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# APPLICATION NOTE ON A TWO-TERMINAL OSCILLATOR





This Note describes a simple, reliable, two-terminal r-f oscillator whose output voltage is substantially constant over a reasonable range of frequencies. For a given ratio of maximum-to-minimum tuning capacitance, this oscillator may furnish less output voltage than conventional oscillators, but the ease with which adjustments can be made, the uniformity of the output voltage, and the simplicity of coil design, are desirable features.

Three variations of the circuit are shown in Figs. 1, 2, and 3. In these circuits, the output of $T_1$ feeds the grid of $T_2$; the output of $T_2$ feeds the grid of $T_1$. Thus, the action of $T_2$ is analogous to that of the tickler in a conventional tickler-feedback circuit. Fig. 1 represents a direct-coupled arrangement. In this circuit, signal and bias for $T_2$ are obtained directly from $T_1$. Because of the direct coupling, the internal plate resistance of one tube is connected in series with the internal plate resistance of the other; hence, the B-supply voltage is divided between $T_1$ and $T_2$. In the circuit of Fig. 2 and of Fig. 3, capacity coupling between $T_1$ and $T_2$ is used; hence, nearly full B-supply voltage is applied to each tube. Fig. 2 differs from Fig. 3 merely in the manner in which B-supply voltage is fed to $T_2$.

In determining the value of R, tune the oscillator to the low-frequency end of the high-frequency band and adjust the value of R for nearly maximum output. Tune the oscillator to the high-frequency end of that band and adjust $L_1$ for the same output that was obtained at the low-frequency end. Now, measure oscillator amplitude over the tuning range of the wave band; a convenient measure of oscillator amplitude is the value of oscillator grid current $I_g$. It may be necessary to change these values of R and $L_1$ in order to obtain a suitable compromise between desired values of tuning range, oscillator amplitude, and uniformity of output. When the values of R and $L_1$ are determined in this manner, they need not be changed when the oscillator is switched to any of the lower frequency bands. In these bands, oscillator amplitude is independent of the value of $L_1$ and is nearly constant over the tuning range of the band.



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For a given amplitude of oscillation, the tuning range of this oscillator circuit may be less than that of a conventional feedback circuit because of the high minimum capacitance introduced into the tank circuit by $T_2$. The shunt-feed circuit of Fig. 3 is suggested as a means of reducing this minimum capacitance. In this circuit, the series combination of $C_c$ and the output capacitance of $T_2$ is connected across the tank circuit; the entire output capacitance of $T_2$ is connected across the tank circuit in the series-feed circuit of Fig. 2. A disadvantage of the shunt-feed scheme of Fig. 3 is that the plate voltage of $T_2$ is reduced by an amount equal to the voltage drop across $R_p$. Thus, for the same B-supply voltage, increased tuning range is obtained at the expense of reduced oscillator voltage.

Typical values of R and $L_1$ are 200 ohms and 1.5 microhenries, respectively. These values are suggested as guides; final values should be determined by test. The condensers $C_p$ are used to isolate the high voltage from the tuning condenser C; condenser $C_p$ may be a padding condenser when the oscillator tracks with a signal circuit in a superheterodyne receiver. The bias on the grid of $T_2$ is used to limit the plate current of $T_2$ to a safe value. This bias is not required under some conditions of operation.

In a typical setup using the oscillator section of a 6A8 as tube $T_1$ and a 6J5-G as tube $T_2$ in the circuit of Fig. 2, a tuning range of 6.4 to 19.7 megacycles (a ratio of 1 : 3.08) was obtained. The oscillator amplitude throughout this range was approximately 100 microamperes. The coil used in this test had a Q of about 100. When the same equipment was used in the shunt-feed circuit of Fig. 3, a tuning range from 6.5 to 20.7 megacycles (a ratio of 1 : 3.18) was obtained. The oscillator grid current became approximately 55 microamperes, because of the comparatively low voltage on the plate of $T_2$.

No specific tube types are recommended for use with this circuit. Twin-triode types may be used in place of the separate tubes shown in Figs. 2 and 3. High output is obtained from tubes having high transconductance ($g_m$); however, such tubes usually have high capacitances, which curtail the tuning range. For high output, high $g_m$ in one tube is just as effective as high $g_m$ in the other tube, because of the ring arrangement of the circuit.

