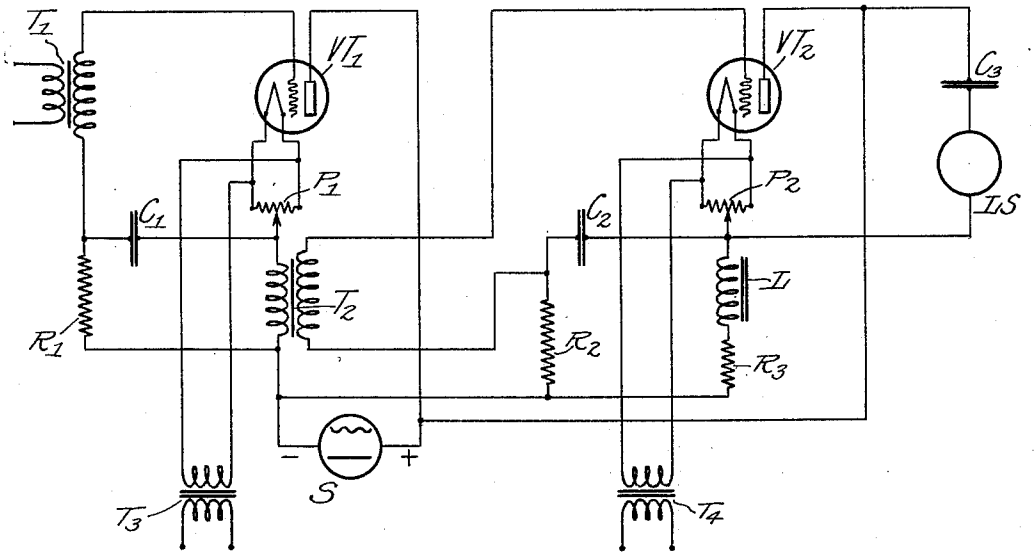
April 19, 1932. B. F. MIESSNER 1,854,854.

AMPLIFIER SYSTEM

Filed Feb. 2, 1929



WITNESS

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Patented Apr. 19, 1932 1,854,854

UNITED STATES PATENT OFFICE

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AMPLIFIER SYSTEM

Application filed February 2, 1929. Serial No. 337,147.

The present invention relates to amplifier systems, and more particularly to coupling arrangements in such systems.

An object is the utilization of the coupling elements ordinarily employed in amplifier systems in multiple function, whereby apparatus generally used for one of the functions may be dispensed with.

The invention is more fully described by reference to the one figure of the accompanying drawings in which is shown an amplifier system including two three-electrode vacuum tubes VT_1 and VT_2 connected in cascade relation for amplifying audio frequency currents supplied to the system through an input device, such as a transformer T_1. There is shown a source of potential S, having positive and negative terminals as indicated for energizing the plate and grid electrodes of the tubes, which source may be any source of unidirectional current, such as the unidirectional pulsating output from an alternating current rectifier followed by a suitable filter system in accordance with general practice.

The filaments of the tubes are indicated as supplied with raw alternating current for heating through transformers T_3 and T_4, though a single transformer may be used for the filaments of several tubes, or any other suitable source of current supply and system for filament heating may be employed.

I show the filament of tube VT_1 connected to the negative terminal of source S by way of a center-tap potentiometer P_1 and the primary winding of transformer T_2, and therefore in series with the plate circuit, so that the connection of the grid of this tube to the negative side of the primary winding of T_2 permits of employing the difference of potential developed therein as a grid biasing potential. The winding of the primary of the transformer may be chosen to give such direct current resistance that the normal direct current component of plate current employed in tube VT_1 results in developing the desired grid biasing potential for the tube.

It is seen that this connection of transformer T_2 does not interfere with the signal current variations flowing through the primary winding, and thus exciting the secondary winding for transfer of signal current energy to the succeeding tube VT_2.

The condenser C_1 of low impedance to signal currents and high resistance R_1 form a filter system for by-passing grid circuits signal currents directly to the filament and reducing and regulating signal current coupling between plate and grid circuits.

In association with tube VT_2 I show a choke and condenser form of output coupling for a loud speaker or other sound reproducer LS, the choke and condenser combination comprising the coil L and condenser C_3. I insert the choke coil L in the connection between the filament of tube VT_2, shunted by a center-tap potentiometer P_2, and the negative terminal of source S, thus employing as before the difference of potential developed therein for energizing the grid of tube VT_2. If needed I may supplement the direct current resistance of the choke coil by a resistance R_3 in order to develop the required biasing potential, which may be desirable in case the tube VT_2 is a so-called power amplifier requiring potential for biasing too large to be satisfactorily developed in coil L.

If a two-winding output transformer is used for connecting the translating device LS to the system in lieu of the choke and condenser coupling, the arrangement may be the same for tube VT_2 as shown for tube VT_1. A filter system comprising condenser C_2 and resistance R_2 is shown for the same purpose as outlined in connection with tube VT_1.

