OBSERVATION OF THE PHENOMENON OF RESONANCE USING SOUND WAVES

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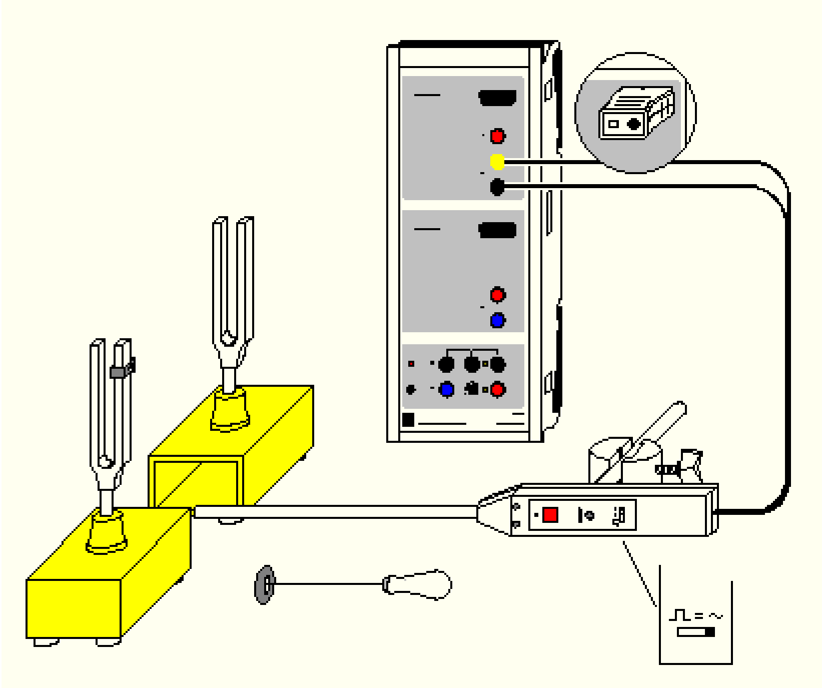
Abstract: This experiment records a beat caused by two tuning forks having slightly different frequencies. The individual frequencies f_1 and f_2, the new oscillation frequency f_n and the beat frequency f_s are determined and compared with the theoretical values.

Keywords: Resonance, amplitude, frequency, tuning fork, microphone.

Resonance describes the phenomenon of an increase in amplitude that occurs when the frequency of an applied periodic force is equal to or close to the natural frequency of the system it affects. Resonance phenomena occur with all kinds of vibrations or waves: mechanical resonance, orbital resonance, acoustic resonance, electromagnetic resonance, nuclear magnetic resonance (NMR), electron spin resonance (ESR), and quantum wave resonance exist. Resonant systems can be used to create vibrations of a specific frequency (for example, musical instruments) or to select specific frequencies from complex vibrations containing many frequencies (for example, filters).

We observed the resonance phenomenon in sound waves using two tuning forks, a sound recording microphone, and the CASSY Lab2 device and software.

Two tuning forks are placed facing each other, if the mass of the tuning forks is the same, if the first tuning fork is hit with a hammer, the frequency of the sound coming out of it will increase sharply due to the frequency of the vibration of the second tuning fork, i.e. resonance will be observed. If the mass of the second tuning fork is slightly smaller, resonance is not observed. The assembly of the experimental device is shown in Figure 1.



Pic.1

In this case, the microphone records the sound coming from the tuning fork, and the CASSY program draws a resonance diagram. Pic.2 . If a puck is inserted into one of the tuning forks and the mass of the stem is slightly increased, resonance will not be observed.

Experiment setup. Position the two tuning forks and the multipurpose microphone and connect the latter to input A of Sensor-CASSY (don't forget to set the microphone to "Signal" mode and switch it on). "Mistune" one of the tuning forks slightly by attaching an additional weight.