The two-terminal feature of this oscillator is an important one for applications which do not require the use of padding condensers. In these applications, the two-terminal oscillator simplifies the switching problem.

# TWO-TERMINAL OSCILLATOR CIRCUITS

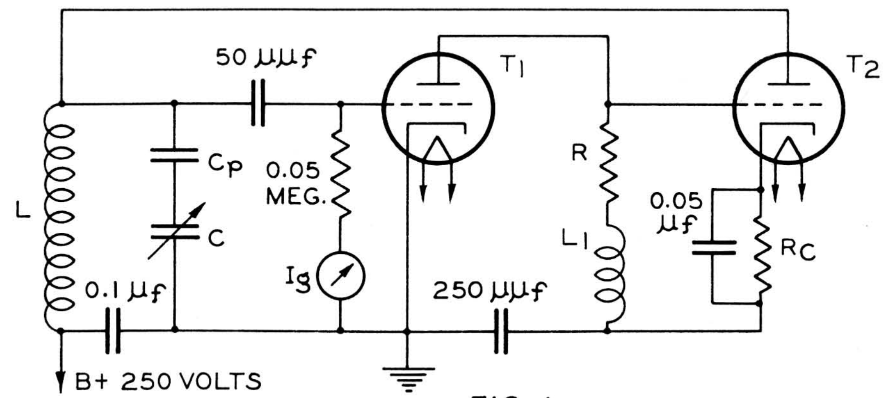


FIG. 1

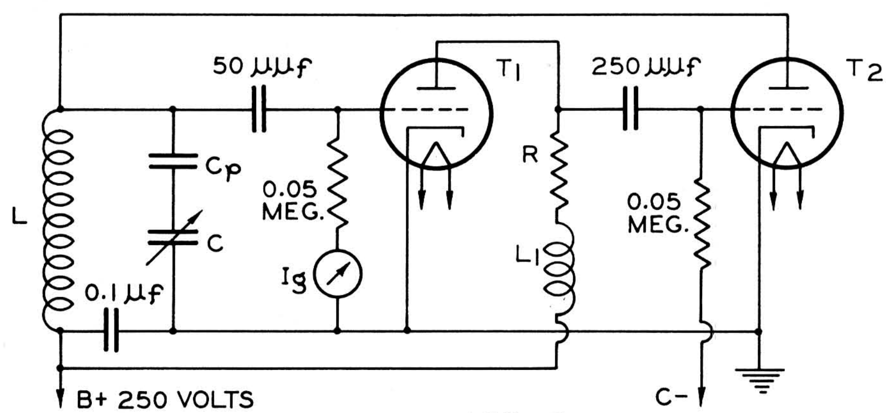


FIG. 2

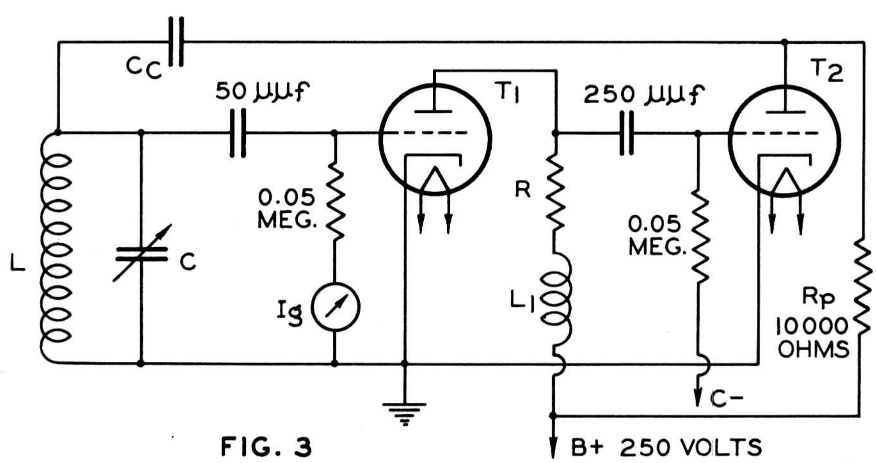


FIG. 3

SEE TEXT FOR VALUES OF $C_C$, $C_P$ AND $R_C$