It is seen that by the connections I employ it is possible to dispense with the usual grid biasing batteries or biasing resistors employed in connection with vacuum tube amplifier systems, and further reduce the amount of potential required from the source S in comparison with a system having a transformer in the plate circuit and a resistor in the connection between the filament and the negative terminal of the source.

In the case of source S being a fluctuating one the fluctuating component through inductance L and resistance R_3 is enhanced by the fluctuating component that passes through condenser C_3 and translating device LS to

these elements. The fluctuating or alternating current component passing through inductance L and resistance R_3 introduces fluctuating potentials on the grid out of phase with those on the plate, so that selecting the values of resistance R_2 and condenser C_2 to control the degree of these fluctuating grid potentials permits of neutralizing wholly or in part as desired the residual fluctuations through translating device LS.

Having thus described my invention, what I claim is:

1. An amplifier system having a plurality of amplifier tubes, each of said tubes having grid-filament and plate-filament circuits, each of said plate-filament circuits having a source of power and an inductance of known resistance between said source of power and said filament, said grid-filament circuits also including said inductance, whereby the average potentials of said grids are maintained at known values relative to those of said filaments, at least one of said inductances constituting the primary of a transformer, the secondary of which is included in the grid-filament circuit of a succeeding tube whereby energy is transferred between the tubes.

2. An amplifier system including an amplifier tube having grid-filament and plate-filament circuits, said plate-filament circuit including a source of power and a reactive impedance between said source and said filament, the grid-filament circuit of said tube including said reactive impedance whereby the average potential of said grid is maintained at a known value relative to that of said filament, said impedance constituting the primary of an output transformer for the plate-filament circuit of said tube.

3. An amplifier system including a plurality of amplifier tubes in cascade, each tube having grid-filament and plate-filament circuits, each of said plate-filament circuits including a source of power, inductances and resistances between said source of power and said filaments, said grid-filament circuits also including said inductances and resistances, and filter resistances and condensers also included in said grid-filament circuit whereby the average potentials of said grids are maintained at known potentials relative to said filaments.

4. An amplifier system including a plurality of amplifier tubes in cascade, each tube having grid-filament and plate-filament circuits at least one of said plate-filament circuits including an inductance of known resistance, the grid-filament circuit of said tube also including said inductance and an indicator and condenser series connected between the plate of said tube and the filament terminal of one of said inductances, whereby said inductance both shunts signal current through said indicator and maintains the average potential of said grid at a known value relative to that of said filament.

5. An amplifier system including a plurality of amplifier tubes in cascade, each tube having grid-filament and plate-filament circuits, at least one of said plate-filament circuits including a source of power, a reactive impedance and a variable resistance between said source of power and said filament, the grid-filament circuit of said tube also including said impedance and resistance, and an indicator and condenser series connected between the plate of said tube and a point between the said impedance and resistance and the said filament whereby said inductance both shunts signal current through said indicator and maintains the average potential of said grid at a known value relative to that of said filament.

6. An amplifier system including a plurality of amplifier tubes in cascade, each tube having grid-filament and plate-filament circuits, each of said plate-filament circuits including a source of power and reactive impedances between said source of power and said filaments, the grid-filament circuits of each of said tubes also including said impedances whereby the average potentials of said grids are maintained at known values relative to those of said filaments, at least one of said impedances constituting the primary of a transformer, the secondary of which is included in the grid-filament circuit of a succeeding tube, whereby energy is transferred between tubes and the plate-filament circuit of at least one of said tubes having an indicator and condenser series connected between the plate of said tube and a point between the impedance and the filament in its respective plate-filament circuit.

7. An amplifier system having a plurality of amplifier tubes, each of said tubes having grid-filament and plate-filament circuits, each of said plate-filament circuits having a source of power and an inductance of known resistance between said source of power and said filament, said grid-filament circuits also including said inductances, whereby the average potential of said grids are maintained at known values relative to that of said filament, at least one of said inductances constituting the primary of a transformer, the secondary of which is included in the grid-filament circuit of a succeeding tube whereby energy is transferred between the tubes, and means for shunting the signal energy in said grid-filament circuit around said impedance.

8. An amplifier system including a plurality of amplifier tubes in cascade, each tube having grid-filament and plate-filament circuits, at least one of said plate-filament circuits including an inductance of known resistance, the grid-filament circuit of said tube also including said inductance, means

for shunting the signal energy in said grid-filament circuit around said inductance, and an indicator and a condenser series connected between the plate of said tube and the filament terminal of one of said inductances, whereby said inductance both shunts signal current through said indicator and maintains the average potential of said grid at a known value relative to that of said filament.

