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N. M. RUST

2,055,090

ELECTRICAL OSCILLATION GENERATOR

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Fig. 1

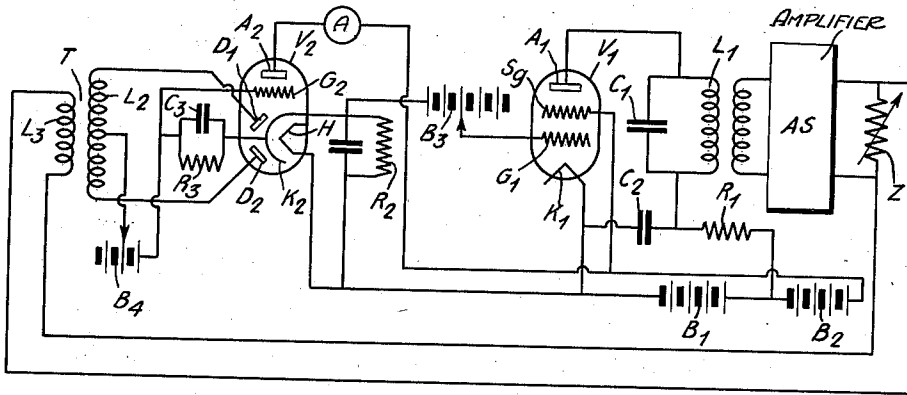


Fig. 2

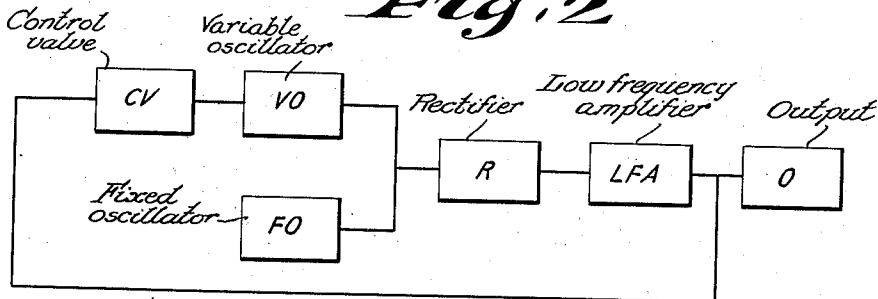
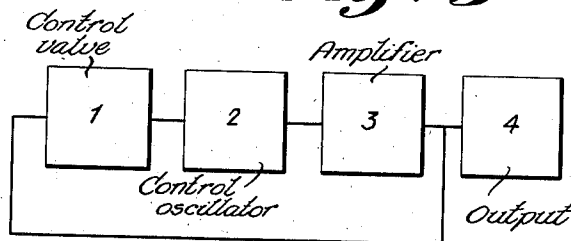


Fig. 3



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ELECTRICAL OSCILLATION GENERATOR

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Application February 17, 1934, Serial No. 711,792
In Great Britain February 23, 1933

1 Claim. (Cl. 250—36)

This invention relates to electrical oscillation generators and more particularly to valve generators of the kind wherein oscillation generation is obtained by virtue of the inherent negative resistance properties of a thermionic valve, such, for example, as a screened grid valve. Electron discharge devices exhibiting negative resistance effects inherently, i. e., without the necessity of any external feed-back circuit, are well known and will be referred to in the present specification as "negative resistance valves". The so-called screened grid valve is an example of a negative resistance valve and, as is well known, for certain conditions of applied potential the characteristic connecting anode current (ordinates) with anode volts (abscissae) shows a downward slope over a portion of its length, i. e., within certain limits of applied potentials the screened grid valve exhibits negative resistance effects inherently.

The present invention is for an improvement in or modification of the invention set forth in my United States Patent No. 2,011,291, granted August 13, 1935.

