

Team Third report



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Flow visualization: MCEN 4151

Our team was planning to experiment Ruben's tube to visualize the sound waves and how the flames would be captured. To begin, we purchased the Ruben's tube from another group in our class to be able to start the experiment. Ruben's tube or as people call it "Standing wave flame tube" were first invented by Heinrich Ruben and Otto Kriger-Menzel, who were German physicists that were looking for a way to use fire as an illustration to the sound wave applied [1]. A schematic of the Ruben's tube is shown in figure 1 to illustrate how it work [2]. The final image was captured using a team collaboration of: Matt Knickerbocker, Blake Chin, Robert Drevno, and Abhishek Kumar.

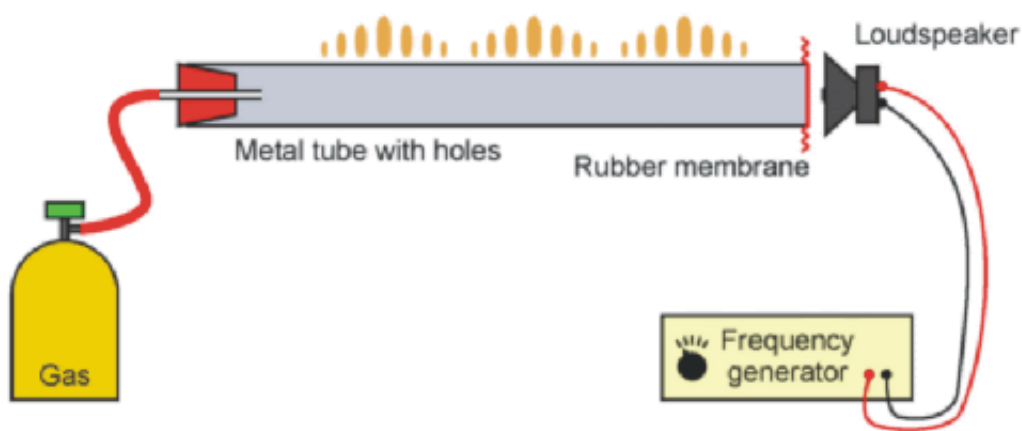


Figure 1. Schematic of Ruben's tube

The goal for this experiment is to visualize sound waves using the tool of Ruben's tube. Sound waves are created when there is a vibration that causes the medium, air, to vibrate, in which they can't be seen by the human eyes. So, using Robert Drevno speaker at one end of the tube, we were able to see the difference in flames height as we were changing the frequency of the sound.

The Ruben's tube was about eight-foot-long in which at one end of the tube was filled with propane gas using a tank. To make sure that the gas is not going out of the tube, a rubber membrane was attached as shown in figure 1. As mentioned earlier, the other end of the tube was the position of the speaker that were about 2 inches away from the tube. Using a lighter to start the flames and a frequency app generator, I was able to capture the final image outputting an approximation of 250 Hz sinusoidal sound waves.

The image was taken using a Canon EOS 50D camera. The setting of the camera was an aperture of F/10, ISO of 500, and a shutter speed of 1/320 seconds. The original image size is 4752 x 3168 pixels and the focal length was 55 mm. The captured image was roughly 4.5-5 inches from flames. To be able to show the best representation of the image, a slight post-processing was achieved using Photos to adjust the level of color contrast and its saturation. The original image and final image are shown in figures 2 and 3 respectively.



Figure 2. Original image



Figure 3. Final image

All in all, the experiment was fun in which the Ruben's tube was an effective way to visualize the sound waves using a speaker. However, I believe if the experiment was done using a large chamber with different medium than air, it would illustrate the sound waves more clearly. I like how the final image reminds me of ballet dancers jumping through the tube in which it gives aesthetic looking. The intent of this experiment was achieved in which we learned more about Ruben's tube and its application to visualize the sound waves.

Reference

- [1] *Ruben's Tube and the Science of Dancing Fire*. (2019). *Owlcation*. Retrieved 2019, from <https://owlcation.com/stem/Rubens-Tube>
- [2] *HSA Ruben's Tube 2013*. (2019). *Sites.google.com*. Retrieved 2019, from <https://sites.google.com/site/hsarubentube2013/>