Date of Lab 4/30 Date of Submission 5/7

Laboratory Report

Title Resononce in a Pipe

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Summary

Resonance occurs when the frequency of the sound (Sound source) and the natural frequency of air column matched. In this lab, we found out ~~the~~ resonance points using various tune forks of that tune by changing water's level in a water/air column. The most echoed point ~~is~~ was in the resonance point. We calculated the wavelength from the length of air column in resonance and compared it to the theoretical values. Some difference showed the position of the antinode.

・Meet a deadline ・Write logically ・Write clearly ・Write with your own words

Teacher's Comments

A compact and clear report.

1	2	3	4	5	6	7	8	9
Due	Summary	Intro.	Method.	Results	Table/Fig.	Discussion	Clearness	General
+					+++	+	+	++

* Use this form as a cover sheet.
* Submit your reports by the seventh day after your lab.

2. Introduction

Objectives : to observe the resonance phenomenon that occurs when the vibration frequency of sound and the natural frequency of air column match. Calculate the wavelength of the sound from the length of the air column and compares it with the theoretical values.

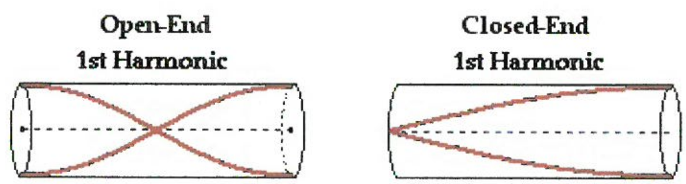
Theory :

- Wavelength : the spatial period of a periodic wave; the distance over which the wave's shape repeats
  $\lambda = V / f$

- Resonance : a phenomenon in which sound generators having equal frequencies, and when one generator sounds, the other sounds a sound.

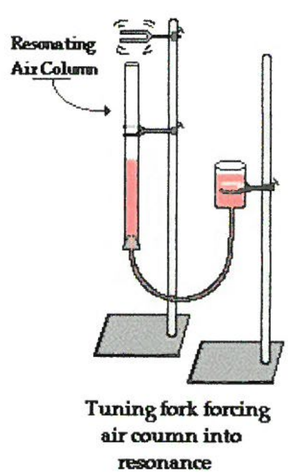
- Both Ends Open Air Column : both ends must be antinode

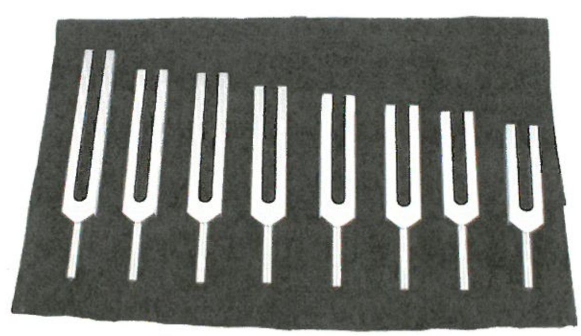
- One End Open Air Column : closed side must be node and the other side must be antinode



3. Experimental

Apparatus : Air-Water Column / Reservoir / Tune Fork (C,B,A,G,F,E,D,C) / Mallet / Stand / Thermometer





Method :

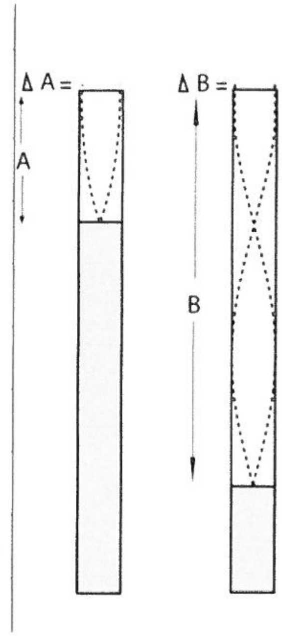
1. Measure the room temperature, then calculate the speed of sound
   V = 331.5 + 0.6t [m/s]

2. Use the speed of sound which I calculate before and find the theoretical wavelength and length of air columns of each frequency of 8 tuning forks
   Wavelength $\lambda exp = V / f$
   Length of Air Column in Resonance $A = \lambda exp / 4$
   - 1st Harmonic
   $B = 3 \lambda exp / 4$
   - 2nd Harmonic

3. Let the surface level of water move to the area of A*theo* or B*theo*, and find the experimental A and B by the resonance between fork tune and air column

4. Then calculate experimental value of wavelength and length of air columns of each frequency of 8 tuning forks

5. Find the location of antinode at the open end by
   $\Delta A = A_{theo} - A_{exp}$
   $\Delta B = B_{theo} - B_{exp}$



4. Result

Temperature : 24.0℃ **Speed of Sound : 345.9**

Table 1 : Comparison of Theoretical and Experimental Values of each Tune Fork

Tune Fork		Theoretical			Experimental						
	Frequency f (Hz)	$\lambda theo$ (cm)	A_{theo} (cm)	B_{theo} (cm)	A_{exp} (cm)	B_{exp} (cm)		λexp (cm)	f_{exp} (Hz)	ΔA (cm)	ΔB (cm)
C	512	67.6	16.9	50.7	16.9	49.5		65.2	530	0	1.2
B	480	72.1	18.0	54.1	17.0	53.3		72.6	476	1.00	0.800
A	426.7	81.1	20.3	60.8	21.0	59.3		76.6	452	-1.00	1.50
G	384	90.1	22.5	67.6	21.3	66.6		90.6	382	1.20	1.00
F	341.3	101	25.2	75.8	24.3	75.2		101.8	340	0.90	0.600
E	320	108	27.0	81.0	26.8	80.2		106.8	324	0.20	0.800
D	288	120	30.0	90.0	29.5	/		/	/	/	/
C	256	135	33.8	101.2	32.6	/		/	/	/	/

Table 2 : % Error

	1st Harmonic (A)	2nd Harmonic (B)
C	0	2.4%
B	5.6%	1.5%
A	4.9%	2.5%
G	5.3%	1.5%
F	3.6%	0.79%
E	0.74%	0.99%

5. Discussion

We could know the resonance point because the sound on that level is different from others. This sound difference shows the appropriate wavelength for the resonance for that tune. As you can see from Table 1, the experimental values are very close to the theoretical, and Table 2 proves it. However, I think this small error was caused by the position of antinode. If you have positive ΔA or ΔB, it means the antinode was jutted out, and negative value means the antinode was got into the tube. Therefore, in my experiment, only 1st Harmonic of A tune has negative number, so that one's antinode was got into the tube. It was occurred because we brought the tune too close to the tube. Others have positive numbers, so they have the antinodes over the brim. Also, it was difficult to hear the sound because everyone was doing same thing at the same time, so misreading and mishearring might happen.

(Interesting observation)

6. Conclusion

- The resonance point of the sound can be know by its echo.
- We can calculate the wavelength from the length of air column in resonance
- We can know the position of antinode by the difference of theoretical and experimental values.

7. Opinion

I was impressed by this lab because the way of hearing was very different. If I moved a cup a little bid up or down, the sound changes and it did not sound well. From this lab, I learned the sound of frequencies are very different. We do not care about it when we are living, but they have very huge difference between one sound and others.

8. Reference

Shutomo Iwai's Lab Report
Kana Fukuchi's Lab Report