At the points *B* and *D*, the orientation of the instantaneous tangential velocity vector of the rotating sound source $\vec{v}_t$ is perpendicular to the sound source – distant observer direction, thus at these instants in time, the observer hears no Doppler shift (up or down in pitch), i.e. $f^{B}_{observer} = f^{D}_{observer} = f_{source}$. Thus, as time progresses, the (distant) observer hears a sinusoidal variation of the frequency over the range: $f^{C}_{observer} \leq f_{source} \leq f^{A}_{observer}$.

For one full revolution of the Leslie speaker rotor, the *x*-component of the tangential speed of the rotating sound source (refer to above figure) as a function of time is: $\boxed{v_x(t) = v_t \cos\omega t = \omega r \cos\omega t}$ thus the frequency heard by an observer/listener (red dot in the above figure) is:

$$\boxed{f_{observer}(t) = \left(\frac{V_{air}}{V_{air} + v_t(t)}\right) f_{source} = \left(\frac{V_{air}}{V_{air} + \omega r \cos\omega t}\right) f_{source}}$$

A rhythmic, or periodic/sinusoidal variation in frequency (= "pitch" in musical parlance) is known as *vibrato*.

The sound from a Leslie cabinet used inside a room, or an auditorium is actually ***far*** more rich and complex than just that as described above! The reason(s) for this are:

a.) The sound radiated from the each of the rotating speakers of the 2-way Leslie speaker cabinet also reflects off of the walls, floor and ceiling in a myriad of ways – single and multiple reflections, and with correspondingly differing path lengths (hence differing propagation delay times) which depend on the details of the geometry of the room, the Leslie speaker cabinet location and observer/listener location in the room. The indirect, reflected sounds seemingly coming from everywhere in the room will thus have their own specific Doppler shifts in frequency, as dictated by the law of reflection from the wall/floor/ceiling surfaces of the room, which are also heard by the observer, in addition to the vibrato sound coming directly from the Leslie cabinet.

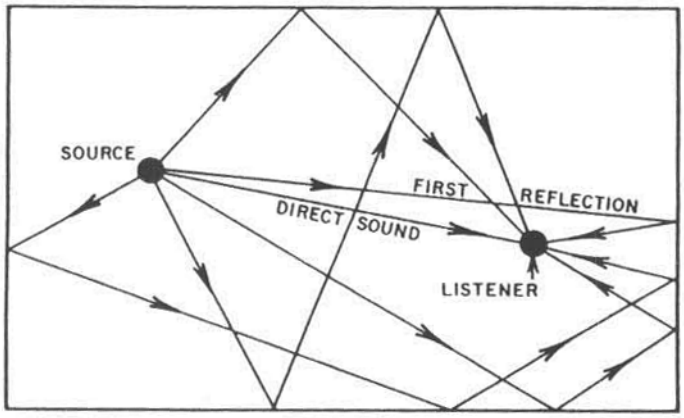

FIG. 1. Multiple reflections from the walls of a room of a single impulse produced by a sound source.