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THERMIONIC OSCILLATION GENERATOR

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Fig. 1

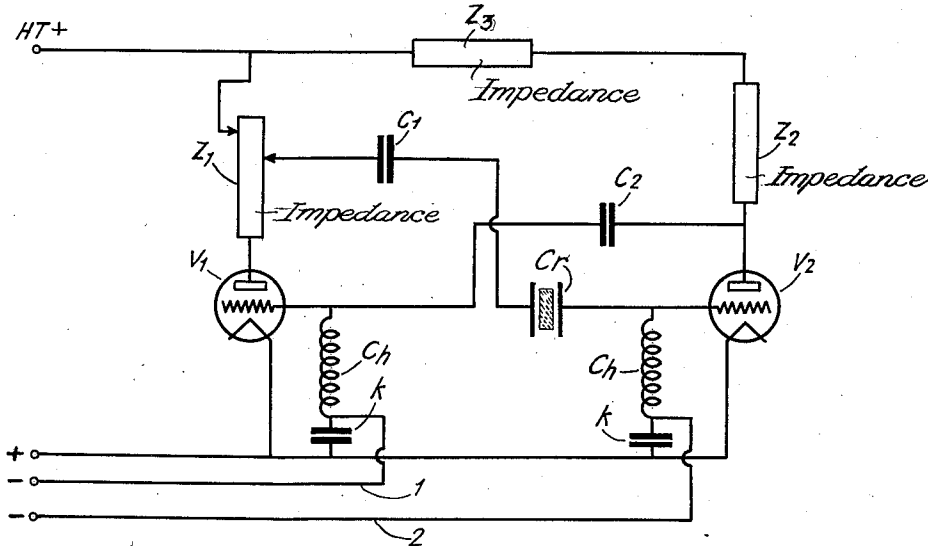
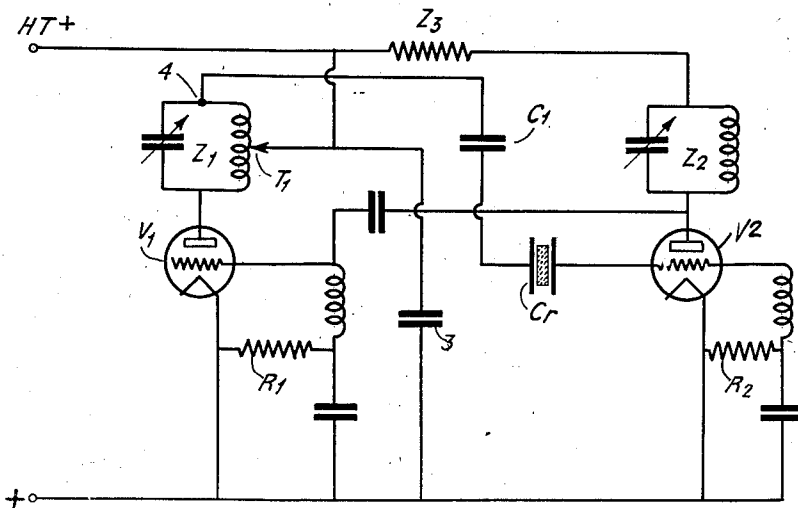


Fig. 2



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THERMIONIC OSCILLATION GENERATOR

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5 Claims. (Cl. 250—36)

This invention relates to thermionic oscillation generators and more particularly to oscillation generators of the kind wherein a piezo-electric crystal or like electro-mechanical vibrator is employed to stabilize and determine the frequency of oscillation.

The invention has for its object to provide an improved oscillation generator arrangement of the kind referred to which shall be of high inherent stability, able to provide a relatively large power output, and capable of being utilized to provide an output either at the fundamental frequency of the crystal or other electro-mechanical vibrator or at a harmonic thereof.

According to this invention an oscillation generating arrangement of the kind referred to consists of a thermionic oscillator stage which obtains its reaction energy via a reaction amplifier stage, energy from a suitable point in the oscillator stage being fed through a path including a piezo-electric crystal or other electro-mechanical vibrator to the input circuit of the reaction amplifier stage and energy from the output circuit of the reaction amplifier stage being fed back to a suitable point in the circuit of the oscillator stage. The terms "oscillator stage" and "reaction amplifier stage" are employed to designate the appropriate individual portions of the whole arrangement in terms of their functions in the said whole arrangement, but it is to be understood that neither of the two stages in question is in itself capable of oscillation.

The invention is illustrated in the accompanying drawing wherein Figure 1 is a block diagram of my present invention, and Figure 2 is a more detailed wiring diagram of a preferred modification of my invention.

Figure 1 shows in generalized diagram form an oscillation generating arrangement comprising two triodes, one of which (V_1) will be referred to as the oscillator valve and the other of which (V_2) will be referred to as the reaction valve. The anode of the oscillator valve is connected to the positive terminal HT+ of a source of anode potential through an impedance Z_1 which in practice is preferably constituted by a tuned circuit consisting of an inductance and a condenser in parallel, the combination being tuned to the desired frequency. A tapping point, which may be variable, on the impedance Z_1 (where Z_1 is a parallel tuned circuit the tapping point will be upon the inductance thereof) is connected through a coupling condenser C_1 and a piezo-electric crystal C_r in series to the grid of the reaction valve V_2 . The anode of the reaction

valve V_2 is connected to the terminal HT+ through two impedances Z_2 Z_3 in series and is also connected through a coupling condenser C_2 to the grid of the oscillator valve. The cathodes of the two valves are connected together and the grid of each valve is connected to the cathode thereof through a circuit consisting of a choke Ch in series with a condenser k the choke being adjacent the grid. Suitable bias potentials are applied to the two valves for example by means of batteries (not shown) connected to leads 1 and 2 connected to the junction points of the respective chokes Ch and condensers k in the respective grid circuits. The whole arrangement is such as to be non-oscillating if the crystal is removed and it will be seen that when the crystal is inserted there is freedom to oscillate at the crystal frequency. The various impedances and coupling condensers are so chosen that the voltage feed back to the grid of the oscillator valve V_1 is of the required phase and magnitude for producing efficient oscillation.

