventing passage therethrough of the waves to be translated, said first-mentioned resistance having a value sufficient to cause reduction of the gain of said device for said waves to be translated at least of the order of ten decibels.

3. A signaling wave translating system comprising an electric space discharge device having anode, cathode and grid structures, cathode-anode and cathode-grid signaling wave circuits for said device having a common impedance comprising in series a condenser and a resistance traversed by the signaling waves for producing negative feedback of said waves in said device, means for varying said resistance sufficiently to produce gain variation of said device for the waves to be translated at least of the order of ten decibels, over the frequency range of said waves, and direct current cathode-anode and cathode-grid circuits for said device having a common impedance comprising effectively in series an inductance of high impedance to waves to be translated and a resistance traversed by anode direct current for providing grid biasing voltage for said device, said impedances being electrically separated except at their ends.

4. A wave translating system comprising an electric space discharge device having anode, cathode, control grid and screen grid electrodes, alternating current cathode-anode and cathode-control grid circuits for said device having a common impedance comprising a condenser and in series therewith a variable resistance for producing variable negative feedback in said device, direct current cathode-anode and cathode-control grid circuits for said device having a common impedance comprising a choke coil with a magnetic core, said impedances being electrically separated except at their ends, a direct current cathode-screen grid circuit for said device comprising a choke coil having a winding on said core, and a by-pass condenser connecting said cathode to a point on said last-mentioned circuit between said last-mentioned winding and said screen grid.

5. In a wave translating system, a screen grid tube, a space current supply source therefor, a path including an inductance coil connected between the tube cathode and the negative pole of said source, a circuit including said coil connecting the cathode and the control grid of the tube, and a connection including a second inductance coil between the screen grid and a point of positive potential on said source, said coils being coupled in series opposing inductive relation.

6. A wave translating system comprising an electric space discharge device having two grids, a circuit comprising an inductance coil connecting the cathode to one of the grids, a second circuit comprising a second inductance coil and said first inductance coil in serial relation connecting the cathode to another of the grids, said coils being so inductively related that for current flowing in series through said coils the flux which is produced by the current in one coil is decreased by the current flowing in the other coil, and a capacity of low reactance for frequencies of the waves to be translated connected across a portion of said second circuit including said coils.

7. A wave translating system comprising an electric space discharge device having an anode, a cathode, a discharge control grid, a second grid, a circuit comprising a source of direct current connecting said cathode and said anode, a circuit connecting said cathode and said control grid, an inductance coil common to said circuits, a path connecting said cathode and said second grid and including said coils and said source in serial relation, with said source connected between said coils, and a by-pass condenser connected across a portion of said path including said coils and said source, said coils being arranged in series opposing inductive relation.

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