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OSCILLATOR SYSTEM

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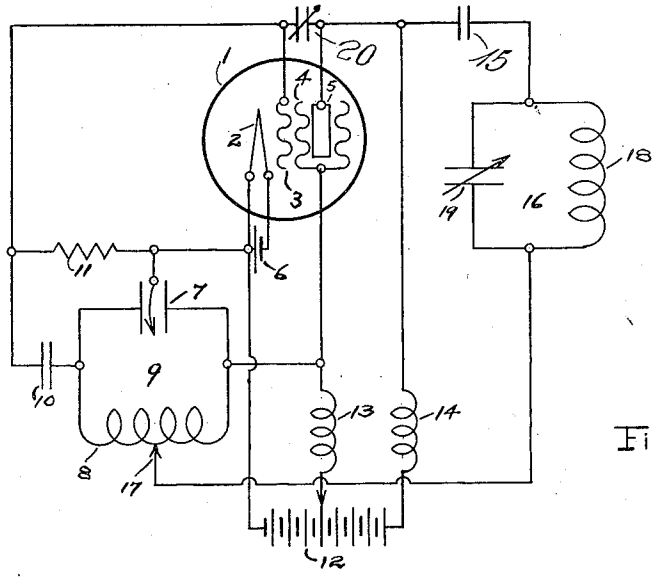


Fig. 1.

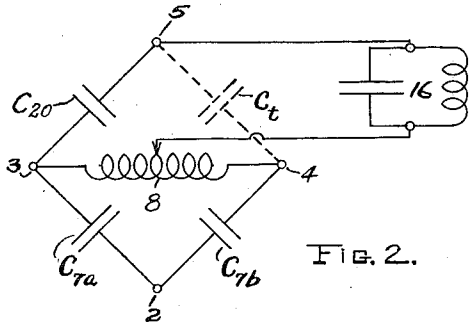


Fig. 2.

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OSCILLATOR SYSTEM

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9 Claims. (Cl. 250—36)

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My invention relates broadly to oscillator systems and more particularly to a balanced oscillator system.

One of the objects of my invention is to provide a balanced bridge type of oscillation generator.

Another object of my invention is to provide a balanced oscillator in which the frequency of oscillation is relatively free from the influence of external circuits which may be coupled to the system.

A still further object of my invention is to provide a balanced bridge type of oscillation generator, the output portion of which forms no essential part of the oscillation generating means.

Other and further objects of my invention will be understood from the specification hereinafter following by reference to the accompanying drawings, in which:

Fig. 1 shows one form of circuit embodying the principles of my invention; and Fig. 2 shows in simple form the radio frequency portion of the circuit of Fig. 1.

In all oscillation generators, it is necessary to couple external apparatus to the oscillator in some way in order to derive useful energy from the oscillator and it generally happens that this coupling must be sufficiently close that the electrical constants of such external apparatus—inductance, capacity and resistance—are in part, transferred in the form of equivalences into the oscillation generator. This transfer of equivalences results in changing those electrical constants of the system which determine the frequency of oscillation and thus makes the frequency of oscillation a function of the load.

The present invention covers a method of arranging the oscillation generator and its output or work circuit in a balanced or bridge arrangement so that the effect of variable load conditions will be reduced.

In the circuit of Fig. 1, reference character 1 indicates an electron tube having a cathode 2, a control grid 3, an inner anode 4 and an outer anode 5. The tube may be of the conventional four element type or it may be of a type especially designed for this kind of service. The cathode 2 is heated by battery 6 and is connected to the rotor of a conventional split variable condenser 7. Obviously two or more condensers in series with the center connection made to the cathode might just as well be employed. The two sections of the condenser 7 are connected to the opposite ends of an inductance and together form resonant circuit 9. One end of the resonant circuit 9 is connected through a blocking condenser 10 to control grid 3. A grid leak 11 connects the control grid and cathode for biasing the former at the desired potential. The opposite end of resonant circuit 9 connects to inner anode 4 which is supplied at the proper positive potential with respect to cathode 2 by its connection to anode battery 12 through choke coil 13.