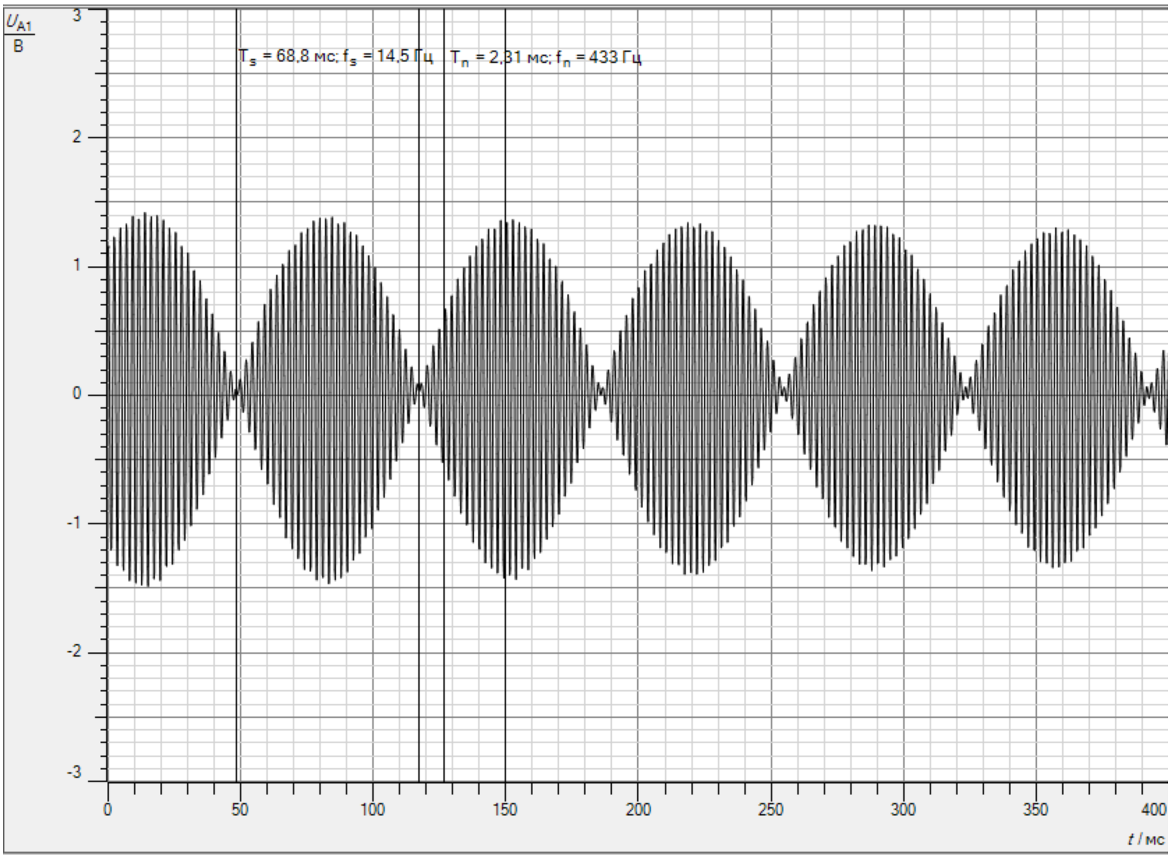
The individual frequencies f_1 and f_2, the new oscillation frequency f_n and the beat frequency f_s are determined and compared with the theoretical values

$$f_n = ½ (f_1 + f_2) \text{ and } f_s = | f_1 – f_2 |.$$

When the amplitudes of the two tuning forks are equal, the nodes and antinodes in the beat become clearly distinguished. The beat frequency f_s is determined from the interval T_s between two nodes as $f_s = 1/T_s$.

To ensure satisfactory accuracy in determining the new oscillation period T_n, you should average the measurements over 10 periods before determining the new oscillation frequency as $f_n = 1/T_n$.

In this example we obtain f_1 = 425 Hz, f_2 = 440 Hz, f_n = 433 Hz, f_s = 14.5 Hz, which closely confirms the theory $f_n = ½ (f_1 + f_2)$ = 432.5 Hz and $f_s = | f_1 – f_2 |$ = 15 Hz.



Pic.2

Analyzing the results, the microphone recorded the sound generated in the tuning fork and turned it into an electromagnetic signal. The CASSY Lab2 program described voltage-time resonances.

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