As above stated the impedance in the anode circuit of the oscillator valve may in practice be constituted by a parallel tuned circuit as shown in Figure 2 and as is also shown in Figure 2 a tapping point T_1 upon the inductance of this tuned circuit may be connected to the terminal HT+ also through a condenser 3 to the common cathode point, the end 4 of said tuned circuit remote from the anode of the oscillator valve being connected through the coupling condenser C_1 and piezo-electric crystal C_r to the grid of the reaction valve. Similarly of the two impedances in series in the anode circuit of the reaction valve, that nearest the anode may be a parallel tuned circuit and the other a resistance. It is, of course, not necessary that the grid biases for the two valves be obtained by means of batteries and automatic bias may be obtained as shown in Figure 2 by means of two resistances R_1 and R_2 one of which is connected between the cathode of the oscillator valve and the junction point of the choke and condenser in the grid circuit thereof the other being similarly connected between the cathode of the reaction valve and the junction point of the choke and the condenser in the grid circuit thereof.

The operation of the illustrated circuit arrangement is as follows:

In the absence of the crystal C_r the impedance of the circuit between Z_1 and the grid of valve V_2 , said circuit including the condenser C_1 and the crystal holder, is too great to allow oscillation.

tions to occur and even when the crystal is present the impedance is still too great to allow of oscillations except at the natural frequency of the crystal.

- 5 Owing to the amplifier action of the valve V_2 the potential developed across the crystal itself may be easily arranged to be quite small having regard to the total power generated by the whole system.
- 10 If the tuned circuits in the anode circuits of the oscillator and reaction valves be tuned to the natural frequency of the crystal the system will oscillate at this said frequency but by suitably adjusting these tuned circuits and setting the
- 15 reaction valve to work on a suitable point on its characteristic the system may be caused to oscillate at twice the natural frequency of the crystal or on some other harmonic thereof. The power output on a multiple or harmonic frequency will, of course, depend upon the harmonic chosen but will be relatively high. For example, when the system operates at double the fundamental frequency it is possible to obtain a power
- 20 output of up to more than 71 per cent of that obtained when oscillating on the fundamental frequency.

Having thus described my invention, what I claim is:

1. An oscillation generating arrangement of the multivibrator type comprising a first thermionic valve, a parallel tuned circuit in the anode circuit thereof, a coupling condenser in series with a piezo-electric crystal said condenser and crystal being connected in a path between said
- 30 tuned circuit and the grid of a second thermionic valve, a second tuned circuit in series with a resistance in the anode circuit of said second valve and a connection including a coupling condenser between the anode of the second valve and the grid of the first.
- 40 2. An oscillation generator comprising a first electron discharge tube having a plate, a grid and a filament, a parallel tuned circuit connected at one terminal to said plate, an impedance connection connected between an intermediate point
- 45 on said parallel tuned circuit and said filament, means for subjecting said grid to a negative potential with respect to said filament, a second electron discharge tube having an anode, a cathode and a control electrode, a piezo-electric
- 50 crystal having one electrode connected to said control electrode and its other electrode to the

other terminal of said tuned circuit remote from said plate connection, a capacitive connection between the grid of the first said tube and the anode of the second said tube, a parallel tuned circuit connected in series with a resistance, said series combination being connected between said anode and said cathode, and means for subjecting said control electrode to a negative potential with respect to said cathode.

3. In an oscillation generator of the multivibrator type, a pair of electron discharge tubes each having a cathode, a grid and an anode, an impedance connected between the cathode and the anode of the first tube, a capacitive circuit between the grid of the first of said tubes and the anode of the second of said tubes, a circuit containing a piezo-electric element, and a capacitor interconnecting the grid of the second tube with a point on said impedance, an impedance circuit interconnecting the grid with the cathode of each tube, an impedance connection between the anodes of said tubes, and means for impressing upon the electrodes of said tubes direct current potentials of such values as to cause said generator to produce oscillations at a natural frequency of said piezo-electric element.

4. In an oscillation generator of the multivibrator type, a pair of electron discharge tubes each having a cathode, a grid and an anode, a capacitive circuit between the grid of the first of said tubes and the anode of the second of said tubes, a circuit containing a piezo-electric device in series with a capacitor and a tank circuit interconnecting the grid of the second tube with the anode of the first tube, a circuit including a tank circuit interconnecting the anode of the second tube with a point intermediate the terminals of the first said tank circuit, an inductive and resistive circuit interconnecting the grid of each tube with its cathode and means for impressing across the electrodes of said tubes direct current potentials of such values as to cause said generator to produce oscillations at a frequency to which one of said tank circuits is tuned.

5. An oscillation generator in accordance with claim 4 and further characterized in that both tank circuits are tuned to a frequency which is harmonically related to a natural frequency of said piezo-electric device.

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