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HORN LOADING OF BASS-REFLEX PORT IMPROVES PORT RADIATION

By Craig Smith

The most straigntforward and practical variation of the bass-reflex enclosure is that in which the port itself is loaded by a small section of horn. The addition of this "port horn" accomplishes two beneficial results that improve the overall performance of the bass-reflex enclosure. The horn-loaded port enables the formulation of a structure of smaller proportions for equivalent low frequency output.

Besides this function of shrinking cabinet size, the port horn plays an important acoustical part in improving the low frequency radiation that emanates from the port. The radiation resistance of a piston for a particular frequency goes up as the size of the piston increases. This characteristic does not necessarily apply only to a physically solid piston. Actually, the mouth of a horn may be considered as a piston, for it is the virtual source of the pulsations of sound. We might call any opening from which sound emerges an infinitely thin and infinitely light membrane, and we may apply to it in all theoretical justice the same laws of radiation physics that apply to an actual physical diaphragm. Thus, the larger we can make the opening from which the sound is to emerge, the better its radiation characteristic will be for a given frequency, especially in the low end.

This is the second advantage of the port horn. It provides better radiation efficiency for the low frequencies coming out of its comparatively large mouth than does the simple port. It is recognized that tne horn seems almost too short to be theoretically efficient. However, as often happens, shortcomings in theory may turn out to be blessings in disguise, if properly utilized. Figure 12-1 shows the radiation characteristic of a very short horn (in relation to the theoretical cutoff wavelength of the horn). Because of this shortness and the corresponding comparatively small size of the mouth (even though it is larger than the original port), the radiation characteristic of the horn is quite ragged, as illustrated. If we were to try to utilize this horn for broad band reproduction, it would be entirely useless because of its ragged and irregular nature. However, we are not interested in broad band response from the port horn. We are interested primarily in its output at one very narrow band of frequencies, at the lower resonant peak of the impedance characteristic of the system. Consequently, we can design this port horn short in length in relation to this low frequency, thereby getting a peaked radiation from the short

horn just where we want to reinforce the radiation characteristic. We have, as it were, turned the tables on the nonresonant horn, and made it resonant for the specific purpose of improving the low frequency radiation over a restricted range, and from an otherwise smaller opening.

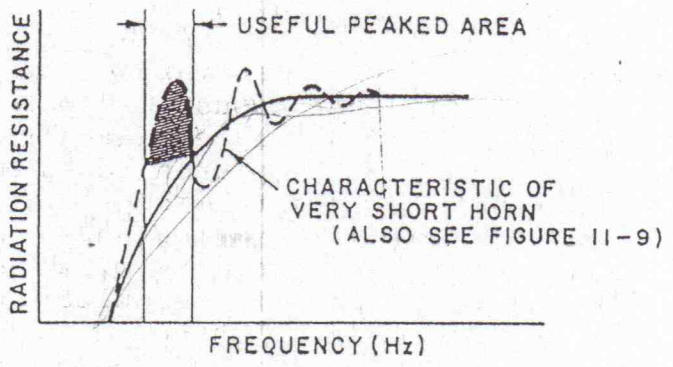

Fig. 12-1. Definite peaked characteristic of short horn and small mouth compared to wavelength make the horn useful as a high efficiency radiator over a small desired frequency range as in the horn loading of a port of a bass-reflex enclosure.