which also monitors echo amplitude. The computer is programmed to sweep through a specified range of carrier frequency and record the echo amplitude as a function of frequency, and it is also used to process the data as described below.

High pressures were generated with a Bridgman piston-cylinder apparatus with kerosene pressure medium. Pressure was determined to within 1% with a Heise gauge.

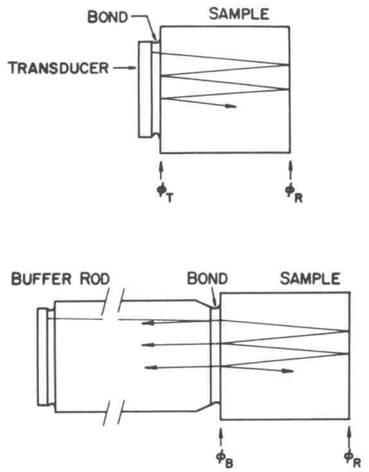

Fig. 2. Schematic diagram of the transducer-bond-sample and buffer rod-bond-sample assemblies in this study.

The transducer-buffer-bond-sample configurations used are illustrated in Figure 2. Samples used in this study--both about 1 cm in size--were a synthetic stoichiometric spinel ($MgAl_2O_4$) crystal obtained from Union Carbide and a synthetic MgF_2 crystal obtained from Optovac, Inc. Opposite faces on the samples were polished flat and parallel to within about one μ. A fused quartz buffer rod was used. Transducers were bonded by Dow Corning resin 276-V9 or, for some zero-pressure runs, phenyl salicylate. Coupling between the buffer rod and samples was achieved in several different ways: with dry lapped contact; with lapped contact immersed in a fluid pressure medium, such as isopentane; with a lapped contact wetted with the fluid (but not immersed); and with a V9 resin bond.

III. DATA PROCESSING

An example of amplitude-frequency data is illustrated in Figure 3(a). The broad amplitude envelope results from the combined response of the electronics and the transducer resonance (in this case the fundamental resonance frequency of the transducer

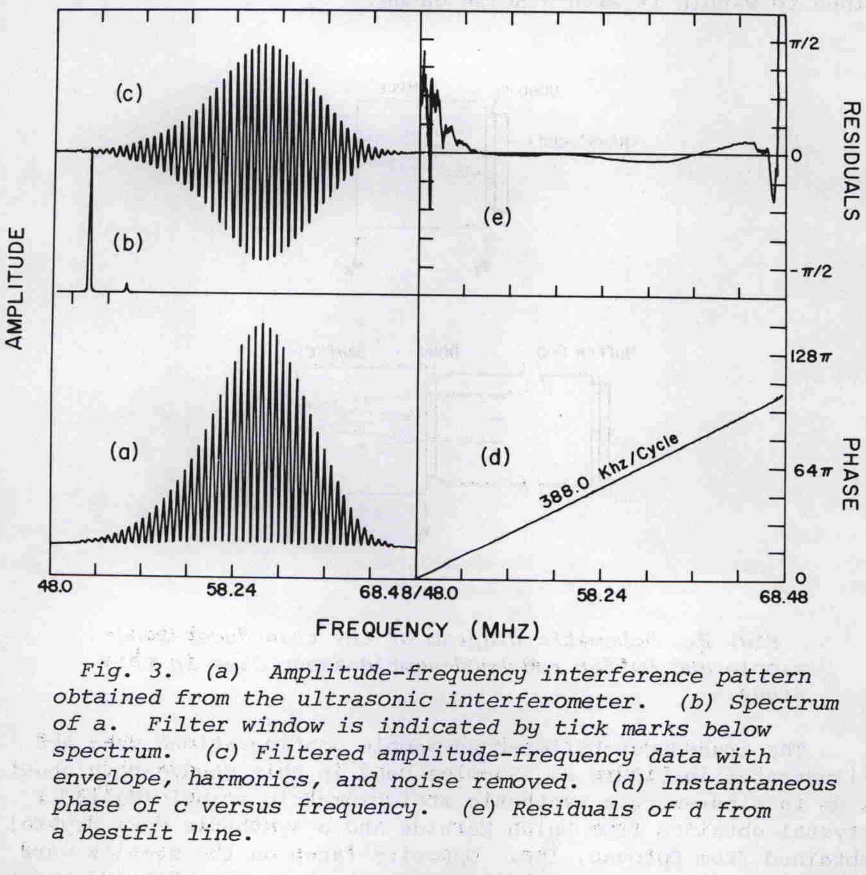

Fig. 3. (a) Amplitude-frequency interference pattern obtained from the ultrasonic interferometer. (b) Spectrum of a. Filter window is indicated by tick marks below spectrum. (c) Filtered amplitude-frequency data with envelope, harmonics, and noise removed. (d) Instantaneous phase of c versus frequency. (e) Residuals of d from a bestfit line.

was 20 Mhz). The narrow peaks result from successive constructive interferences of the superposed echoes in the sample. The condition for constructive interference is that the phase difference between successive echoes be equal to $2n\pi$, where n is an integer, i.e.:

$$\frac{4\pi fL}{v} + \phi_r = 2n\pi \qquad (1)$$

where f is the carrier frequency, L is the sample length, v is the sound velocity in the sample, and ϕ_r is the total phase shift produced by reflections at the sample faces. If the carrier frequency