

THE FOUR-ELECTRODE VACUUM TUBE AS BEAT-FREQUENCY OSCILLATOR*

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Summary—This paper describes briefly the use of one UX-222 four-electrode vacuum tube as a double oscillator and detector. Audio-frequency output is obtained in the beat note between the fundamental of the oscillation due to one grid and the second harmonic of that due to the other, giving a beat-frequency oscillator.

BEAT-FREQUENCY oscillators now available employ a pair of three-electrode vacuum tubes as oscillators. One is adjusted to generate a fixed frequency, while the other is arranged so that the generated frequency may be varied over a band of ten kc above or below the frequency of the fixed oscillator. By coupling to the output of each oscillator, and detecting the combination by means of a third three-electrode tube, there is obtained in the plate circuit of this third tube current of frequency equal to the difference between the frequencies of the two oscillators. By arrangement of the oscillator

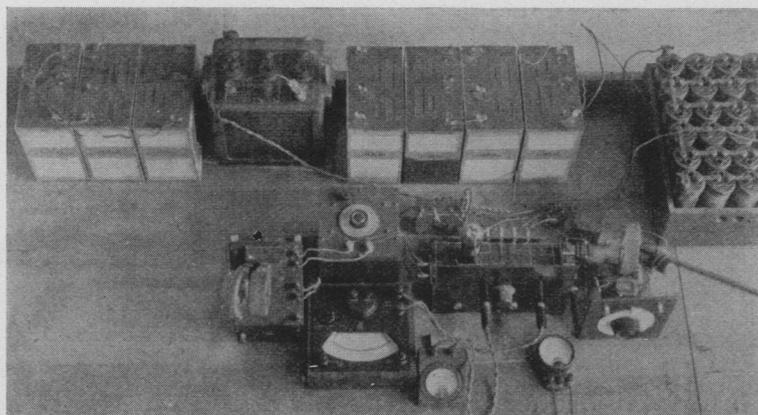


Fig. 1—Laboratory setup of the four-electrode vacuum-tube beat-frequency oscillator.

frequencies as indicated, the beat frequency is in the audio-frequency band and may be amplified for use in conjunction with many important and well-known laboratory tests of audio-frequency apparatus.

* Dewey decimal classification: R344.

It will be noted that the outer grid is coupled to the plate only through the interelectrode capacitance. This was found to provide sufficient reaction to maintain oscillation at a frequency of approximately 32 kc, variable by condenser C_2 to 35 kc. The plate circuit was

Plate voltage 200 v
Screen-grid voltage 16 v
Frequency 360 cycles per sec.
A—12 ma calibrating line
B—oscillator output
C—60-cycle timing wave

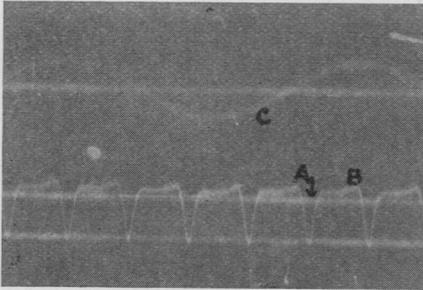
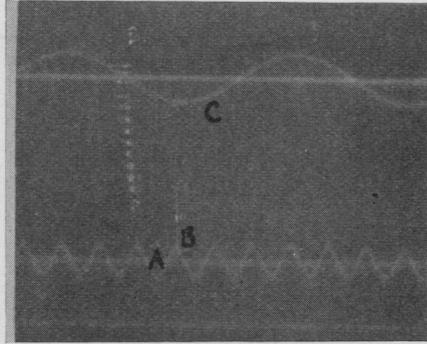


Plate voltage 200 v
Screen-grid voltage 25 v
Frequency 286 cycles per sec.
A—12 ma calibrating line
B—oscillator output
C—60-cycle timing wave

Plate voltage 200 v
Screen-grid voltage 16 v
Frequency 240 cycles per sec.
A—12 ma calibrating line
B—oscillator output
C—60-cycle timing wave
Coupling of plate to inner grid circuit greater than that used to obtain trace at top of page.

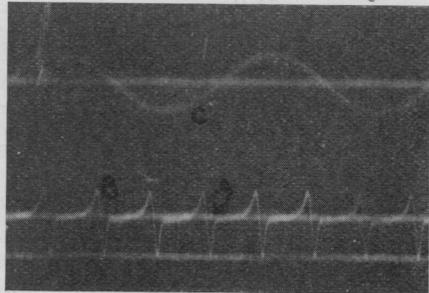


Fig. 3—Wave form of audio-frequency output.

coupled inductively to the inner grid circuit, and the resultant oscillation adjusted to 70 kc.

To obtain audio-frequency output, the difference frequency resulting from the combination of the 70 kc with the second harmonic of

the 32–35 kc variable frequency was filtered and amplified. The second harmonic was used to keep the oscillations from pulling into step for low-frequency outputs.

Several oscillograms, indicating the wave form of the output of the oscillator, are included in Fig. 3, with data affixed.

Of particular interest is the fact that changes in plate voltage have little influence on wave form and amplitude, while changes in screen-

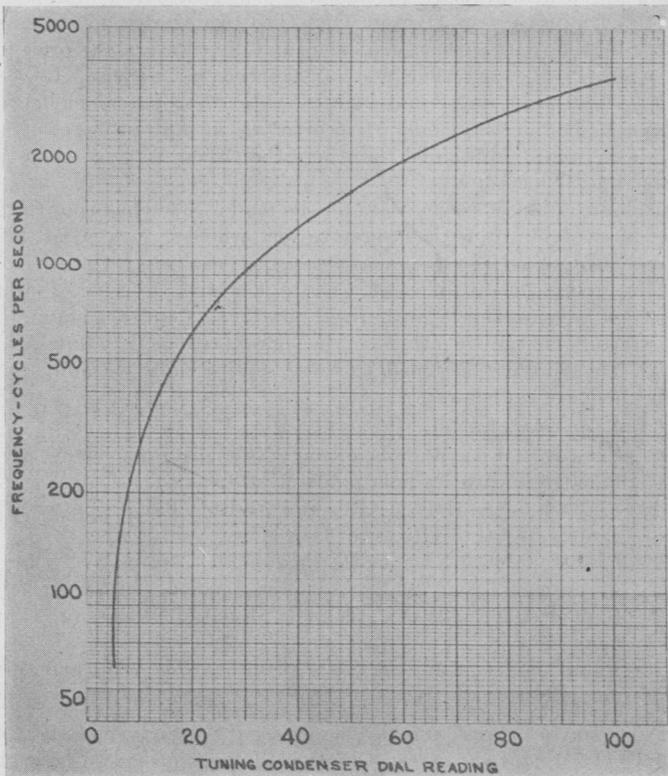


Fig. 4—Calibration curve for beat-frequency oscillator.

grid potential provide great changes in these important characteristics of the output.

Calibration of the oscillator is given in Fig. 4.

This work was undertaken under the direction of Prof. Weyl and Mr. Brainerd of the Moore School faculty. It is described more completely in a master's thesis of that school.