Vibrating Air Columns

(Longitudinal) Standing Waves in a Pipe:

= superposition of two counter-propagating traveling waves (one right moving, one left moving)

Rarefaction and compression of air molecules = displacement of air molecules from their equilibrium positions

See UIUC Physics 406 animation of longitudinal displacement of air molecules in a pipe…

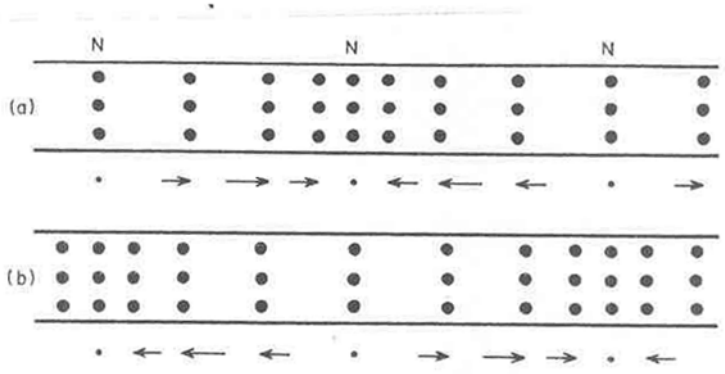

FIG. 5. Longitudinal standing wave in an air column. (a) At an instant of maximum displacement of the air molecules. (b) One-half cycle later.

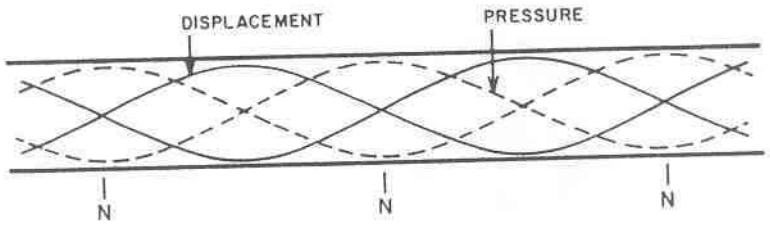

FIG. 6. Graphic representation of a longitudinal standing wave.

Three basic kinds of "organ pipes":

a.) Both ends ***closed*** (analogous to "fixed" ends on a vibrating string)
b.) Both ends ***open*** (analogous to "free" ends on a vibrating string)
c.) One end ***open***, one end ***closed*** (analogous to one end fixed, one end free on string)

⇒ **Boundary Conditions** on mathematical allowed solutions to the wave equation that describes the longitudinal waves propagating in an organ pipe