Parallel faces on opposite ends of each sample were polished with diamond paste on a silk velvet cloth. It was found that polished faces were necessary in order to obtain clear resonances.

As the frequency of the oscillator was swept from 5 to 15 MHz, 15–25 resonances could be detected. The condition for a resonance has been given by WILLIAMS and LAMB[10] as:

$$2\pi f_n \tau - \phi_n = n\pi,$$

where $\tau = l/v$, l is the sample length and v is the velocity of sound, f_n is the resonant frequency and

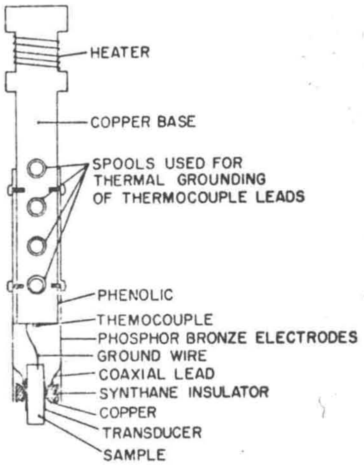

FIG. 1. Sample holder for sound velocity measurements.

ϕ_n is the phase shift which occurs when a sound wave is reflected at the sample boundary. WILLIAMS and LAMB[10] have derived an expression for ϕ_n as a function of frequency, depending upon the acoustic impedances of the sample, bonding material, and transducers, and upon the resonant frequency of the transducers (10 MHz in this case). However, it was found experimentally that for Mg_2Sn, ϕ_n was nearly frequency independent except near 10 MHz where we expected a phase shift of 180° as the frequency was passed through the fundamental of the transducers.

In the region where ϕ_n is independent of frequency, the velocity of sound is given by:

$$v = 2l\,\frac{df_n}{dn}$$

As a check, measurements were made of the velocity of sound in Ge and compared to the values of MCSKIMMIN.[11] It was found that shear measurements agreed to within 1 percent and longitudinal measurements to within 2 percent over the temperature range 77–300°K.

The velocity of sound in Mg_2Sn is shown in Figs. 2 and 3. The solid lines in Fig. 3 were computed from the three velocities in Fig. 2, and agreed satisfactorily with the measured values. None of the velocities showed more than a 2·5 percent change between 100° and 300°K. From the sound velocities and the X-ray density of

$$3{\cdot}592\ \text{g/cm}^3,^{(12)}$$

the elastic constants at 300°K were calculated to be:

$$C_{11} = (8{\cdot}24 \pm 0{\cdot}33) \times 10^{11}\ \text{dyn/cm}^2,$$

$$C_{12} = (2{\cdot}08 \pm 0{\cdot}33) \times 10^{11}\ \text{dyn/cm}^2,$$

$$C_{44} = (3{\cdot}66 \pm 0{\cdot}07) \times 10^{11}\ \text{dyn/cm}^2.$$

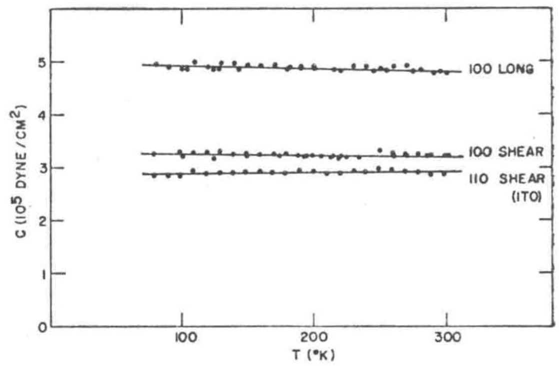

FIG. 2. Sound velocity in Mg_2Sn: [100] and [110] directions.

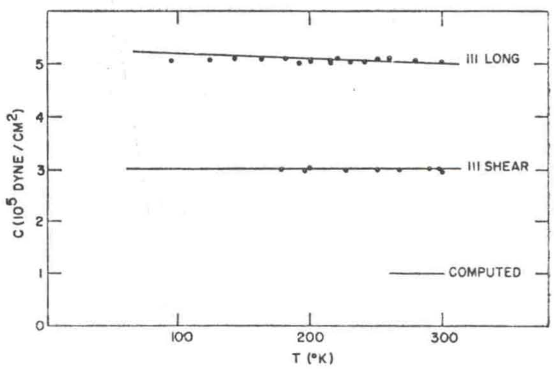

FIG. 3. Sound velocity in Mg_2Sn: [111] direction. Solid line computed from the three velocities in Fig. 2.