Measuring the speed of sound using a resonance tube

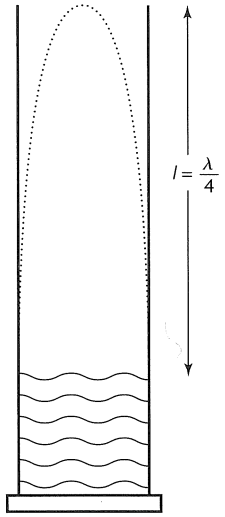
It is assumed that you:

a know that, for all forms of wave motion, $v = f\lambda$, where v is velocity, f is frequency and λ is wavelength

b understand that the air inside the tube will resonate in much the same fashion as air inside an organ pipe. That is, standing waves can be set up so that a pressure antinode occurs at the closed end of the tube while a pressure node occurs at the open end of the tube.

Theory

The diagram on the right shows the simplest standing wave that can be set up in the resonating tube. The frequency which causes such a standing wave is called the *fundamental* or *1st harmonic* and always occurs for the shortest length of tube which produces resonance.



Pressure amplitude

At resonance, the length of the tube, l, is related to the wavelength of the standing wave set up in the air inside the tube and since the resonant frequency, f, and wavelength, λ, are related to the velocity of sound in the air, the speed of sound in air can be determined.

Equipment required

- tall measuring cylinder
- approximately 75 cm of glass tubing with internal diameter of approximately 40 mm
- stand and clamp for the tube
- series of tuning forks of differing frequency (~128 Hz to ~2048 Hz, including 512 Hz if possible)
- two large rubber stoppers

Purpose of this experiment

- To determine the velocity of sound in air, at room temperature, by means of a resonance tube.
- To establish that resonance occurs in the tube, at a certain frequency, only when the tube has particular fixed lengths.

Diagram of the experiment