ACOUSTIC DAMPING FOR LOUDSPEAKERS*

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The fundamental resonance of loudspeakers is recognized by many as a source of annoyance. Usually this resonance can be damped electrically by suitable selection of the amplifier impedance.[1] What is less well-known is that damping can also be achieved by acoustical means incorporated into the loudspeaker or the enclosure. This paper deals with the theory and methods for providing acoustic damping.

Electrical damping requires the use of a low impedance amplifier. When this type of source is not available, and in the absence of other damping means, performance of the system may be seriously impaired. For example, a typical home radio or record player has a pentode output stage without inverse feedback. This type of output stage is known to provide a source of high impedance. A loudspeaker driven from this source will exhibit a resonant condition which may cause poor transient response or "hang-over" and it may be responsible for the acoustic feedback in record players. Acoustic damping may be found helpful in this instance.

Another use for acoustic damping will be found in the design of high-fidelity systems, where frequent attempts are made to improve damping by lowering the amplifier impedance to a value approaching zero. There is a limit to the amount of damping which may be obtained in this manner.[2, 3] Furthermore, electrical damping per se is not very effective in eliminating the resonance in cabinets with reflex ports. Acoustic damping can readily provide such additional damping as may be required.

Much effort and circuitry has been devoted to attempts to obtain damping from the electrical side. By contrast, the use of acoustic damping has been given little attention. In this paper we outline a simplified theory of acoustic damping for loudspeakers and enclosures. To provide a rational basis for the design of acoustic damping the acoustic constants of the loudspeaker and the enclosure must be known. Thence, an equivalent electrical circuit can be set up and the damping resistance may be determined experimentally by adjusting the electrical circuit constants. Keeping this approach in mind, first we derive the resonant frequency equations of a loudspeaker in a flat baffle and in an enclosure. Next, from these two equations we determine the acoustic mass and compliance of the loudspeaker cone. Thirdly, we set up an equivalent electrical circuit and determine the required damping resistance. And finally we build the acoustic damping into the enclosure and test its acoustic performance.

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