The circuit thus far described is the familiar Colpitts oscillator and with such a circuit, it is conventional practice to connect or couple the load to resonant circuit 9. In the particular form of my invention shown in Fig. 1, I do not do this in the conventional manner but instead, I derive energy from the oscillator through the medium of an output circuit connected between outer anode 5 and a point along inductance 8. The outer anode 5 is maintained at the desired potential with respect to cathode 2 by its connection to anode battery 12 through choke coil 14. The output circuit comprises blocking condenser 15 and resonant circuit 16 in series connection between outer anode 5 and tap connection 17 along inductance 8. Resonant circuit 16 consists of inductance 18 and variable capacity 19 in parallel. Resonant circuit 16 may be tuned to the same frequency as resonant circuit 9 or it may be tuned to a harmonically related one.

Resonant circuit 16 may be replaced by any other form of impedance such as an inductance or a resistance. Choke coils, 13 and 14 may also be replaced by other high impedances such as resistances. The remainder of the circuit of Fig. 1 comprises balancing condenser 20 connected between control grid 3 and outer anode 5. The function of balancing condenser 20 will be made clear in what follows.

Fig. 2 shows in simplified form, the equivalent high frequency portion of the circuit of Fig. 1. All parts of Fig. 1 which are not essential to an understanding of the principles of my invention are omitted from the circuit of Fig. 2. In the circuit of Fig. 2 the cathode 2, control grid 3, inner anode 4 and outer anode 5 are indicated at the apexes of the bridge. Reference character C_{7a} denotes that portion of condenser 7 of Fig. 1 which is between control grid 3 and cathode 2. The grid to cathode interelement capacity is considered lumped with that of capacity C_{7a}. Reference character C_{7b} denotes that portion of condenser 7 of Fig. 1 which is between cathode 2 and inner anode 4. The interelement capacity between cathode and inner anode is considered lumped with capacity C_{7b}. Inductance 8 is between control grid 3 and inner anode 4 as in Fig.

1. The reactance of blocking condenser **10** is considered negligible as that reactance may be made negligible by choice, if desired, without affecting the operation of the circuit. The interelement capacity between control grid **3** and inner anode **4** is considered lumped with capacities C_{7a} and C_{7b} in series. Reference character C_t denotes the interelement capacity between inner anode **4** and outer anode **5** whereas C_{20} denotes the capacity of balancing condenser **20** of Fig. 1 which is connected between control grid **3** and outer anode **5**. Resonant circuit **16** which comprises the high frequency portion of the output circuit is connected between outer anode **5** and a point along inductance **8**. Now, C_t is fixed by the design of tube employed, and the ratio C_{7a}/C_{7b} may be fixed by the design of condenser **7**. Therefore if C_{20} is so chosen that,

$$C_{20}=\frac{C_t C_{7a}}{C_{7b}} \quad (1)$$

then, neglecting electron flow, an alternating potential across inductance **8** will not produce a potential between cathode **2** and outer anode **5** nor will an alternating potential be produced across resonant circuit **16** if tap **17** on inductance **8** is so placed that it suitably divides the impedance of inductance **8**. This is equivalent to stating that the generated oscillations, neglecting electron flow, are not coupled to the output circuit **16** through the interelement capacities of the tube.

From Equation (1) it may be deduced that any suitable impedances Z may be employed in place of the capacities C. Using the same subscripts as indicated in Equation (1) it will then be seen that the following generic equation is to be satisfied by the conditions under which the system of my invention may be operated:

$$Z_{20}=\frac{Z_t Z_{7a}}{Z_{7b}} \quad (2)$$

Further consideration will show that the oscillation generating portion of the circuit acts so as to satisfy the conditions required for oscillation, for determining the frequency and for causing pulses of electrons to be projected through the grid-like structure of inner anode **4** to the outer anode **5**. The pulses of electrons impinging upon outer anode **5** cause corresponding variations in potential across choke coil **14** and coincidentally, across resonant circuit **16** to which the desired load may be coupled.

As previously stated, the oscillation generating portion of the circuit of Fig. 1 is of the Colpitts type. Obviously any other form of oscillator might have been employed with equal facility, for example, had the Hartley type been chosen Equation (2) would still hold. The only difference in that case would be that branches C_{7a} and C_{7b} of Fig. 2 would be inductive whereas inductance **8** would be replaced by a capacity branch.

My invention comprises means for balancing out the effect of interelement impedance which may exist between an auxiliary element and those elements of an oscillation generator which may be positioned within the same electron tube. It will be noted that Equations (1) and (2) are independent of any steady potentials which may exist or be impressed in the circuit. It is also apparent from the equations that they are independent of the frequency and amplitude of the existing alternating potentials.

