AN AUDIO-FREQUENCY LABORATORY OSCILLATOR

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The present paper is the result of a search for a laboratory oscillator having the following requirements: silence in operation, inexpensiveness, freedom from moving parts requiring adjustment, capability to deliver an alternating current to operate a bridge circuit without amplification, possibility of a comparatively pure tone with harmonics reduced to minimum, elimination of storage and dry cells as far as possible, utilization of equipment ordinarily found in an electrical measurements laboratory, flexibility in the production of any frequency from 1 to 5,000 cycles per second.

Many apparatus supply companies have available audio oscillators of various types from the simple buzzer and induction coil combinations to the beat frequency oscillator with several stages of amplification. None of these fit the above specifications.

A vacuum tube as an oscillator would be ideal if a simple circuit of sufficient flexibility could be designed. Dr. Ramsey in his text "Experimental Radio" page 89, outlines an experiment in which an audio transformer is used as an inductance in a Hartley circuit to produce low frequency oscillations. Dr. Ramsey

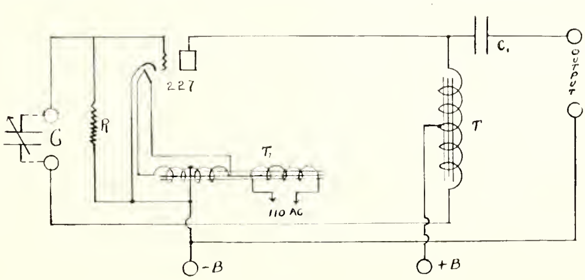

Fig. 1.

makes the observation that the frequency of the circuit will be low, in most cases low enough to count. If the condenser in this circuit is omitted the oscillator still oscillates since the distributed capacity of the inductance is ordinarily large enough to produce oscillations in the audible range. The distributed capacity of the transformer coil thus becomes a capacity in parallel with the tuning condenser. By connecting the tuning condenser in series with the grid inductance the distributed capacity of the coil lowers the apparent inductance of the coil, the frequency being controlled more completely by the tuning condenser. In such a circuit a grid leak must be used because the condenser in the grid isolates the grid. Figure 1 shows a simple but successful type of such an oscillator.

For convenience a 227 type tube was used with the A. C. filament transformer T_1 to supply the heat or current. The inductance T was the secondary coil of an input push-pull transformer. No condenser was incorporated in the construction

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of the oscillator as it was desirable to use a variable laboratory air condenser C for the higher frequencies and a .05—1 ufd. Leeds and Northrup decade condenser for the lower frequencies.

The oscillator described above finds application as a bridge driver and as a modulator to a radio frequency oscillator in radio measurements, where the frequencies need not be too accurately known. The calibration of this instrument will shift slightly as alternating line voltages vary.

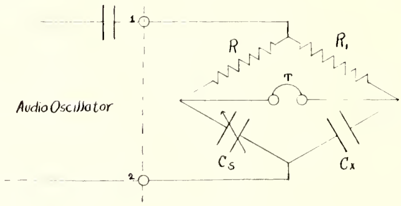

Fig. 2.

Figure 2 shows a capacity bridge using telephones with the oscillator as a source of alternating current. Such a bridge driver is, in the experience of the author, the best inexpensive source for this type of circuit. The tone in the headphones is clear, no external noise is caused in the room by the A. C. source, measurements may be made with frequencies at which the ear is most sensitive and the amount of auxiliary equipment is reduced to a minimum.

A more exact type of oscillator is shown in Figure 3. By using direct current tubes and an amplifyer thus limiting the actual power drain from the oscillator circuit, the harmonic distortion is reduced and the actual load cannot influence the frequency of the oscillator. In Figure 3 an ordinary good quality transformer of recent manufacture is substitute for the push pull inductance of Figure 1. Either type coil may be used, but experimental results seem to favor the type of coil used in Figure 1.

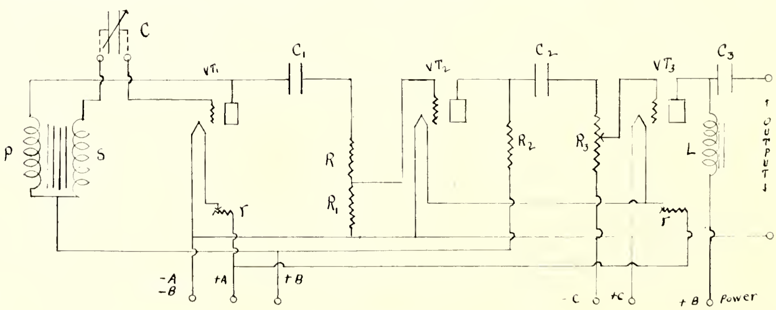

Fig. 3.

Any type of amplifyer may be used in conjunction with the circuit of Figure 1, provided its input impedance is practically infinite.

In Figure 3 a volume control is incorporated between the second and third tube. Three tubes are used to get sufficient power without over-loading the oscillator tube. A 210 type tube may be substituted for the 171A tube by providing for separate filament supply and a higher plate voltage. The constants of Figure 3 are as follows: A battery—6 volts, VT_1—201A, VT_2—112A, VT_3—171A, C(0—1) ufd. Coupling condensers C_1, C_2, C_3—1 ufd., B—90 volts, R and R_1—200,000 ohms, R_2—50,000 ohms, R_3—200,000 ohm potentiometer, L—30 Henry Choke, r rheostats suitable to tubes chosen.

In conclusion the author claims no originality for the basic circuits described in this paper but wishes to suggest the possibilities of such circuits in electrical measurements and to pass on to others his solution to the problem of finding a simple efficient laboratory audio oscillator.