Negative-Resistance on Terman Oscillators

Takeji SATO

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If Terman oscillators are designed so that the amplification factor $\mu \geqq 3$ at the resonant frequency, the oscillators satisfy the conditions for oscillation, and present the negative resistances. On the negative resistance, the relations between μ and the voltage feedback type takes the form of a hyperbola and the current type has a straight line

Although we could approach Terman oscillators from the viewpoint of feedback, it is more basic to consider it in terms of a negative-resistance. It can be shown that in Terman oscillator circuits, the amplifier serves to supply an a-c negative-resistance under the amplification factor $\mu \geqq 3$. In dealing with the voltage amplifier, we assume that the input and output resistance are infinity, and zero respectively, on the other hand, in case of the current amplifier, input and output resistance are reversed, as compared with the voltage type.

First we wish to calculate the resistance $\dot{z}_1$ which appears looking back from the last shunt-

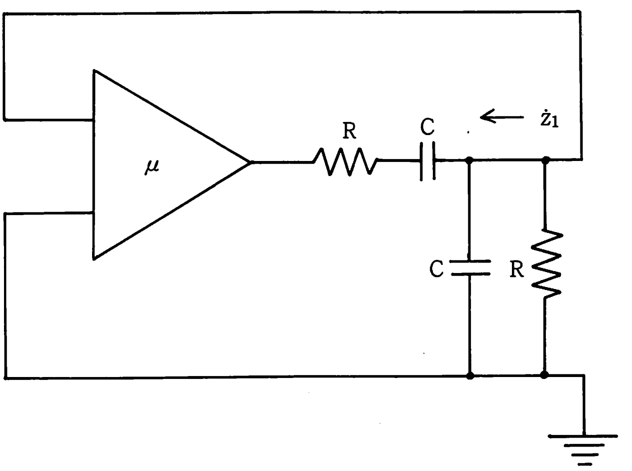

Fig. I Terman oscillator with voltage feedback.

arm resistor at the voltage feedback type. Fig.1 shows Terman oscillator with the voltage feedback circuit. By use of Kirchhoff's circuit laws, the impedance is given by

$$\dot{z}_1 = \frac{1}{3-\mu}R - j\frac{1}{3-\mu}R \tag{1}$$

In this case, the resonant frequency $\omega_1 = \frac{1}{CR}$ is used. In the oscillator with the current feed-

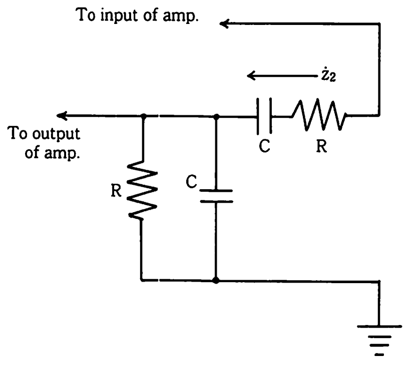

Fig.2 Current feedback circuit on Terman oscillator

back circuit shown in Fig.2, using the similar method we calculate the impedance z_2 :

$$z_2=\frac{3-\mu}{2}R-j\frac{3-\mu}{2}R \qquad (2)$$

Here we have the frequency of the oscillation, which is the same frequency as the voltage feed-back used, $\omega_2=\frac{1}{CR}$.

It is clear that the oscillatory condition, which gives us a negative-resistance, is satisfied by means of $\mu \geqq 3$, and the curves on z shown in Fig.3 are evidently one is a hyperbola, and the other is a straight line. Although two types of negative-resistance characteristics are generally either short-circuit stable or open-circuit stable, Terman oscillators are not either.

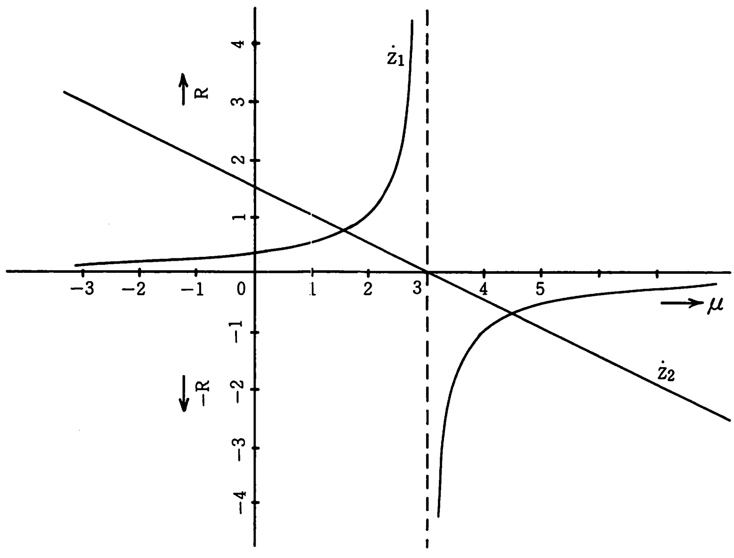

Fig.3 Negative resistances on Terman oscillators.