NOTES ON THE EFFECT OF DISTANCE FROM THE SOURCE ON THE VELOCITY OF SOUND AT ULTRASONIC FREQUENCIES

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Abstract

Measurements of the velocity of ultrasonic waves have been made at a greater distance than heretofore. It is found to be independent of frequency within 0.01 percent which is the error of measurement.

In a previous paper[1] a method of obtaining the velocity of ultrasonic waves was described. It was found that when measurements were taken in proximity to the face of the sound-emitting crystal the resulting velocity was higher than that calculated from data obtained in a region more remote from the face. It was also noted that this effect was more marked as the frequency decreased. Hence it seemed desirable to continue the measurements in a region still more remote from the sound source, since the previous work indicated that an asymptotic value had almost been reached.

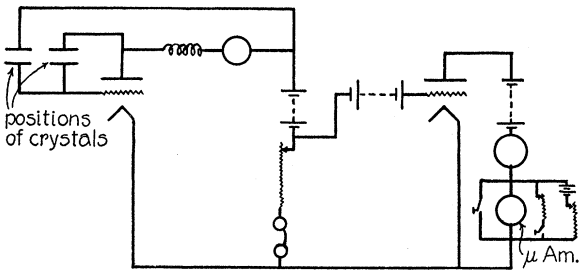

Fig. 1. Direct current amplifier.

With this in mind, the length of the sound chamber was doubled, and a direct current amplifier (shown in Fig. 1) was constructed in order to detect the sound energy at this increased distance. By using the proper grid bias on the amplifier tube the change in plate current produced by the motion of the reflector was increased by a factor of ten.

With the use of this amplifier, the measurements recorded here were made from the data secured in the region between 50 centimeters and 100 centimeters from the sound source.

To obtain satisfactory stationary wave-trains in this region it was found necessary to pad the inside of the sound chamber with acoustic felt to reduce

[1] C. D. Reid, Phys. Rev. **35**, 814 (1930).

the effect of reflected energy from the walls. This prevented the use of dry air in the present experiments as it has been found difficult to dry out the felt. However, the felt lining does maintain the humidity at a constant value and the experimental results have been corrected for this humidity.

In order to determine the value of the humidity thus obtained, a hair hygrometer was calibrated over a small range of humidities by placing it under a bell jar with two different saturated salt solutions and assuming that the motion of the hygrometer needle in the interval between these fixed humidities to be a linear function of the humidity.

The results of these measurements are recorded in Table I.

TABLE I. *The velocity of sound in moist air free from carbon dioxide.*

Frequency	No. of runs	Velocity at 0°C
140	2	332.09
105	7	332.05
84	3	332.12
70	4	332.05
60	2	332.01
42	4	332.15

Average velocity at 0°C 332.08 ± 0.02 meters/sec.
Relative humidity 32 per cent
Velocity in dry air at 0°C—$V_H - 0.014\ \mathrm{H} = V_0$
$332.08 - 32 \times 0.014 = 331.63$ meter/sec.

From the figures recorded in Table I it may be concluded that the velocity of sound in the frequency range included is constant within 0.01 percent when the measurements are carried out in a region sufficiently remote from the source.

When the velocity obtained in this manner is corrected for humidity by use of the relation determined by previous experiments it is found to agree with the former results within experimental error. This serves as a check on the humidity formula.

The above experiments have been carried on under the direction of Dr. G. W. Pierce.