120. A Constant Frequency Oscillator and its Oscillation Frequency.*

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As an alternating current source of radio and audio frequency the triode valve oscillator is widely used. For many purposes it is quite necessary to keep the change of the frequency of the oscillation current of such an oscillator as small as possible.

To attain this object, Mr. M. Matsudaira and H. Nukiyama has proposed a special arrangement, the connection of which is shown in Fig. 1. The two sets of plate battery are introduced in the plate

Fig. 1.

circuit of each valve separately so that the impedance of the grid circuit is small and the average grid voltage can be kept at a proper value. The resistance R introduced between the filament and the

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oscillation circuit will give an increasing bias when the amplitude of oscillation increases. If the value of the resistance R is properly chosen, the frequency of oscillation is almost independent of the filament current and the plate voltage in a wide range. At this state, since the valve may not give out reactive power (bibliography 1, 2, 3), it is quite probable that the frequency of oscillation is equal to the resonance frequency of the oscillation circuit.

(I) The Experimental Result.

From the point of view above stated, we have made some careful investigations about the relation between the oscillation frequency of the constant frequency oscillator and the resonance frequency of its oscillation circuit. Our experimental arrangement is shown in Fig. 2 in which the oscillator A is our constant frequency oscillator and the

Fig. 2.

oscillator B is an arbitrary oscillator. The natural change of frequency of the oscillator B was ascertained to be inappreciable for the duration of few minutes.

To measure the resonance frequency of the oscillation circuit of the oscillator A including the effect of the capacity of the batteries, lead wires, resistance and the valve electrodes, we simply cut the filament current and changed the condenser C so that the reading of the valve voltmeter connected at its terminal is a maximum. In this state, the frequency of the supply current from the oscillator B is the resonance frequency of the oscillator A. It is neither necessary nor

possible to determine the absolute value of this frequency in the degree of accuracy which is required in our present object of investigation.

After measuring the resonance frequency, we lighted the filament and made the oscillator A also oscillate. In this state we left the connection of the valve voltmeter unchanged since the input admittance of the valve voltmeter is equivalent to a capacity which can not be neglected in our case (bibliography 4). By observing the beat by the detector D, we adjusted the frequency of the oscillator A equal to that of the oscillator B by changing the capacity C. If the necessary change of the capacity is Δc , this is the required measure of the difference between the resonance frequency and the oscillation frequency. In the present case we kept L and C at a constant value of

$$L=2.84 \text{ m.h.} \quad C=733 \mu.\mu.f.$$

and we observed the value of Δc at different adjustment of the bias resistance R. The result is shown in the following table.

R	Δc	$\Delta f/f$ calculated
0 ohm	3.2 $\mu.\mu.f.$	0.22 %
2,000 „	2.0 „	0.14 „
5,000 „	0.0 „	0.00 „
10,000 „	-4.0 „	0.28 „

Fig. 3.

It will be seen that when $R=5000$ ohm the oscillation frequency is equal to the resonance frequency.

Fig. 3. shows, at different values of R, the change of frequency of the oscillator A when the filament current is changed. Here it will also be noticed that when $R=5000$ ohm the oscillator possesses the character of constant frequency.

(II) Conclusion.

When a triode valve oscillator has a character

of constant frequency, the frequency of oscillation itself is a particular frequency, i.e., the resonance frequency. This fact furnishes a ground to state that a constant frequency oscillator can reasonably be used as a permanent standard of frequency.

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