The parent invention claims an oscillation generator of the kind referred to comprising a negative resistance valve, resonant means associated with said valve for controlling the frequency of oscillations generated thereby and means actuated in dependence upon the oscillatory output from said valve for applying controlling bias potentials to said valve whereby the amount of negative resistance exhibited by said valve is automatically controlled in a direction to produce substantial constancy of output. No claim is made to this in the present specification.

The present invention may be regarded as a development or extension of the principles set forth in my United States Patent No. 2,011,291, supra, the objects of the present invention being to provide either a beat frequency generator arrangement or an oscillator succeeded by an amplifier in cascade therewith wherein despite variations (effected for the purpose of control) of the frequencies of the oscillators in the case of a beat frequency generator arrangement or despite variations in the gain of an amplifying system at different frequencies and/or variations in the load fed from said amplifier system in the case of an oscillator succeeded by a cascade connected amplifier arrangement, the output amplitude shall remain substantially constant. By the term "output amplitude" is meant the amplitude of the voltage set up across a predetermined impedance which may be regarded for the purpose

of the present invention as the output impedance.

According to this invention voltage set up across the output impedance of an amplifier preceded by a negative resistance valve oscillator or of a beat frequency generator including a negative resistance valve oscillator is utilized for the generation of controlling bias potentials which are applied to said negative resistance valve oscillator whereby the amount of negative resistance exhibited by said valve oscillator is automatically controlled in a direction to produce substantial constancy of amplitude in the voltage set up across said output impedance.

Figure 1 illustrates one embodiment wherein the invention is applied to an arrangement comprising a negative resistance valve oscillator succeeded by an amplifier system; Figure 2 shows the invention as applied to a beat frequency oscillator circuit arrangement; and Figure 3 illustrates the broad essentials of the circuit of Figure 1.

In Figure 1 a screened grid valve V_1 is employed as a dynatron oscillator the anode A_1 of said valve being connected to the cathode K_1 thereof, through a circuit including a parallel tuned circuit L_1C_1 in series with a resistance R_1 and an anode battery B_1 . The positive terminal of the anode battery is connected to the negative terminal of an additional battery B_2 whose positive terminal is connected to the screen grid SG of the valve V_1 . A condenser C_2 is connected between the cathode K_1 of the valve and the tuned circuit end of the resistance R_1 , and the control grid G_1 of the valve is connected through a preferably adjustable source B_3 of bias potential and a capacity shunted resistance R_2 to the cathode of the valve. The control grid end of the condenser shunted resistance R_2 is connected to the cathode K_2 of a valve arrangement V_2 which, for the sake of brevity, will be herein referred to as a "double-diode-triode", said double-diode-triode having an indirectly heated cathode whose heater H is anchored in potential by being connected to the cathode K_1 of the screened grid valve V_1 . The double-diode-triode consists of the heater H , the indirectly heated cathode K_2 heated thereby, a pair of diode anodes D_1, D_2 , which cooperate with said indirectly heated cathode to constitute a full wave rectifier, a control grid G_2 and what is termed a "valve anode" A_2 , the control grid G_2 and the valve anode A_2 also cooperating with the indirectly heated cathode K_2 after the manner of an ordinary thermionic valve. The valve anode A_2 is connected through a suitable indicating meter

A to the positive terminal of the high tension source B₂ and the diode anodes D₁, D₂ are connected to the opposite ends of an inductance L₂ herein termed the "input inductance" (this inductance is the secondary winding of an input transformer T) whose center point is connected through a suitable adjustable source of bias potential B₄ to the grid G₂ of the double-diode-triode. The control grid G₂ of the double-diode-triode is connected through a further resistance R₃ shunted by a condenser C₃ to the cathode K₂ thereof.

