Oct. 19, 1943. W. P. MASON 2,332,102

NEGATIVE TRANSCONDUCTANCE TUBE OSCILLATOR

Filed Nov. 26, 1941

FIG. 1

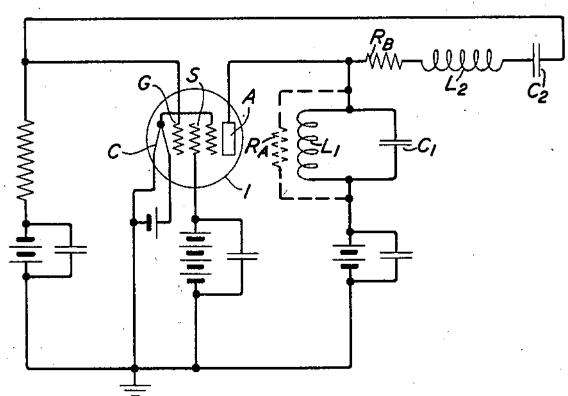
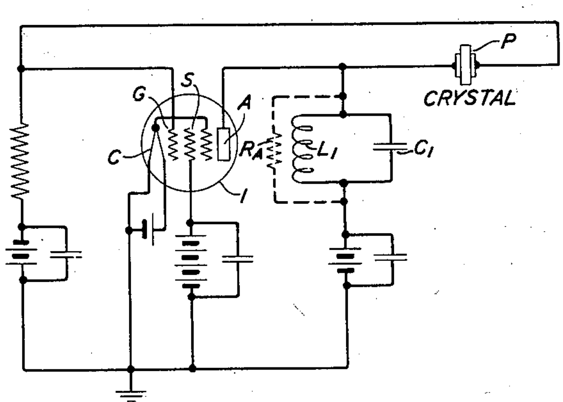


FIG. 2



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Patented Oct. 19, 1943

2,332,102

UNITED STATES PATENT OFFICE

2,332,102

NEGATIVE TRANSCONDUCTANCE TUBE OSCILLATOR

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Application November 26, 1941, Serial No. 420,499

6 Claims. (Cl. 250—36)

This invention relates to negative transconductance tubes and special circuits combined therewith to form negative transconductance tube-oscillators, amplifiers or the like.

The primary object of the present invention is to operate all circuit elements of such negative transconductance devices at their resistance points to insure that the gain through the over-all circuit is maximum—and that battery, tube and other fluctuations produce no corresponding frequency fluctuations.

This object is achieved by the joint use of resonant and antiresonant circuits in combination with the negative transconductance discharge devices.

A further object of my invention is to use piezoelectric crystals operating at their resistive points in combination with negative transconductance discharge devices.

A still further object of my invention is to combine stray tube capacities, such as interelectrode capacitances, with other impedance elements associated with a negative transconductance discharge device whereby the over-all effect of said combination is resistive at the operating frequency of the oscillator.

A fuller description of the invention appears hereinafter in connection with the drawing wherein:

Fig. 1 represents a circuit diagram showing one form of negative transconductance tube-oscillator; and

Fig. 2 represents a modified form of the same circuit.

Referring to Fig. 1 of the drawing, there is shown an electron discharge device 1 having a negative transconductance characteristic whereby an increase in potential on the control grid electrode causes a decrease in the electron current to the output electrode. The output current is therefore in phase with the applied grid potential rather than 180 degrees out of phase as in a conventional tube. Specifically, one form of discharge device which possesses these desired characteristics has been realized in a beam power pentode such as the RCA 6L6 tube, when the same is operated under the following conditions:

+15 volts on the anode A
+150 volts on the screen grid S
−1.8 volts on the grid G

The filament or cathode C, the biasing batteries and the by-pass condensers are conventional elements.

Similar negative transconductance characteristics may be obtained with a Western Electric 7575-F tube by using the control grid and the suppressor screen as the grid and anode respectively, and by applying proper potentials thereto.

The various forms of discharge tubes indicated above have been cited as examples—other types of tubes having the negative transconductance characteristic may be used.

Associated with the discharge tube 1 and cooperating therewith for producing maximum output and high frequency stability, are two impedance circuits L_1C_1 and L_2C_2.

