Demonstrating the principle of phase plugs used in loudspeakers by Wave Interference

In cone type speakers high frequency sound reproduction can suffer from wave cancellation and lobing. These bad effects can be reduced by a phase plug. The phase plug is a plug attached to the centre of the voice coil while the dust cap is missing.

First let's see an ideal speaker: the high frequencies radiated from a point. This point source radiates the high frequencies and the outer part of the diaphragm works as a waveguide for soundwaves: there is no cancellation or lobing effects.

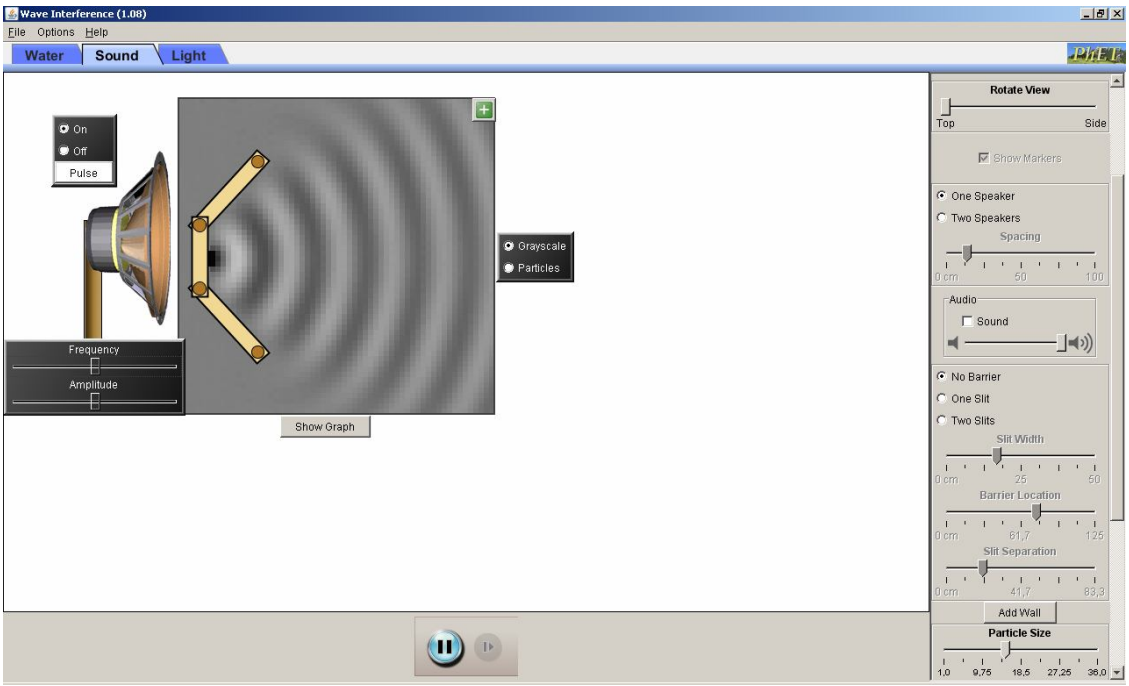

Figure 1. High frequency radiation pattern of an ideal speaker

In real world the diaphragm isn't a point source. Each part of the speaker cone participates in forming the sound field. Speakers with high damping cone material radiate high frequencies mainly by centre part of the cone.