The tuned circuit L₁C₁ in the anode circuit of the screened grid valve V₁ is coupled to an amplifying system AS whose output sets up voltage across an output impedance Z which may, for the purposes of this invention, be regarded as a simple resistance though, of course, it need not be a simple resistance. Voltage derived from that set up across the output impedance Z is applied to the input inductance L₂ by means of a suitable coupling coil L₃ (i. e. is applied to the primary of the input transformer T) and it will be seen, therefore, that with this arrangement the amplitude set up across the output impedance will be substantially constant notwithstanding that the said impedance, i. e. the load, may vary and/or the gain of the amplifying system may vary, for example, be different at different values of working frequency. Adjustment of the bias, provided by the source B₄ effects adjustment of the total output volts set up across the output impedance Z of the whole arrangement, i. e., this bias source is varied to control the value of voltage amplitude which will be maintained substantially constant in the output impedance. In this way constancy of output at a predetermined (and adjustable) value is obtained over a wide range of working frequencies.

Where the invention is applied to a beat frequency oscillator of the usual kind comprising a variable oscillator and a fixed tuned oscillator, an arrangement closely analogous to that just described and illustrated schematically in the accompanying Figure 2 is employed. In an application of this kind, the variable oscillator VO is a controlled dynatron or negative resistance oscillator, as above described, and its output is combined with the output from a fixed tuned oscillator FO to produce a beat frequency which is fed to a rectifier R the rectified output being then fed to an amplifier, for example, a low frequency amplifier LFA in the case (to which the present invention is very advantageously applied) where the beat frequency is a tone frequency. The voltage derived from the output of the amplifier LFA is fed to a control valve arrangement CV consisting of a double-diode-triode as above described, which control valve is utilized to control the dynatron oscillator also as above described. The output circuit is represented by O. Obviously either or both of the component oscillators in the beat frequency oscillator arrangement can be controlled as above described and/or made variable in frequency manually.

The resistance R₁ in series with the tuned circuit L₁C₁ in the first described embodiment is not essential, but it is advantageously provided, since by adjusting it to a correct value, adjustment of the anode potential for the screened grid

valve V₁ is facilitated and a close approximation to linear operation more easily obtained. The control of the bias on the grid G₂ of the double-diode-triode V₂ is of great sensitivity because although the diode and anodes are biased back the grid is left at normal potential and in these circumstances the double-diode-triode operates at a point on its characteristic where the mutual conductance is of normal value, i. e., relatively high.

Again the use of the resistance R₂ connected between cathode K₂ of the double-diode-triode and the heater H thereof to provide control E. M. F. for the dynatron also results in gain of sensitivity. Of course, the output may be controlled in ways other than that above described; for example, potentiometer control between output impedance Z and the control valve V₂, i. e. the double-diode-triode, may be resorted to, or the resistance R₂ may be a potentiometer resistance whose movable tapping point is connected to the control valve circuit. The arrangement described, however, is preferred and with this said arrangement working on audio frequencies, it has been found possible to maintain a substantially constant output in spite of variations of the order of 40 decibels (i. e. variations in voltage amplification of about 100:1) in the amplification of the amplifier following the oscillator.

Although in the preceding description of the illustrated embodiments the use of a double-diode-triode has been referred to, (this arrangement gives great sensitivity) the invention is obviously not limited thereto, and fundamentally, any type of rectifier could be employed. Thus in broad essentials the arrangement of Figure 1 consists of four portions as represented by the four rectangles of the accompanying Figure 3, the first rectangle 1 representing any form of rectifier or rectifier and amplifier circuit providing the control E. M. F.; the rectangle 2 representing any form of controlled dynatron oscillator; the rectangle 3 representing an amplifier; and the rectangle 4 representing an output circuit arrangement.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:

In combination, a control oscillation generator comprising an electron discharge device having a cathode, an anode, a screen grid, and a control grid, and means for causing the emission of secondary electrons from said anode, resonant means in circuit with the anode and cathode for controlling the frequency of the oscillations generated thereby, means in circuit with said oscillation generator for producing a beat frequency, a rectifier for receiving said beat frequency, an amplifier for receiving the output from said rectifier, an impedance in the output of said amplifier, and a feed-back path extending from said impedance to the control grid of said oscillation generator for applying bias potentials to said control grid in such sense and amount as to substantially compensate for changes in amplitude which would otherwise occur in the voltage set up across said impedance.