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HIGH FREQUENCY OSCILLATOR

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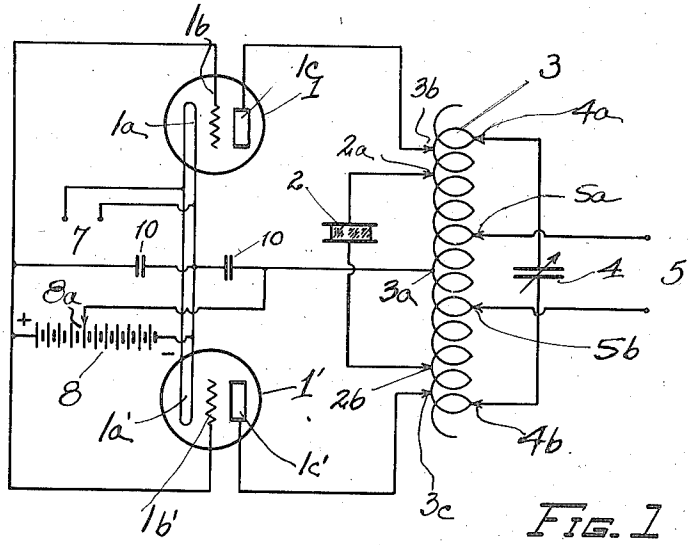


FIG. 1

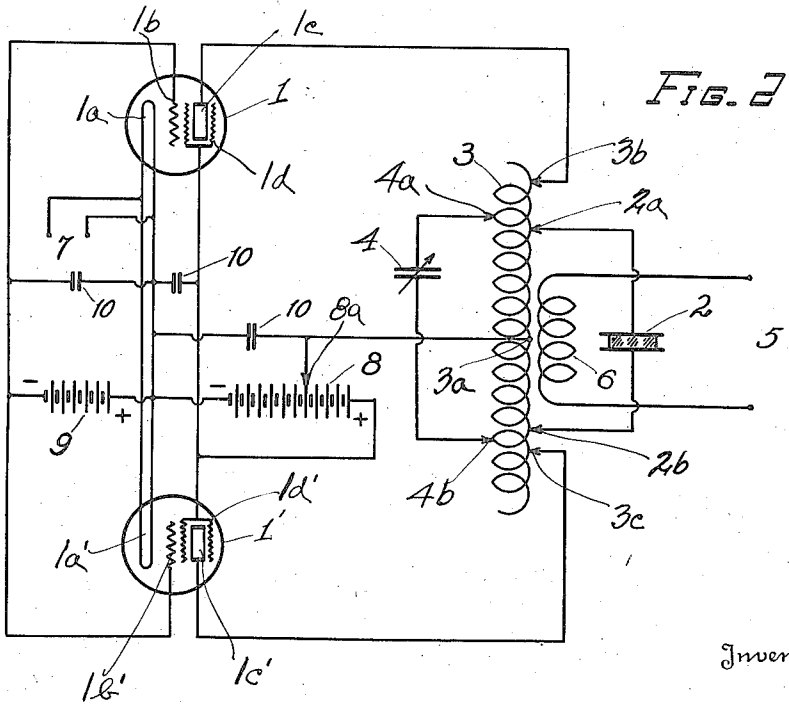


FIG. 2

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HIGH FREQUENCY OSCILLATOR

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5 Claims. (Cl. 250—36)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

My invention relates broadly to high frequency oscillators and more particularly to a high frequency oscillator arranged for precision operation at constant frequency.

One of the objects of my invention is to provide a circuit arrangement for a high frequency oscillator of the push pull type in which the plate circuits of the electron tubes are arranged to have a negative voltage-current characteristic and having a high degree of precision in the maintenance of constant frequency oscillations.

Another object of my invention is to provide an arrangement of push pull oscillator circuit in which the plate circuits of the tubes have a negative voltage-current characteristic and are controlled by a piezo electric crystal element for the maintenance of constant frequency oscillations.

Still another object of my invention is to provide an arrangement of push pull oscillator circuit wherein an inductance is connected between the plate circuits of symmetrically positioned tubes, and a negative voltage current characteristic imparted to the output circuits, and the frequency of oscillations sustained by the circuits maintained constant by the piezo electric crystal element electrically connected with the inductance.

