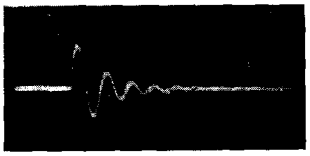

FIG. 2

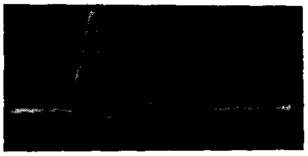

FIG. 3

the coefficients L, R, and 1/C are constants. In this case, as is well known, the natural oscillations of the circuit are harmonic oscillations which attenuate in time, and their frequency is determined essentially by L and C.

In the case when L depends on the current or C depends on the voltage, additional frequencies appear in the oscillations, distorting the temporal characteristic of the circuit oscillations.

Thus, if a coil with an iron core is introduced into the oscillating circuit, and a sufficiently large voltage is applied to the circuit to charge the capacitor, then the alternating magnetization of the core will cause the inductance L of the coil to cease to be a constant, and the free oscillation picture will differ greatly from that in the linear mode.

Figures 2 and 3 show the natural oscillations of the current in the resonance circuit at charging voltages $U_1 = 6$ V (Fig. 2, linear mode) and $U_2 = 100$ V (Fig. 3, nonlinear mode).

The circuit consists of a capacitance $C = 4 - 16\ \mu F$ connected in series with an inductance, which is the secondary winding of a high-voltage transformer with $L \approx 10$ H; the ohmic resistance of the circuit is $R = 300\ \Omega$.

Voltage from part of the active resistance, proportional to the current in the circuit, is fed to the input of an S1-29 oscilloscope with a long-persistance screen. An oscilloscope of this type is convenient for the investigation and photography of slow electric oscillations.

Similar distortions are observed also when the capacitance of the circuit (or part of it, if e.g., a varicond of the D811 type is applied parallel to the fixed capacitor) depends on the voltage.

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INFLUENCE OF MOTION OF THE MEDIUM ON THE PHASE DIFFERENCE BETWEEN THE OSCILLATIONS OF A SOUND SOURCE AND A SOUND RECEIVER

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RECENTLY Baranskiĭ and Zubareva[1] described a demonstration of the Fizeau and Michelson–Morley experiments using sound waves. In their demonstrations, the loudspeaker and the microphone are mounted on the base of a pendulum at a distance l from each other. When the loudspeaker and the microphone are in the plane of the swing of the pendulum, moving with velocity v relative to the air, an additional phase difference arises between the oscillations radiated by the loudspeaker and received by the microphone:

$$\Delta\varphi = \frac{\omega l}{c - v} - \frac{\omega l}{c} \approx \frac{\omega l v}{c^2},$$

where ω is the circular velocity of the sound generator and c is the speed of sound. When the line of sound propagation is rotated relative to the plane of the swinging of the pendulum, no phase difference is observed.

The described demonstration is difficult to perform in a small auditorium. When the setup moves, the Doppler shift of the reflections of the sound in the room may distort the required results. Suspension of a long pendulum together with a plank is also difficult: reduction of the length of the pendulum not only decreases v, but also makes it is impossible to observe distinctly the alternations of the phase differences in the to-and-fro swings, since they occur too rapidly.

A more compact and convenient variant of the experiment is to mount the loudspeaker and the microphone on a table and to produce an artificial "ether wind" with the aid of a table fan. Such an experimental setup excludes practically the influence of reflections inside the room. A fan of 30 cm diameter produces a directed stream of air with a velocity of approximately 3 m/sec extending approximately 1 m. Since this velocity exceeds the velocity that can be conveniently obtained with the aid of a pendulum, the observation of the phase shift becomes more distinct. For a frequency of 10 kHz and an average air speed of 3 m/sec over an extent of 1 m, $\Delta\varphi$ is approximately 90°. If ω is chosen such that a straight-line Lissajous figure is produced, an almost circular figure is obtained after the fan is turned on. The air speed is measured by a simple anemometer. The sensitivity of the setup is such that the transformation of the line into a narrow ellipse on the oscilloscope screen can be observed even without a fan, by blowing strongly with the mouth along the sound propagation direction. A selective amplifier or a simple high-frequency filter in the microphone circuit will help eliminate the noise of the fan and of the room.

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