EXPERIMENTAL DESIGN

JBL has designed and constructed a new phasing plug for the model 2440 and 375 compression drivers. These have a 0.1 metre voice coil diameter. Figure 9 is a photograph of this four ring plug. Since the velocity of sound is sensitive to the spacing between the plug and the diaphragm, the suppression of a given mode is also sensitive to this spacing.

Figure 10 shows the frequency response curve of a typical 2440 compression driver on a 0.0254 metre diameter terminated tube using the previous phasing plug design as a solid curve. Predicted chamber resonances are at 3,520, 6,740, 10,360 and 14,460 Hz for this transducer. The existing phasing plug does a good job of suppressing the first resonance, but the 6,740 Hz resonance shows through at about 7,600 Hz. The third resonance, predicted for 10,360 Hz appears to occur at 9,600 Hz and is almost coincident with the voice coil decoupling frequency just above 10 kHz. The 14.5 kHz resonance is not obvious. The null appearing at 17 kHz is a cross mode of the loading tube and could fill an entire paper by itself.

Figure 10 also shows the response of the same diaphragm mounted on the new Smith plug as a dashed curve. The normal spacing between the diaphragm and the plug has been slightly increased to illustrate, for this report, the existance of the predicted resonances. Chamber resonances are subtly seen at 4,100, 7,300 and 9,500 Hz.

Mechanical resonance of the diaphragm is visible at 8,400 Hz and the decoupling frequency is on schedule at 10 kHz. Considerable hash is seen around 14 kHz and the predicted dip may or may not be there. The tube cross mode is still at 17 kHz.

A final dotted response curve is seen in Figure 10 using an experimental voice coil and diaphragm which will be the subject of another paper in this session. The three diaphragms of Figure 10 are driven at different input voltages.

Since the Smith design is characterized by a finite spacing between the edge of the chamber and the largest ring, the magnetic field strength is enhanced by as much as 15 - 20% over the case wherein the pole piece is brought to an edge to accommodate the phasing plug.

CONCLUSION

Recent inovations in phasing plug design have added spice to the life of the transducer designer. It still remains to be shown, however, that any one design is superior to any others. A design optimization procedure for the concentric ring type has been reviewed. Such procedures for optimization of the salt shaker and the radial slot are eagerly awaited.

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).

