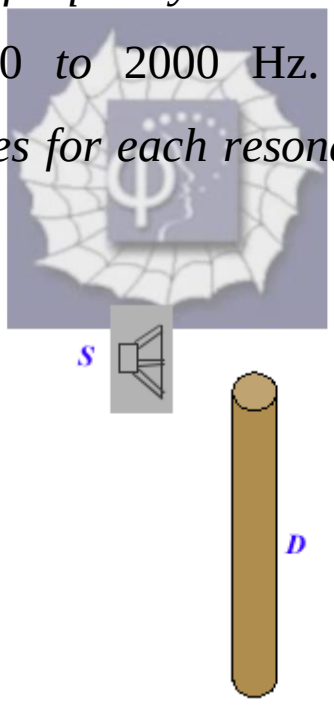
151.

Problem 20.39 (RHK)

S is a small loudspeaker driven by an audio oscillator and amplifier, adjustable in frequency from 1000 *to* 2000 Hz *only. D is a piece of cylindrical sheet-metal pipe* 45.7 cm *long and is open at both ends. We have to find* (a) *the frequencies at which resonance will occur when the frequency emitted by the speaker is varied from* 1000 *to* 2000 Hz. *We will sketch the displacement nodes for each resonance. We may neglect the end effects.*



Solution:

The open end of a tube is a pressure node. Therefore, at resonance for stationary waves both ends of the cylindrical pipe will be pressure nodes. This condition

determines wavelength, λ, at resonance in terms of the length of the pipe, L,

$$\frac{\lambda}{2}\times n = L,\ n = 1,2,3,\ldots$$

or

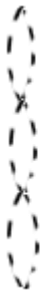
$$\lambda = \frac{2\times 0.457}{n}\ \text{m} = \frac{0.914}{n}\ \text{m}.$$

Resonant frequencies will therefore be

$$f = \frac{v_s}{\lambda} = \frac{343\times n}{0.914}\ \text{Hz} = 375n.$$

From this result we note that the resonant frequencies in the range 1000 to 2000 Hz will be

$$f = 1125\ \text{Hz, } 1500\ \text{Hz, and } 1875\ \text{Hz.}$$



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