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TRIODE OSCILLATOR AND THE LIKE

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Fig. 1

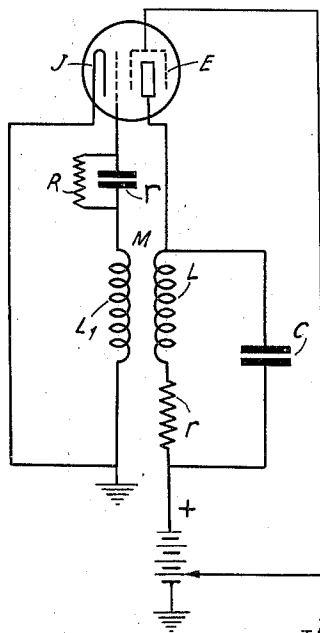


Fig. 2

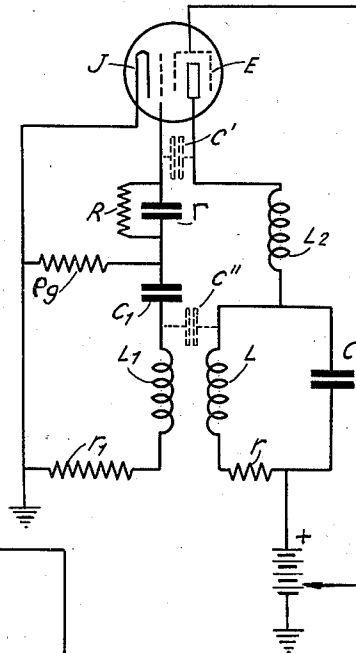
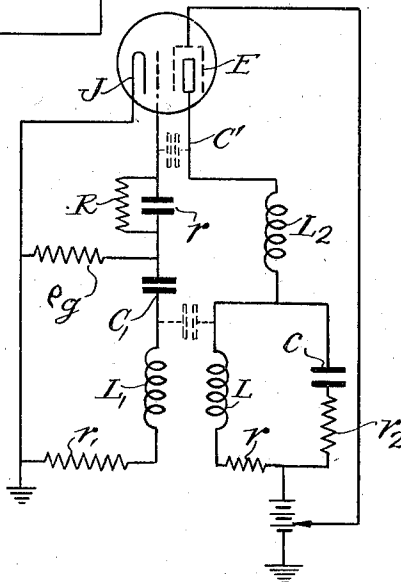


Fig. 3.



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TRIODE OSCILLATOR AND THE LIKE

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5 Claims. (Cl. 250—36)

The present invention consists in improvements in circuits destined to produce oscillations of triodes and multi-electrode tubes, said improvements having for their purpose the rendering of the frequency of oscillations independent of the characteristics of the tube, or at least of those characteristics susceptible to variation with time. This performance will be termed frequency stabilization.

From a theoretical standpoint in designating P and P_g the resistances of the plate and the grid of the tube, it was found that generally the equation representing the value of the angular frequency ω has the expression

$$(1) \quad P \times P_g \times A(\omega) + P \times B(\omega) + P_g \times C(\omega) + D(\omega) = 0$$

A , B , C , D , being functions of ω and of constants of circuits and whereby certain functions, for instance B and C , have coil resistances in the factor. These functions are in the end not independent and if there is at the same time $B=0$, $D=0$, there follows in general $C=0$.

The invention consists of placing the oscillator together with the tuned circuit at the plate of the tube, of inserting in series thereto, between the plate and the said oscillator, a certain impedance Z , and of likewise inserting in series in the grid circuit, between the oscillating grid and the coupling organs to the oscillatory circuit, another impedance Z_1 . Z_1 is to be determined either by deduction or by measurements in such manner that the variable potential at the grid during the oscillation would have, due to the addition of Z_1 , that same phase as if the resistance of the grid were an infinite one.

Once this condition is realized, Z is hereafter to be determined in such manner as to annul at the same time the quantities $B(\omega)$, $C(\omega)$, $D(\omega)$; this being possible if Z_1 has been chosen as before indicated. Thus the equation determining the frequency is reduced to $A(\omega)=0$ and it gives a value for ω strictly independent of P and P_g , which signifies that practically the oscillation thus constituted will have frequency independent of the heating of the filament of the tube, of the plate potentials, of the screen, of the eventual grid polarization, etc., and finally independent of the degree of the evacuation of the tube.

