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Note on the Theory of the Optimum Angle of a Conical Horn

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NOTE ON THE THEORY OF THE OPTIMUM ANGLE OF A CONICAL HORN

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Hoersch[1] has given a theoretical explanation of the optimum angle of a conical horn experimentally found by the writer.[2] The optimum angle is the one giving the greatest amplification, the horn acting as a receiver. The theory of Hoersch states that the angle is an optimum when the dissipation at the vertex is equal to the dissipation at the open end. The value of this angle is expressed by the formula:

$$\Theta_m = 1/\sqrt{n}\ \sqrt{\rho\omega^3 y_2/2\pi^3 a} \qquad (1)$$

wherein n has the integer values 1, 2, 3, etc., these being used respectively for the fundamental and the overtones taken in order; ρ is the mean density of the air; ω is 2π times the frequency; y_2 is defined by the admittance, y_1+iy_2, this term being the ratio of the volume displacement and pressure; a is the velocity of sound.

It is the purpose of this note to compare the experimental results with Hoersch's theory. The experimental values that are unchanged are $\sigma=0.16$ cm², $a=34\times10^3$ cm/sec. The other values and the experimental and computed values of Θ_m are shown in the following table.

n	f	Θ_m	Θ_m COMPUTED
1	256	0.10	0.12
1	512	0.13	0.16
2	256	0.072	0.08
2	512	0.10	0.12

The results of computation are consistently about 20% higher than in the experiment.

The conclusion is that the agreement between experiment and theory justified confidence in the explanation of the optimum angle as given by Hoersch.

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THEORY OF MEGAPHONES AND RECEIVING HORNS

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In 1919, A. G. Webster[1] published a theory of the action of horns used as receivers. Recent development has given an in-

1 Hoersch, Phys. Rev.
2 Stewart, Phys. Rev. XVI, No. 4, Oct. 1920.
1 Proc. Nat'l Acad. of Sci. Vol. 5, p. 275, 1919.