The circuit L_1C_1 consists of a parallel combination of inductance L_1 and capacitance C_1, connected effectively from the anode to the cathode, which may be grounded as shown in Fig. 1. C_1 is constituted by a parallel combination of lumped capacity and inherent tube capacity.

The circuit L_2C_2 consists of a series combination of inductance L_2 and capacitance C_2 and is connected in the path leading from the anode to the grid. L_2C_2 is resonant at the same frequency to which L_1C_1 is antiresonant—this common frequency being the frequency at which the combination of tube and circuits described will oscillate.

At the common natural response frequency, the impedance of the series-connected circuit will be a low resistance and the impedance of the L_1C_1 combination will also be resistive. R_A denotes the inherent resistance at antiresonance of the L_1C_1 circuit, while R_B represents the inherent resistance at series resonance of the L_2C_2 circuit.

The combination thus described with respect to Fig. 1 is effective in causing all the circuit elements thereof to operate at their resistance points, thereby insuring maximum gain, and since no phase shifts are introduced, providing frequency stability.

Referring to the modification illustrated by Fig. 2, the only essential change introduced here is the substitution of a resonating piezoelectric crystal element P in place of the resonant combination L_2C_2. The crystal operates at its series resonance point with great stability and provides, as in the case of L_2C_2 of Fig. 1, a predominantly resistive effect at the oscillator frequency. The circuit L_1C_1 in Fig. 2 is antiresonant at the same frequency as the crystal. R_A in Fig. 2 has the same significance as in Fig. 1.

Other changes may readily suggest themselves to those skilled in the art, such as the particular form of negative transconductance tube or the particular form of the associated resonant and antiresonant circuits.

What is claimed is:

1. An oscillation generator comprising an electron discharge device having a cathode, control electrode and anode, means associated with said three electrodes to constitute therewith a negative transconductance translating device, a feedback circuit between said anode and control electrode comprising an effective series resonant combination of inductive and capacitive elements tuned to a desired frequency of generated oscillations, and a parallel resonant circuit connected to said anode and cathode, said parallel resonant circuit being tuned to the same frequency as said series resonant circuit and comprising in part the interelectrode capacitances of said device.

2. An oscillation generator comprising an electron discharge device having a cathode, control electrode and anode, means associated with said electrodes to constitute a negative transconductance translating device, a feedback circuit between said anode and control electrode comprising an effective series resonant combination of inductive and capacitive elements tuned to a desired frequency of generated oscillations, and a parallel resonant circuit connected to said anode and cathode, said parallel resonant circuit being tuned to the same frequency as said series resonant circuit.

3. An oscillation generator comprising an electron discharge device having cathode, anode, screen grid and control grid electrodes, means associated with said electrodes to constitute therewith a negative transconductance translating device, an antiresonant circuit connected from said anode to said screen grid and cathode, a feedback path connected from the anode to the control grid and containing therein a series resonant circuit, both resonant and antiresonant circuits being resistive at the same predetermined frequency to provide maximum output and greatest frequency stability.

4. An oscillation generator comprising an electron discharge device provided with cathode, anode, screen grid and control grid electrodes, means associated with said electrodes to constitute therewith a negative transconductance translating device, an antiresonant circuit connected between said anode, screen grid and cathode, a feedback path connected from the anode to the control grid and containing therein a piezoelectric crystal impedance element, said antiresonant circuit being predominantly resistive at the characteristic piezoelectric crystal frequency.

5. An oscillation generator comprising an electron discharge device provided with cathode, anode, screen grid and control grid electrodes, means associated with said electrodes to constitute therewith a negative transconductance translating device, an antiresonant circuit connected between said anode, screen grid and cathode and comprising in part the interelectrode capacitances of said discharge device, a feedback path connected from the anode to the control grid and containing therein a series resonant circuit, both resonant and antiresonant circuits being resistive at the same predetermined frequency to provide maximum output and greatest frequency stability.

6. An oscillation generator comprising an electron discharge device provided with cathode, anode, screen grid and control grid electrodes, means associated with said electrodes to constitute therewith a negative transconductance translating device, an antiresonant circuit connected between said anode, screen grid and cathode and comprising in part the interelectrode capacitances of said discharge device, a feed back path connected from the anode to the control grid and containing therein a piezoelectric crystal impedance element, said antiresonant circuit being predominantly resistive at the characteristic piezoelectric crystal frequency.

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