There will now be described, in a special example, an embodiment of the invention in order to provide a better understanding of the nature of the invention and it is obvious that the various modes of execution are thereby not limited.

Fig. 1 illustrates an oscillator of the conventional type here given for the purpose of exposition, and Figs. 2 and 3 illustrate different embodiments of the oscillator of the present invention.

Fig. 1 represents an oscillator of the classical type. A tuned circuit L , C is inserted in the

plate circuit. The grid is acted upon by a self-induction coil L_1 having a mutual negative inductance M with coil L . The grid circuit is closed across a high resistance R shunted by a large capacity Γ . The self-inductance L possesses, on the other hand, a certain resistance r . It is assumed that no capacitive coupling exists and that the grid-plate capacity is negligible. This result is obtained by means of a screen grid tube, the screen being indicated at E .

Fig. 2 represents an oscillator of the same type but stabilized in accordance with the invention, and whose frequency will be exactly equal to

$$\frac{1}{\sqrt{LC}}$$

The grid circuit is at first constituted by the resistance R and the large capacity Γ and then closed at ground through a resistance P_g advantageously of the order of the value of R . Parallel to P_g , there is placed the coupling inductance L_1 in series to a capacity C_1 having exactly the value

$$C_1 = \frac{1}{L_1 \omega^2}$$

Under these conditions, it is clear that the capacity Γ substantially constitutes a short circuit for the high frequency. When L_1 , C_1 resonate, then the grid potential is given by $jM\omega i$ (i being the current in the self-inductance L , and M the mutual inductance between coils L and L_1) wholly as if the resistance of the grid (constituted by P_g and the inner grid resistance of the tube) would not exist at all. The capacity C_1 hence plays the part intended by the invention. The plate circuit is thus constituted by the tuned circuit L , C having in series a self-inductance L_2 precisely equal to L and having a certain resistance which may be taken at will. It is this self-inductance which, in accordance with the invention, accomplishes the control of the stabilization of the oscillator.

In the following, some useful variations will be referred to for the practical application of the invention:

In the first place, if, in the branch C of the tuned circuit L , C , a resistance r_2 , shown in Fig. 3 is to be considered, then without modification of the value of C_1 , it is necessary, in order to stabilize the frequency that the self-inductance L_2 placed in series to the tuned circuit be given the value

$$L_2 = L \left(\frac{r - r_2 \left(1 + \frac{KM}{L} \right)}{r + r_2} \right)$$

K being the coefficient of coupling between the inductances L_1 and L_2 .

In the second place, if there exists between the grid and the plate of the tube a grid-plate

capacity C' , indicated in dotted lines in Figs. 2 and 3, it is necessary, in order to stabilize the frequency, not to modify the value C_1 and to choose for the self-inductance L_2 the value:

$$L_2 = L \left\{ 1 - (K+1) \frac{r_1}{r} \times \frac{C'}{C} - \left(1 - \frac{2M}{L} - \frac{M^2}{L^2} \right) \frac{C'}{C} \right\}$$

r_1 being the resistance of the self-inductance L_1 .

The case may also be envisaged in which the coupling between L_1 and L is in part a capacitive one. For instance, C'' , indicated in dotted lines in Figs. 2 and 3, may be the capacity existing between the end having variable voltage of the self-inductance L_1 and that of the self-inductance L . C_1 must be determined, in accordance with the invention, in taking account of the existence of the entire complex circuit placed in parallel to L_1 across the capacity C'' . In fact this circuit is reduced at resonance to a high resistance

$$\frac{L}{rC}$$

itself shunted by a self inductance L_2 , placed at ground (mass) across the very small capacity between the plate and the ground (mass) so that C_1 will be very slightly different from

$$C_1 = \frac{1}{L_1 \omega^2}$$

Once the determination of C_1 is completed, there remains the determining of L_2 . The calculation then reveals that in this case

$$L_2 = L \left\{ 1 + \frac{C''}{C} \left(1 - \frac{M}{L} \right)^2 \right\}$$

is the value which must be chosen to provide stabilization.

