4

Bass-Reflex or Phase-Inversion Enclosures

Bass-reflex enclosures (or *phase-inversion* enclosures, as they are more correctly referred to) offer the best approach to utilizing the energy generated by the back radiation from the cone speaker. If the cone is not baffled, the back radiation interferes with the front radiation. Infinite baffles ensure that the back radiation never meets the front radiation in a detrimental manner.

BASS REFLEX DEFINED

The phase-inversion enclosure allows the back radiation to be usefully added to the output of the front radiation. This improves the low-frequency response of the system. The mechanics of this process may be described as follows: The entrapped air volume of the enclosure is used as an extension of the cone to move a volume of entrapped air in a port or opening approximately equal to the area of the air displaced by the front of the cone.

The air volume in the enclosure acts as a "spring" coupling the back of the cone to the "cone" of air entrapped in the port area. This "spring" has the effect of delaying the transfer of the cone movement to the volume of entrapped air in the port area. This

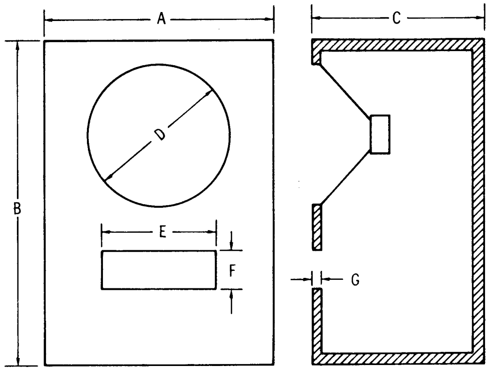

Fig. 4-1. Basic dimensions of phase-inversion enclosures.

time delay brings the two radiations (from the cone and from the port) from an out-of-phase, or opposed, condition into an in-phase condition at the necessary low frequency.

One popular misconception regarding phase inverters is that as the frequency decreases, the front radiation from the cone becomes less, and all the acoustic power heard emerges from the port. Actually, the very best that can ever be achieved would be approximately equal outputs from the port area and from the front of the cone, inasmuch as radiations from the port are directly related to the movement of the cone. One cannot get "something for nothing." As a matter of fact, there is slightly less acoustical power from the port area as compared to the front of the cone because some energy is lost via absorption inside the enclosure.

Fig. 4-1 illustrates the main features of a phase-inversion enclosure. Dimensions A × B × C (in inches) = the volume of the enclosure in cubic inches. For conversion to cubic feet divide cubic inches by 1728 ($=12^3$). D is the speaker mounting opening, which is equal to the diameter of the surround compliance of the driver. E × F is the port area; E × F × G is the port volume.

With this type of enclosure, three main variables are adjusted to achieve increased low-frequency response: (1) enclosure volume can be altered, (2) port area and volume can be scaled up and down, and (3) the free-air resonance of the speaker cone may be of different values for various sizes of cones and types of drivers.

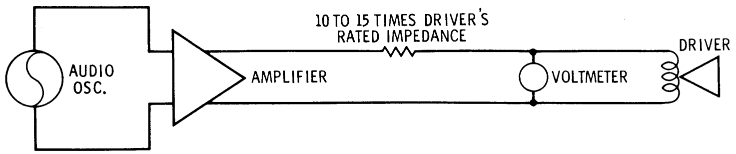

Fig. 4-2. Electrical circuit for measuring impedance (or resonance) of a speaker.

Table 2-1 in Chapter 2 states the rated diameter and effective piston area of the most commonly used sizes of woofers (low-frequency speakers). It is important to know the effective piston area of the cone used because, ideally, the port should be the same area. If the port is made larger than the cone area, there is danger that the speaker is no longer baffled. At this point the port becomes large enough to allow interfering back radiations to mingle with

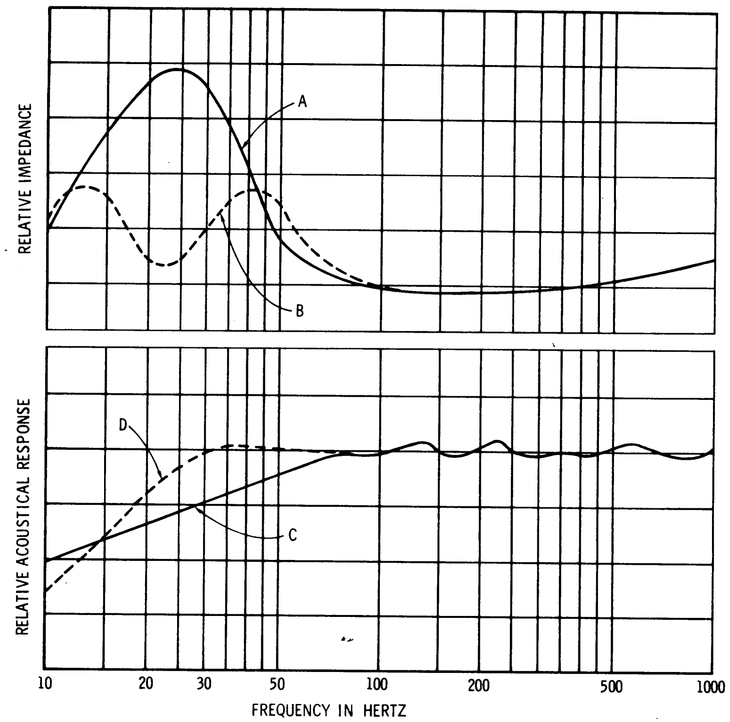

Fig. 4-3. Characteristic curves for a low-frequency driver. (A—impedance of driver in free air, B—impedance of driver in a tuned enclosure, C—acoustical response of driver mounted in an infinite baffle, D—acoustical response of driver mounted in a ported enclosure).

front radiations as the frequency increases above resonance. If the port is made smaller than the cone area, then the port radiations cannot equal the output of the front radiations from the cone. When the cone area and the port area are equal, they can generate approximately equal acoustical energy, which results in almost double the output that would be expected from the same driver in an infinite baffle at the same low frequency.