4) Method 4--Through Transmission Technique -- There are several variations of this technique. They all require that two crystals can be used, one on each side of the specimen and in addition a comparison signal may or may not be sent through a delay network parallel to the specimen under test. The particular procedure being used depends on the attenuation of the ultrasonic signal in the specimen at the frequency being employed. If the attenuation is low, then the setup shown below may be employed. (See Figure 22.)

A long wave train is used to drive the transmitting transducer. The frequency of the oscillator is varied until each reflection in the test specimen either constructively or destructively interfered with the subsequent reflection. A measurement of the frequency will then allow an accurate measurement of transit time.

If the attenuation in the material is very high, an accurate measurement of transit time can be made by coupling two transducers directly to the material and transmitting an ultrasonic signal directly through it. The accuracy of this method for velocity measurement increases with the length of the specimen and may be improved by comparing with the transit time in some well-known standards.

5) Method 5--Resonance Techniques -- Another method that may be used when the material being evaluated does not attenuate the ultrasonic signal excessively is the resonance method, as shown in Figure 23. For this method, the crystal is driven by a continuous wave and the frequency of this wave is varied. At the resonant frequency of the test specimen, or harmonics of this frequency, there will be an increase in the amplitude of the waves in the material that is, when the wave reflected from the back surface of the test specimen arrives at the crystal with the same phase as the transmittal signal. A measurement of the plate current of the output tube will allow one to determine when the resonant condition and its associated change in crystal loading occurs. The frequencies at which resonance occurs is accurately measured with a frequency counter. The resonant frequency may be used to determine the velocity of the wave in the material by using any of several methods for determining which harmonic a given resonant frequency represents.

3. Experiments

In preparation of the sound velocity measurements that were conducted in the high-pressure apparatus, feasibility studies were initiated using a quartz crystal.

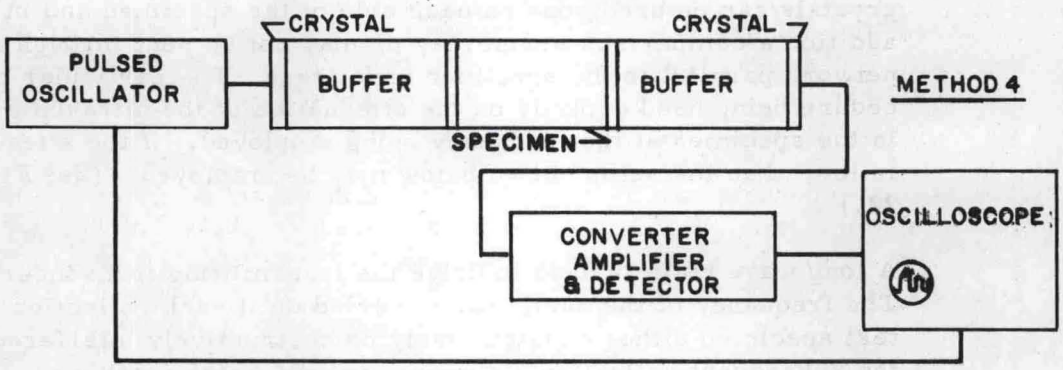

Figure 22 BLOCK DIAGRAM FOR THROUGH TRANSMISSION

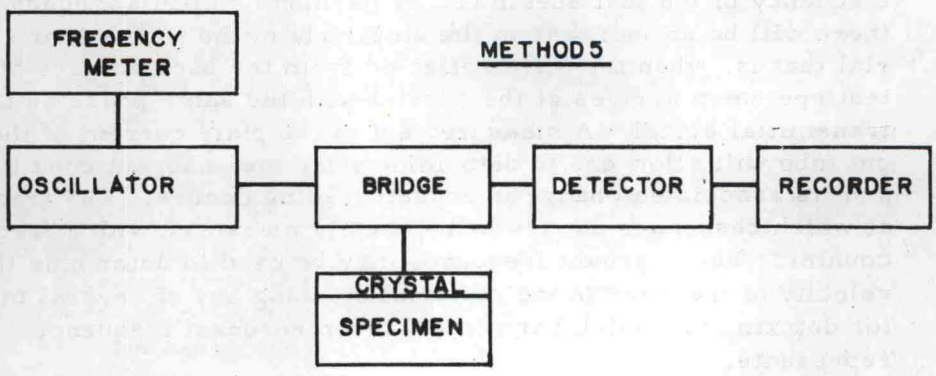

Figure 23 BLOCK DIAGRAM FOR RESONANCE TECHNIQUES