There remains thus to be envisaged the entirely general case in which all the mentioned circumstances are realized at the same time. It is evident that in the first approximation the small differences in the value $L_2 = L$ are added to each other permitting the provision and dimensioning, without difficulty, of the value to be given to the self-inductance of the stabilization.

What I claim is:

1. Oscillating circuit comprising a thermionic tube having a cathode, grid and plate, a tuned circuit in the plate circuit of the said tube, coupling means between this tuned circuit and the grid circuit of the tube, and means for stabilizing the oscillating frequency, said means comprising an impedance inserted in series in the grid circuit between the oscillating grid of the tube and the said coupling means, this impedance being determined so that the alternating tension on the grid during oscillation has the same phase as if the grid impedance were infinite, and a second impedance inserted between the plate of the tube and the tuned circuit, this second impedance being determined so as the oscillation frequency is independent of the internal impedances of the tube.

2. Oscillating circuit comprising a thermionic tube having a cathode, grid and plate, a parallel circuit tuned to the oscillation frequency in the plate circuit of the said tube having an inductive branch presenting a finite ohmic resistance and a capacitive branch, an inductance in the grid circuit of the tube, an ohmic resistance between the grid and cathode of the tube, coupling means between the inductances in the grid circuit

and in said parallel tuned circuit, a capacity in series with the inductance in the grid circuit and substantially tuning the latter at the oscillation frequency, and an inductance substantially equal to the inductance in the inductive branch of said parallel tuned circuit inserted between the plate of the tube and said plate tuned circuit.

3. Oscillating circuit comprising a thermionic tube having a cathode, grid and plate, a parallel circuit tuned to the oscillation frequency in the plate circuit of the said tube having a branch containing a coil the inductance of which is L and the resistance r and a capacitive branch having in series a resistance r_2 , a coil in the grid circuit of the tube coupled with the said coil of said parallel circuit, the mutual inductance of both coils being M and their coupling coefficient K , an ohmic resistance between the grid and cathode of the tube, a capacity in series with the grid circuit coil and substantially tuning the latter at the oscillation frequency, and an inductance L_2 inserted between the plate of the tube and the said parallel tuned circuit and calculated by means of the formula:

$$L_2 = L \left\{ \frac{r - r_2 \left(1 + \frac{KM}{L} \right)}{r + r_2} \right\}$$

4. Oscillating circuit comprising a thermionic tube having a cathode, grid and plate, a parallel circuit tuned to the oscillation frequency in the plate circuit of the said tube having a branch containing a coil the inductance of which is L and the resistance r and a capacitive branch the capacity of which is C , a coil in the grid circuit of the tube coupled with the said tuned circuit coil, the grid circuit coil branch resistance being r_1 , the mutual inductance of both coils being M and their coupling coefficient being K , an ohmic resistance between the grid and cathode of the tube, a capacity C' between the grid and the plate of the tube, a capacity in series with the grid circuit coil and substantially tuning the latter at the oscillation frequency, and an inductance L_2 inserted between the plate of the tube and the said parallel tuned circuit and calculated by means of the formula:

$$L_2 = L \left\{ 1 - (K+1) \frac{r_1 C'}{r C} - \left(1 - \frac{2M}{L} - \frac{M^2}{L^2} \right) \frac{C'}{C} \right\}$$

5. Oscillating circuit comprising a thermionic tube having a cathode, grid and plate, a parallel circuit tuned to the oscillation frequency in the plate circuit of the said tube having a branch containing a coil the inductance of which is L and a capacitive branch the capacity of which is C , a coil in the grid circuit of the tube coupled by induction and capacity with the said parallel tuned circuit coil, the mutual inductance of both coils being M and their coupling capacity C'' , an ohmic resistance between the grid and cathode of the tube, a capacity in series with the grid circuit coil and substantially tuning the latter at the oscillation frequency, and an inductance L_2 inserted between the plate of the tube and the said parallel tuned circuit and calculated by means of the formula:

$$L_2 = L \left\{ 1 + \frac{C''}{C} \left(1 - \frac{M}{L} \right)^2 \right\}$$