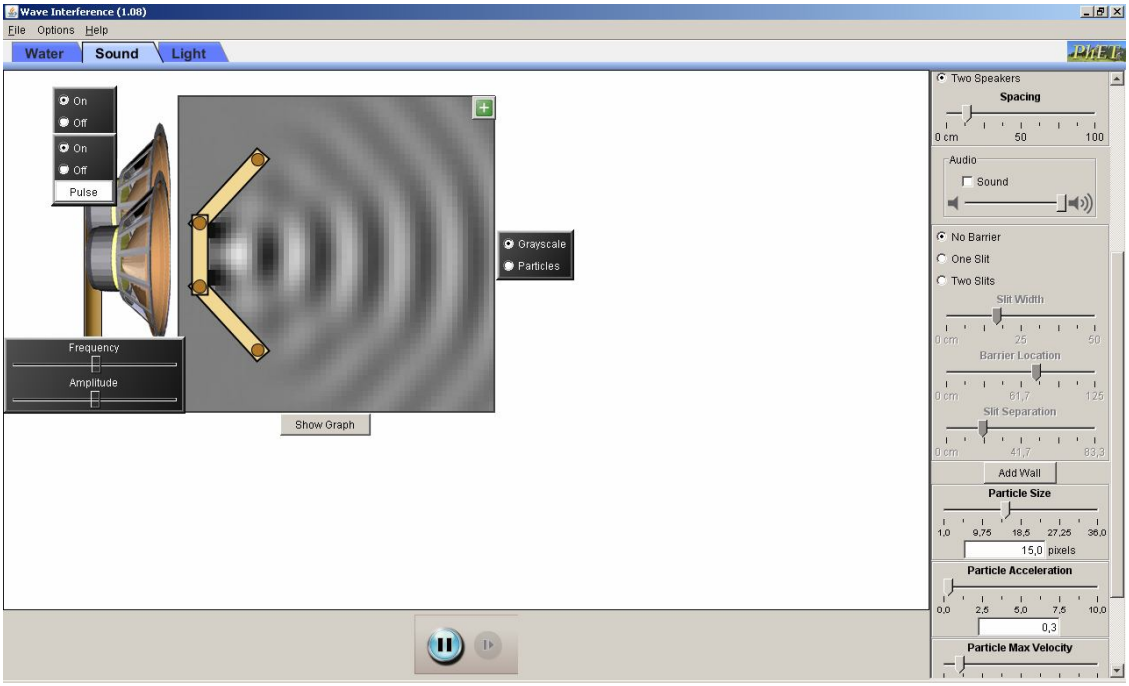

Figure 2. High frequency radiation pattern of a real cone speaker simulated with two point source

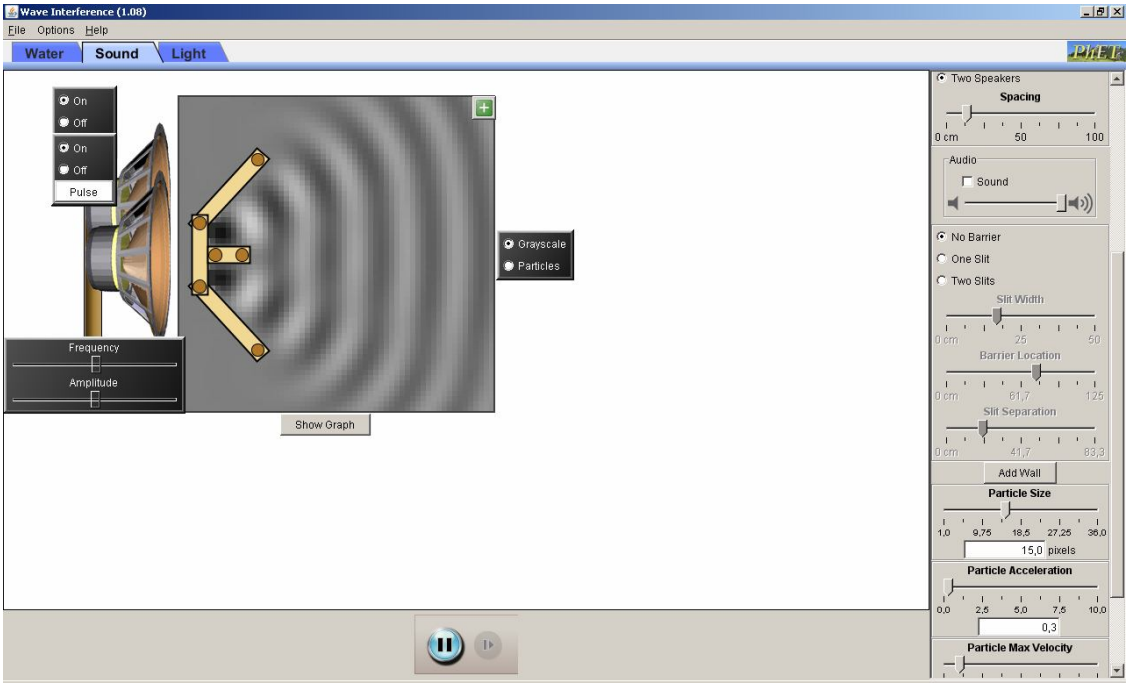

Figure 3. High frequency radiation pattern of a real cone speaker with a phase plug attached to the centre; high frequency cone movement simulated with two point source

As shown above more then one point source can cause lobbing effect. The power is radiated in a very small angle.

With phase plug one side of the cone is „separated" from the other side. There is no lobbing or wave cancellation at high frequencies. The phase plug can extend the speaker response with an octave. At much higher frequencies the phase plug speaker behaves same as the normal cone speaker.

Phase plugs have an other advantage: as there is no dust cap the cone doesn't compress the air under the dust cap.

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