I have found the oscillator circuit of my invention highly stable in its operation and while I have described it in certain of its preferred embodiments I desire it to be understood that modifications may be made and that no limitations are intended other than are imposed by the scope of the appended claims.

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

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

1. An oscillation generator comprising an electron tube having a cathode element, a control grid element, and a grid-like anode element, and branch circuits connecting said elements, in combination with a second anode element within said tube and a branch circuit interconnecting said second anode element with said control grid, the characteristics of said combination being such that the impedance of the branch between said control grid element and said second anode element is substantially equal to the product of the interelement impedance between said grid-like anode element and said second anode element, and that of the branch circuit between said cathode element and said control grid element, divided by the impedance of the branch circuit between said cathode element and said grid-like anode element, and in addition to said combination an output circuit connecting said second anode element with a point along the branch circuit between said control grid element and said grid-like anode element.

2. An electron tube having a cathode, a control grid and a grid-like anode, circuits interconnecting said electrodes wherewith an oscillation generator is provided, a second anode within said tube having a reactive connection with said control grid, and an output circuit disposed between said second anode and a point along that one of said oscillation generator circuits which interconnects the control grid and the grid-like anode, the arrangement being such that the alternating potential produced upon said second anode through the interelement capacity existent between said anodes is substantially equal to and opposite in phase to that induced upon said second anode through said reactive connection.

3. In a device for generating oscillations and transmitting them to a work circuit, an electron tube three electrodes of which in combination with input and output circuits therefor are adapted to generate oscillations, a fourth electrode within said tube, means including a source of direct current interconnecting said fourth electrode with others of said electrodes while offering a high impedance to alternating currents of the frequency generated, means including a resonant circuit for operatively associating said input and output circuits with one another so as to produce oscillations, a resonant circuit interconnecting said fourth electrode and a point along the aforesaid resonant circuit, and means whereby the effect of interelement capacities in producing high frequency potentials upon said fourth electrode is substantially neutralized.

4. An oscillation generator including an electron tube having a cathode element, a control grid element and a grid-like anode element, and branch circuits connecting said elements, in combination with an auxiliary element within said tube and a branch circuit interconnecting said auxiliary element with said control grid, the characteristics of said combination being such

that the impedance of the branch between said control grid element and said auxiliary element is substantially equal to the product of the interelement impedance between said grid-like anode element and said auxiliary element, and that of the branch circuit between said cathode element and said control grid element, divided by the impedance of the branch circuit between said cathode element and said grid-like anode element, and in addition to said combination, a resonant circuit disposed in series connection between said auxiliary element and a point along the branch circuit between said control grid element and said grid-like anode element.

5. An electron tube having a cathode, a control grid and grid-like anode, circuits interconnecting said electrodes wherein an oscillation generator is provided, an auxiliary electrode within said tube having a reactive connection with said control grid, and a work circuit disposed between said auxiliary electrode and a point along that one of said oscillation generator circuits which interconnects the control grid and the grid-like anode, the arrangement being such that the alternating potential produced upon said auxiliary electrode through the interelement capacity existent between said grid-like anode and said auxiliary electrode is substantially equal to and opposite in phase to that induced upon said auxiliary electrode through said reactive connection.

6. In a device for generating oscillations, an electron tube at least three electrodes of which in combination with input and output circuits therefor are adapted to generate oscillations, an auxiliary electrode within said tube, means including a resonant circuit for operatively associating said input and output circuits with one another so as to produce oscillations, a second resonant circuit disposed between said auxiliary electrode and a point along the aforesaid resonant circuit, and means whereby the effect of interelement capacities in producing high frequency potentials upon said auxiliary electrode is substantially neutralized.

7. In a device for generating oscillations, an electron tube at least three electrodes of which in combination with interconnecting circuits therefor are adapted to generate oscillations, an auxiliary electrode within said tube and an additional circuit connecting said auxiliary electrode with a point along one of said first mentioned circuits, and means whereby the effect of interelement capacities in producing high frequency potentials upon said auxiliary electrode is substantially neutralized.

8. A device for generating oscillations in accordance with claim 7 wherein said additional circuit comprises a resonant circuit.

9. A device for generating oscillations in accordance with claim 7 wherein said means comprises a variable capacity.

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