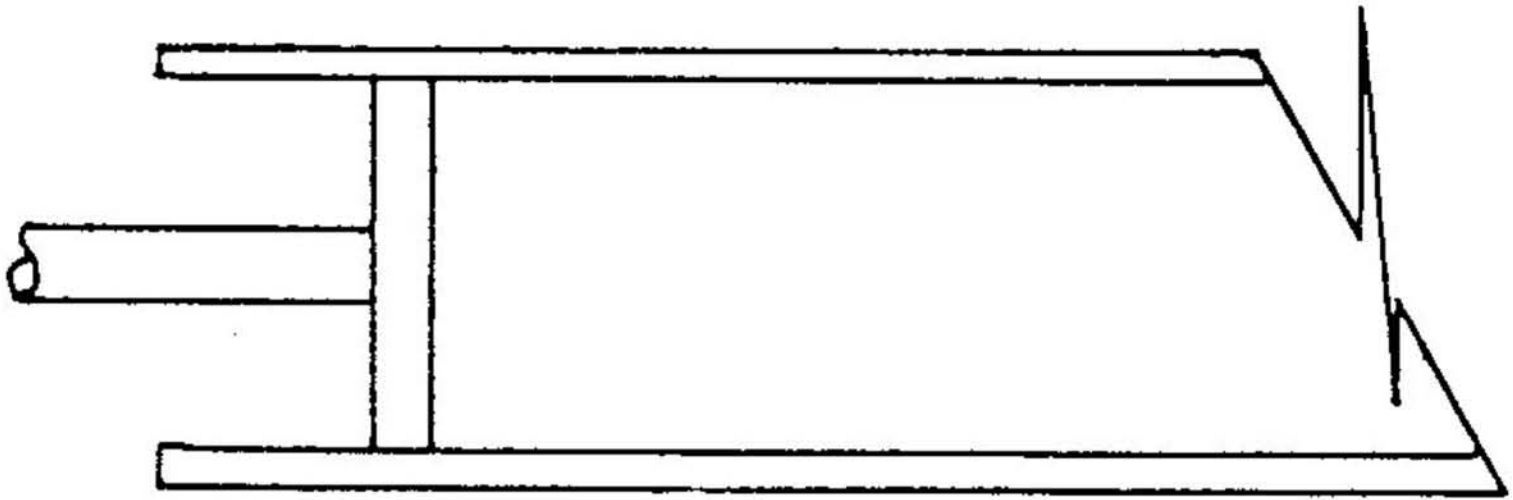

Figure 1. Piston-In-A-Tube Radiation System

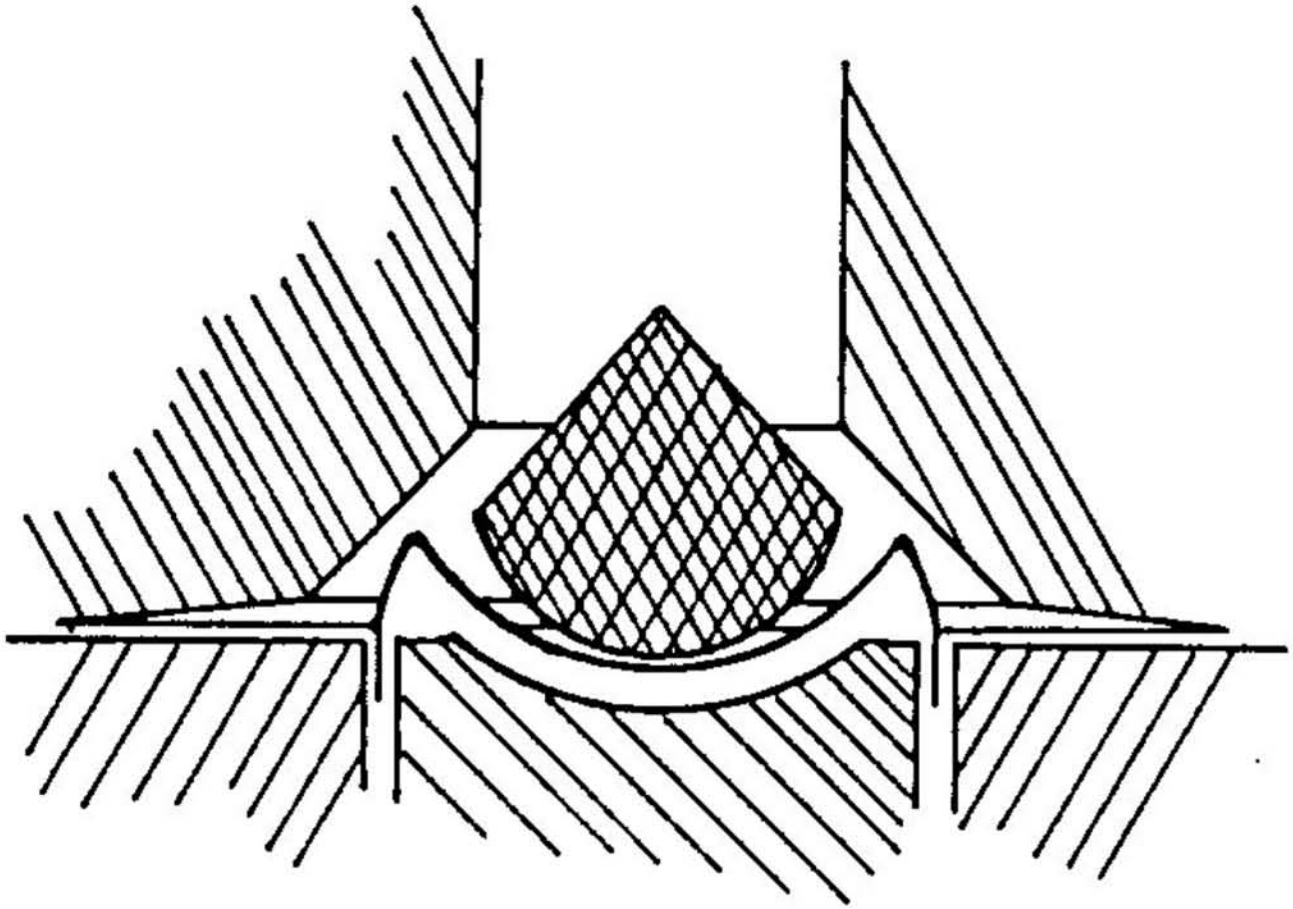

