Experiment No. Date: ……/……/2080

TO DETERMINE THE VELOCITY OF SOUND IN LABORATORY BY USING RESONANCE TUBE APPARATUS AND HENCE FIND THE VELOCITY OF SOUND IN AIR AT NTP

APPARATUS REQUIRED:

1. Resonance tube apparatus
2. Water
3. Tuning fork
4. Rubber Pad
5. Thermometer

THEORY:

The resonance air column apparatus (resonance tube apparatus) is one of the simplest techniques used to measure the speed of sound in air at room temperature. The resonance tube apparatus is used to find:

1. Wavelength of sound.
2. Frequency of tuning fork.
3. Velocity of sound at laboratory temperature.
4. End correction of a tube (pipe).

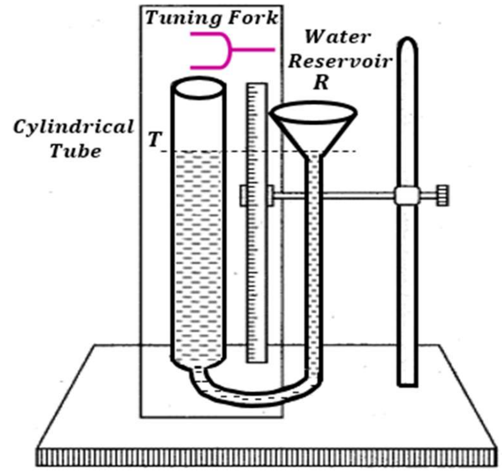


Figure*: *Resonance tube apparatus

Construction:

The apparatus used for the experiment consists of a long cylindrical tube that is attached to the water reservoir. The space above the water in the cylindrical tube is occupied by air. The length of water level and hence the length of air column inside the tube can be varied by raising or lowering the water reservoir.

Working:

When a vibrating tuning fork is held above the open end, we can observe that longitudinal waves are sent down the air column. These waves are then reflected back from the water surface and thus produce standing waves. Here, the surface of water acts as the closed end. Also, nodes are produced at the water surface and antinodes are produced at the open end. On adjusting the length of air column to a proper length, resonance is observed. The resonance is indicated by the increase in the intensity of the sound.
(***At resonance, the frequency of vibration of air column is equal to the frequency of vibrating tuning fork***).

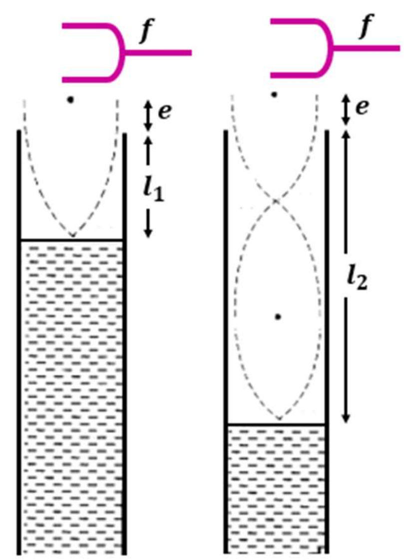
Resonance:

Resonance is the tendency of a system to oscillate with greater amplitude at some frequencies than at others.

It is a phenomenon when the frequency of an externally applied periodic force on a body is equal to its natural frequency, the body readily begins to vibrate with an increased amplitude.

Let,

$f = \text{frequency of tuning fork}$
$l_1 = \text{first resonating length}$
$l_2 = \text{second resonating length}$
$\lambda = \text{wavelength of sound}$
$v = \text{velocity of sound}$ **at laboratory temperature**
$e = \text{end correction of tube (pipe)}$



Then, for first resonance,

$$\frac{\lambda}{4} = l_1 + e \dots\dots\dots (1)$$

And, for second resonance,

$$3\frac{\lambda}{4} = l_2 + e \dots\dots\dots (2)$$

On subtracting equation (1) from equation (2), we get

$$\lambda = 2(l_2 - l_1)$$

Now, velocity of sound: $v = \lambda f$

$$\therefore \quad v = 2f(l_2 - l_1)$$