REFERENCES

[1] C.R. Hanna and J. Slepian, "The Functions and Design of Horns for Loudspeakers," reprinted in J. Audio Eng. Soc., vol. 25, #9, pp. 573-585 (Sept. 1977).

[2] D.B. Keele, Jr., "Low-Frequency Horn Design Using Thiele/Small Driver Parameters," presented at the 57th Convention of the Audio Eng. Soc.," Preprint No. 1250 (K-7) May 1977.

[3] E.C. Wente and A.L. Thuras, "A High Efficiency Receiver for a Horn Type Loudspeaker of Large Power Capacity," reprinted from the BSTJ, Jan 1928 by J. Audio Eng. Soc., vol. 26, pp. 139-144.

[4] H. Fletcher, oral communication in Fundamentals of Acoustics class, Brigham Young University, Provo, Utah, 1959.

[5] J.N. Armstrong ET. AL. "Loudspeakers" patent no. 2,923,782 dtd 2 Feb. 1960.

[6] B.H. Smith, "An Investigation of the Air Chamber of Horn Type Loudspeakers," J. Acoustical Society of America.

[7] C.A. Henricksen, "Phase Plug Modeling and Analysis: Radial versus Circumferential Types." presented at the 59th Convention of the Audio Eng. Soc., Preprint No. 1328 (F-5).

BOB SMITH'S CONCENTRIC RING DESIGN - [6]

Smith considers a disk shaped air chamber as shown in Figure 2. One wall and the edges are solid and the other wall, the diaphragm, moves in response to a voice coil signal. Assigning these boundary conditions, and an arbitrary function to define the axial component of velocity at the far wall, $f(r)$, to the wave equation he obtains his equation (2) for the potential and equation (3) to approximate the pressure. These equations are elegant, but not necessary to this review.

The first case analyzed is the case wherein the horn throat connects to the center of the chamber as shown in Figure 2. Under this condition the function $f(r)$ may be defined as:

$$f(r) = u_r = P_r/\rho c \qquad 0 \leq r \leq a_1$$

$$= 0 \qquad a_1 < r \leq a$$

The result is a family of radial standing waves in the chamber such that $k_n a$ is a root of the Bessel function of the first kind of order one (J_1) as n varies from 1 to ∞. You may see Smith's equation (7) for all the gory details. This standing wave pattern, as illustrated in Figure 2, produces a pressure null in the horn throat resulting in a null in the output of the entire transducer. The resonant frequencies are given for the first few modes for a 5×10^{4} m spacing as:

$$f_1 = 176/a \qquad f_2 = 338/a \qquad f_3 = 518/a \qquad (2)$$

$$f_2 = 724/a, \text{ for } a \text{ in metres}$$

These frequencies have been corrected for air viscosity, but more recent measurements of viscosity reduce these frequencies approximately 1% lower.