3. TUNING DROPPER

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First let us discuss origin of sound we hear. There are some waves on surface of a jet. Velocity of these waves is equal by modulus to velocity of a jet. It is directed opposite to it, so these waves are at rest in reference frame of earth. Amplitude of these waves grows and when its value reaches radius of a jet r jet breaks up to drops. Periodic fall of drops on a membrane causes its vibrations. As a result we hear sound. So we will not hear sound if we put membrane in place where a jet is whole. Theoretical results, which will be presented later, are true if

$v \ll \dfrac{2\pi\rho c^2}{\eta} \sim 10^7 \text{Hz}$ which means that loose of energy caused by

viscosity is negligible. If $v \gg \dfrac{c}{2\pi}\sqrt{\dfrac{\rho g}{\sigma}} \sim 100\text{Hz}$ then waves are capillary.

$$x(z,t) = ae^{\alpha t}\cos\frac{2\pi z}{\lambda}$$

Here x is radius of a jet. Dependence of α on frequency of a wave is given on the figure 1. You see that there are waves, which grow at fastest, and waves, which do not grow at all ($\alpha < 0$). We often have a certain constant frequency of drops if there are no external sounds.

Frequencies of oscillations of a membrane are determined from next equation:

$$V_{s,n} = \mu_s^{(n)}\frac{1}{r_m}\sqrt{\frac{T}{\sigma_m}}.$$

Strong sound can cause oscillations of a tube and a cone. Main frequency of a cone is proportional to $\dfrac{c \cdot \cos\alpha}{r}$.

Here c is speed of sound in the material of which the cone is made, α is the angle of disclosing of the cone and r is radius of the cone. This is confirmed experimentally. A cone concentrates sound with wavelength less then length of the cone so intensity of sound is bigger than in case no cone is used. In fact a cone absorbs part of the energy. Frequency of vertical oscillations of a tube decreases with growth of its
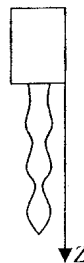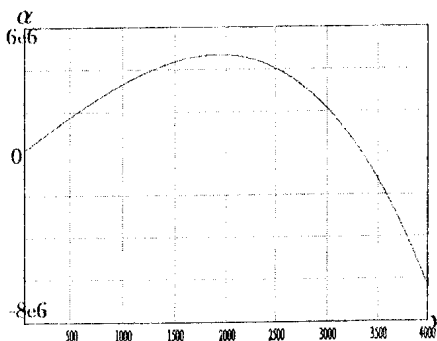

Fig.2

Fig.1

height. Frequency of horizontal oscillations of a tube decreases with growth of its radius. A membrane on the top of a tube oscillates with bigger amplitude then a membrane fixed on a ring.

If the main frequency of a membrane is much bigger than the drop frequency then we hear frequency of the membrane but not the drop frequency. We usually do not hear cone and tube frequencies because their oscillations have small amplitude.

When we put a membrane in the place of decay of a jet we do not hear sound. External vibrations can cause lifting up of decay level. That means that we got a system, which generates sound only when external vibrations are applied. Any external sound can cause vibrations of a membrane, which can cause stronger sound than initial sound was. If the frequency of the external sound belongs to the interval of possible drop frequencies ($\alpha > 0$) then frequency is conserved. Interval of conservable frequencies can be regulated by change of jet velocity, jet radius and membrane. System can be used as an amplifier of a tuning fork sound, human voice or other vibrations.

Acknowledgements:

References:

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