Figure 3. Teardrop Design Phasing Plug

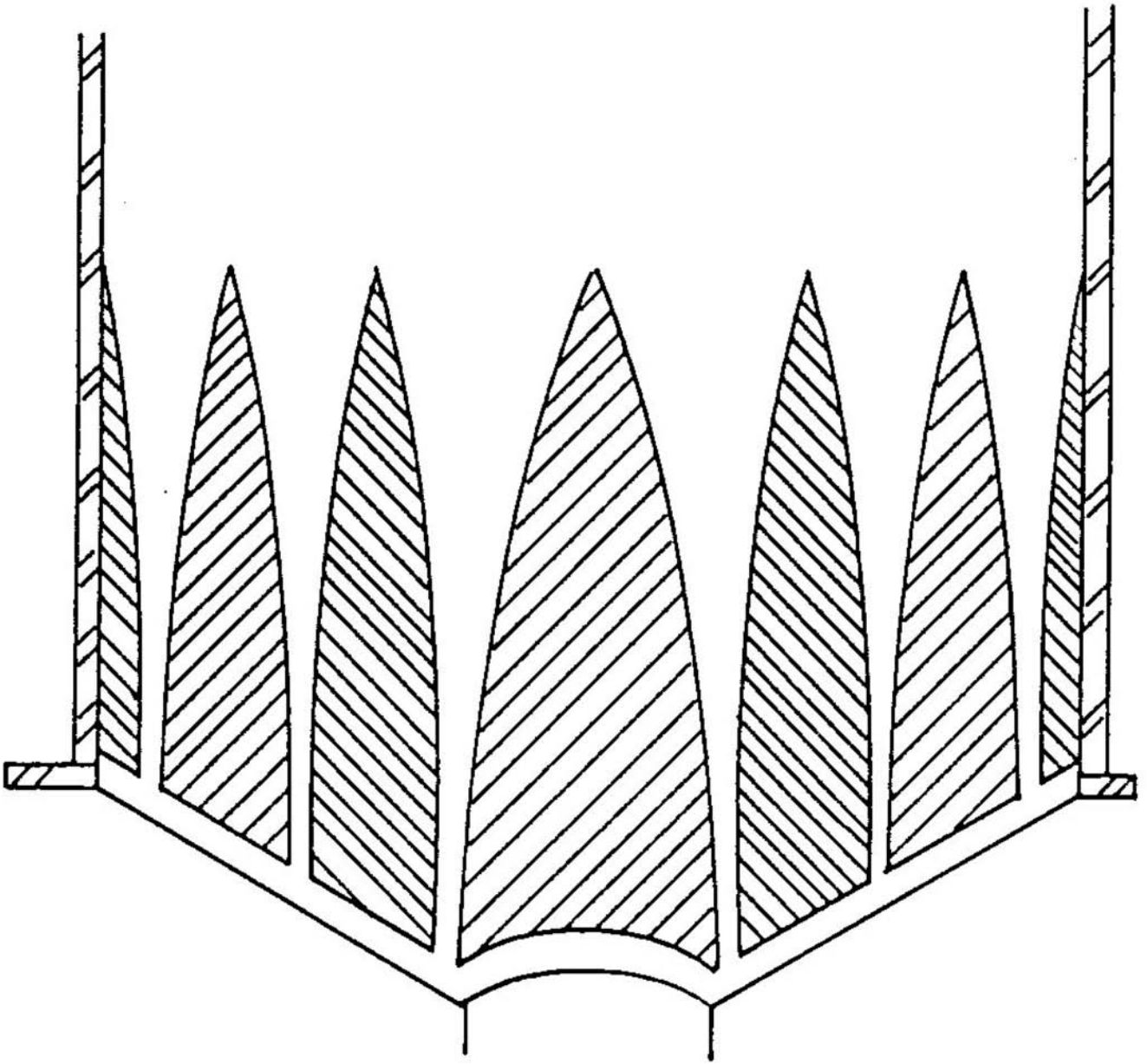

Figure 4. Variation on the Teardrop Design for Large Diaphragms