9. An amplifier system including a plurality of amplifier tubes in cascade each of said tubes having grid-filament and plate-filament circuits, at least one of said plate-filament circuits including a source of power and an inductance and a variable resistance between said source of power and said filament, the grid-filament circuit of said tube also including said inductance and resistance, means for shunting the signal energy in said grid-filament circuit around said impedance, and an indicator and condenser series connected between the plate of said tube and a point between said inductance and resistance and the said filament whereby said inductance both shunts signal current through said indicator and maintains the average potential of said grid at a known value, relative to that of said filament.

10. An amplifier system including a plurality of amplifier tubes in cascade, each tube having grid-filament and plate-filament circuits, each of said plate-filament circuits including a source of power and an inductance between said source of power and said filaments, the grid-filament circuit of each of said tubes also including one of said inductances, whereby the average potentials of said grids are maintained at known values relative to those of said filaments, at least one of said inductances constituting the primary of a transformer, the secondary of which is included in the grid-filament circuit of a succeeding tube, whereby energy is transferred between the tubes, means for shunting the signal energy in said grid-filament circuit around said inductance, and the plate-filament circuit of at least one of said tubes having an indicator and a condenser series connected between the plate of said tube and the point between the inductance and the filament in its respective plate-filament circuit.

11. An amplifier system including a plurality of amplifier tubes in cascade, each tube having grid-filament and plate-filament circuits, each of said plate-filament circuits including a source of power and an inductance between said source of power and said filaments, the grid-filament circuit of each of said tubes also including one of said inductances, whereby the average potentials of said grids are maintained at known values relative to those of said filaments, at least one of said inductances constituting the primary of a transformer, the secondary of which is included in the grid-filament circuit of a succeeding tube, whereby energy is transferred between the tubes, means for shunting the signal energy in said grid-filament circuit around said inductance, the plate-filament circuit of at least one of said tubes having an indicator and a condenser series connected between the plate of said tube and the points between the inductance and the filament in its respective plate filament circuit, and means for shunting the signal energy in the grid-filament circuit of said last mentioned tube around the inductance in said grid-filament circuit.

12. The combination of a three electrode vacuum tube, input and output circuits, a source of unidirectional pulsating current having its positive terminal connected to said output circuit, an impedance connected between the filament of said tube and the negative terminal of said source, a connection including a condenser and translating device between the positive terminal of said source and said filament, a connection for impressing the potential developed in said impedance upon the grid of said tube, and means for controlling the degree of the fluctuating component of said grid impressed potential, said impedance shunting signal current through said indicator and maintaining the average potential of said grid at a predetermined value relative to that of said filament.

13. In an amplifier system, a space discharge device comprising a cathode, a grid electrode and an anode so inter-related as to form an input circuit and an output circuit for said device, a second space discharge device having an input circuit and an output circuit, means included in said first named input circuit for coupling said first named output circuit to the input circuit of said second mentioned space discharge device, said means being adapted to maintain the average potential of said grid electrode at known potential relative to said cathode.

14. In an amplifier system, a space discharge device having a cathode, a grid electrode and an anode related so as to form an input circuit and an output circuit, a second space discharge device having an input circuit and an output circuit, a coupling means comprising a transformer having its primary included in both said first named input and output circuits and its secondary in the input circuit of said second named space discharge device, said transformer being adapted to couple said first named output circuit to the input of said second spaced discharge device, said primary being adapted to maintain the average potential of said grid electrode at known potential relative to said cathode.

15. In an amplifier system, a space discharge device having a cathode, a grid electrode and an anode related so as to form an input circuit and an output circuit for said

device, a second space discharge device having an input circuit and an output circuit, a coupling means comprising a transformer having its primary included in both said first named input and output circuits and its secondary in the input circuit of said second named space discharge device, said transformer being adapted to couple said first named output circuit to the input of said second space discharge device, a condenser connected between said cathode and said grid electrode, a resistance connected between the grid terminal of said condenser and one end of said primary, said primary being adapted to maintain the average potential of said grid electrode at known potential relative to said cathode.

16. In an amplifier system a space discharge device comprising a cathode, an auxiliary electrode and an anode so inter-related as to form an input circuit and an output circuit for said device, an energy utilizing means having an input circuit, means included in said first-named input circuit for coupling said output circuit to the input circuit of said utilizing means, said coupling means being adapted to maintain said auxiliary electrode at a known average potential relative to said cathode.

17. In an amplifier system a space discharge device comprising a cathode, a grid electrode and an anode so inter-related as to form an input circuit and an output circuit for said device, a source of uni-directional pulsating current connected in said output circuit, an energy utilizing means having an input circuit, means included in said first-named input circuit for coupling said output circuit to the input circuit of said utiliziing means, and means for impressing the potential developed in said coupling means, from the flow of current therein from said source, upon the grid electrode of said device and means for controlling the degree of the fluctuating component of said grid impressed potential.

In witness whereof, I have hereunto subscribed my name this 30th day of January, 1929.

BENJAMIN F. MIESSNER.