Other and further objects of my invention reside in a precision type of high frequency oscillation circuit as set forth more fully in the specification hereinafter following by reference to the accompanying drawing, in which:

Figure 1 illustrates a push pull oscillator circuit employing three element electron tubes in which the plate circuits are arranged to have a negative voltage-current characteristic; and Fig. 2 shows a circuit arrangement of my invention in a push pull type of oscillator circuit employing four element electron tubes.

In a circuit having a negative characteristic the current decreases as the potential increases and vice versa as the potential decreases the current increases. If a crystal oscillator is placed in such a circuit with proper adjustments it will control the frequency of the oscillations of such circuits, the negative characteristic permitting oscillations.

In Figs. 1 and 2 of the drawing, the electron tubes are shown at 1 and 1'. A piezo electric crystal 2 is connected across inductance coil 3 located in the plate circuits of the tubes. A variable condenser 4 is shown connected also across coil 3. The load may be taken from the circuit through terminals 5 either by tapping on the coil 3 as shown in Fig. 1 or by inductive coupling with the use of coil 6 as shown in Fig. 2. A source of filament supply voltage is connected at 7 and source 8 furnishes required energy for the plate and grid circuits of Fig. 1 and for the plate and screen grid circuit of Fig. 2. A bias potential 9 is provided for the grids of the tubes of Fig. 2. By-pass condensers are illustrated at 10.

In the operation of the circuit of my invention, if the crystal 2 is disconnected entirely from the circuit the circuit operates as a self-oscillating circuit the frequency of which is controlled by the capacity of condenser 4, the inductance of coil 3 and the distributed capacities associated with these elements. Synchronization between the two tubes is obtained due to the coupling of one half of coil 3 with its other half in order that each half of the coil is connected in the plate circuit of tube 1 and tube 1'. Synchronization is also obtained to a certain degree due to the use of condenser 4 bridged across the two halves of coil 3. Unless this coupling link be provided synchronization of the two halves of the system would not be possible since each half of the system would oscillate independently. However, with the arrangement shown, the two tubes operate in unison and give greater output with better wave form than a system employing a single tube. When the crystal 2 is introduced into the circuit connected across coil 3 the frequency of the oscillations of the circuit will be determined by it provided coil 3 and condenser 4 are tuned to approximate the reasonance point of the crystal 2. At points of resonance of 3 and 4 further away from the frequency of crystal 2, the circuit will oscillate at a frequency determined by inductance 3 and condenser 4 and associated capacities. However over a considerable band of frequency adjustment of inductance 3 and condenser 4 about the resonant frequency of crystal 2, the oscillations of the system will be controlled by crystal 2.

In Figure 1, my invention has been illustrated as applied to the three electrode electron tube 1 which includes a cathode 1*a*, control grid 1*b*, and anode 1*c*, and tube 1' which includes cathode 1*a*', control grid 1*b*', and anode 1*c*'. The cathodes 1*a* and 1*a*' are supplied with heating current from the common source 7. The source of potential 8 has tap 8*a* thereof connected to the anode circuit of tubes 1 and 1', as shown. The coil 3 has the anode potential introduced in the mid-connection 3*a* thereof. The connection from the two halves of coil 3 to the respective output circuits are made through adjustable taps 3*b* and 3*c*. The condenser 4 connects to the two halves of coil 3 by adjustable taps 4*a* and 4*b* which are beyond the positions to which taps 3*c* and 3*d* are adjusted. A piezo electric crystal is connected to inductance 3 through adjustable connections 2*a* and 2*b* within the limits of the positions of taps 3*b* and 3*c*. The output from inductance 3 is delivered to circuit 5 through taps

5a and 5b located on coil 3 within the limits defined by the positions of taps 2a and 2b.

