INVESTIGATING A PNEUMATIC HORN

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1-Introduction

A pneumatic horn is a device to create an extremely loud noise for signaling purposes. It can be constructed by stretching a balloon over the opening of a small container or cup with a tube through the other end. Blowing through a small hole in the side of the container can produce a sound. These horns are widely installed on large semi-trailer trucks, fire trucks, trains, and some ambulances as a warning device and on ships as a signaling device. We must investigate how relevant parameters affect the sound.

2-Theory

These horns, normally, have a constant volume of air inside the bottle with temperature and pressure which is the same as pressure and temperature outside the bottle but when the air is blown to the air horn the pressure inside the bottle becomes more than the pressure outside. Since the temperature and the bottle volume has a little change, as Ideal gas law it can be written:

$$PV = n\,RT \qquad (1)$$

Sound is a longitudinal wave that the direction of propagation is parallel to the direction of vibration. There are different types of acoustic pipes, open ended pipe or closed ended pipe. Here we need to use open ended pipe.

Figure 1- Standing waves in open ended pipe

The quality in a sound of being deep is called resonance. When the inherent frequency of voice pipe resonates with frequency wave it creates better sound.

3-Experiments

Fast Fourier transform analysis converts a signal from its original domain (often time or space) to a representation in the frequency domain and vice versa.

$$X_k = \sum_{n=0}^{N-1} x_n e^{-i 2\pi k n / N} \qquad k = 0, \ldots, N-1. \qquad (2)$$

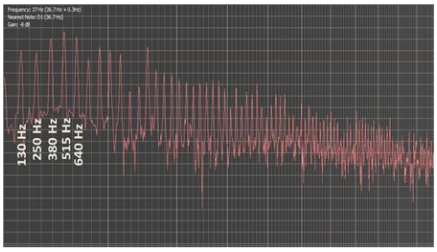

Figure 2- FFT analysis in air horn

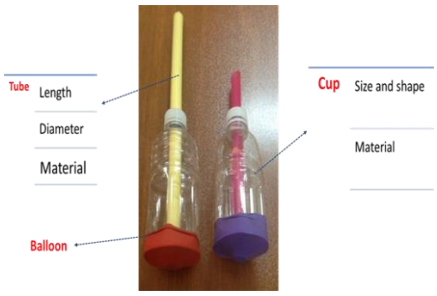

Figure 3- Different shapes of a pneumatic horn

4-Conclusion

Different parameters like the shape, size and material of the components have been investigated. Membrane has a dramatic effect on the sounds. These changes have a significant impact on the elasticity, thickness and also material. If the traction of balloon becomes further, the voice become thinner and vice versa.

References

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