Figure 2 illustrates my invention as applied to a push pull type of oscillator circuit employing four element electron tubes 1 and 1' wherein, in addition to the cathode, control grid, and anode, as described in Figure 1, I provide a screen grid 1d and 1d'. The bias potential for the screen grids 1d and 1d' is supplied from potential source 8. The bias potential for the control grids 1b and 1b' is supplied from potential source 9. The mid-tap connection 3a leads from inductance 3 to the tap 8a on source of potential 8. The taps 3b and 3c on coil 3 lead to the anodes 1c and 1c' respectively and are located adjacent the extreme ends of the inductance 3. In the arrangement shown in Figure 2, the condenser 4 has the adjustable taps 4a and 4b leading thereto arranged at points on inductance 3 within the limits of the positions of taps 3b and 3c. The piezo electric crystal element 2 has taps 2a and 2b connected therewith and disposed at points along inductance 3 in positions on opposite sides of the mid-connection 3a within the limits imposed by the positions of taps 4a and 4b. The coupling coil 6 provides means for transferring the output energy to the output circuit terminals 5.

I have found the high frequency oscillator system of my invention highly stable in its operation for the production of high frequency oscillations having a high degree of consistency.

While I have shown the principles of my invention in certain preferred embodiments, I desire that it be understood that modifications may be made and that no limitations upon my invention are intended other than are imposed by the scope of the appended claims.

The invention herein described may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalty thereon or therefor.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. A high frequency oscillator comprising a pair of balanced electron tubes each having a cathode, anode and control electrode, a source of potential, an inductance, said source of potential having the negative terminal thereof connected to said cathodes and a positive terminal thereof leading to a center connection along said inductance, and a more positive terminal thereof connected in common to said control electrodes, opposite ends of said inductance connected with the anode of each of said electron tubes, an electrical circuit including an adjustable condenser connected in shunt through adjustable taps adjacent remote ends of said inductance, adjustable taps on said inductance intermediate the aforesaid taps and the center connection to said inductance and leading to an output system, a piezo electric crystal element connected in shunt with said inductance symmetrically with respect to the center connection thereto.

2. A high frequency oscillator comprising a pair of electrically balanced electron tubes each including a cathode, a control grid, an anode and a screen grid, a source of biasing potential, the positive terminal of said source of biasing potential connected in common to said cathodes and the negative terminal thereof connected in common to said contral grids, an inductance, a separate source of potential, the negative terminal of said separate source of potential connected to said cathodes, a positive terminal of said separate source of potential connected to a central connection on said inductance, adjustable taps disposed adjacent the remote ends of said inductance and electrically connected with the anodes of the respective electron tubes, a further positive terminal of said separate source of potential connected in common to said screen grids, said oscillator thereby comprising a negative resistance circuit, a tuning path electrically connected to adjustable taps on said inductance intermediate the central connection on said inductance and the taps connected with the anodes of the respective electron tubes, and a frequency determining element connected in shunt with said inductance symmetrically with respect to the central connection thereto.

3. A high frequency oscillator comprising a pair of multiple electrode electron tubes, an inductance, a source of potential having its negative terminal connected in common to cathode electrodes in said electron tubes, a positive terminal of said source of potential connected to the center of said inductance, variable opposite terminals of said inductance connected to the outputs of said electron tubes, a further positive terminal of said source of potential connected in common to other electrodes in said electron tubes, tuning means variably connected with said inductance, a piezo electric crystal element having its opposite faces connected to said inductance symmetrically on either side of said center connection, and output means connected with said inductance.

4. A high frequency oscillator comprising a pair of balanced electron tubes each having a cathode, an anode and a control electrode, a source of potential, the negative terminal of said source of potential connected in common to said cathodes, a positive terminal of said source of potential connected in common to said control electrode, an inductance, a less positive terminal of said source of potential connected to the center of said inductance, said anodes variably connected to said inductance on either side of said center connection thereto, a tuning element variably connected to said inductance, a piezo electric crystal element having its opposite faces connected to said inductance symmetrically on either side of said center connection, and output means connected with said inductance.

5. A high frequency oscillator comprising a pair of balanced electron tubes each having an anode, a cathode, a control electrode and a screen grid, a source of biasing potential, the positive terminal of said bias potential connected in common to said cathodes and the negative terminal of said bias potential connected in common to said control electrodes, a source of power potential, the negative terminal of said source of power potential connected in common to said cathodes, a positive terminal of said source of power potential connected in common to said screen grids, an inductance, a less positive terminal of said source of power potential connected to the center of said inductance, said anodes variably connected to said inductance on either side of said center connection thereto, a tuning element variably connected to said inductance, a piezo electric crystal element having its opposite faces connected to said inductance symmetrically on either side of said center connection, and output means connected with said inductance.

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