Figure 18 shows the sample configuration in more detail. The quartz tranducer, either X or Y (or AC) cut for compressional or shear excitation, respectively, is mounted on the face of the punch. Lateral support is given by rings of hot-pressed MgO or Al_2O_3. An evaporated coating of platinum or gold on the face of the transducer allows electrical contact to the punch face (RF ground) on one side and to the RF lead on the other side. The sample, either jacketed or unjacketed is located between the punches. Lava (pyrophyllite) gasketing completes the cell.

b. Modes of Operation

Several modes of operation are available as detailed in the next section.

The primary method for obtaining shear and bulk data for materials is by measuring ultrasonic shear and longitudinal wave velocities in the materials when they are in the prescribed environments. There are several method used to accurately measure the ultrasonic shear and longitudinal wave velocities in small specimens. This is because no one method is satisfactory for all cases. Among the factors which affect the selection of a method for any particular case are the accuracy desired; the ultrasonic attenuation of the material; the configuration of the material, and the associated equipment used to cause the desired environmental conditions; and the ingenuity of the investigator.

Some of the standard methods used for measuring ultrasonic velocities in test specimens are described herein along with their limitations. Most of these techniques are either the work of, or derived from, the work of H.J. McSkimmin, of the Bell Telephone Laboratories. Each of the methods described requires an accurate measurement of the specimen thickness which may be done mechanically and the time required for an ultrasonic wave to propagate through the specimen.

1) Method 1 -- Pulse-Echo, Phase Comparison -- This method may be used for either X- or Y- cut crystals when the material being evaluated does not attenuate the ultrasonic wave rapidly. The block diagram is shown as Figure 19.

The oscillator operates continuously and some harmonic, for example the fifth, is selected from each of the harmonic generators. The transducer is driven by short pulses from the gated harmonic generator. If the attenuation of the ultrasonic wave in the specimen is low enough many reflections of the wave will take place. A short pulse length will allow each of these reflections to be clearly distinguished after the initial driving has dissipated. These reflected signals are then fed through some associated circuitry and into an oscilloscope and the time between successive reflections

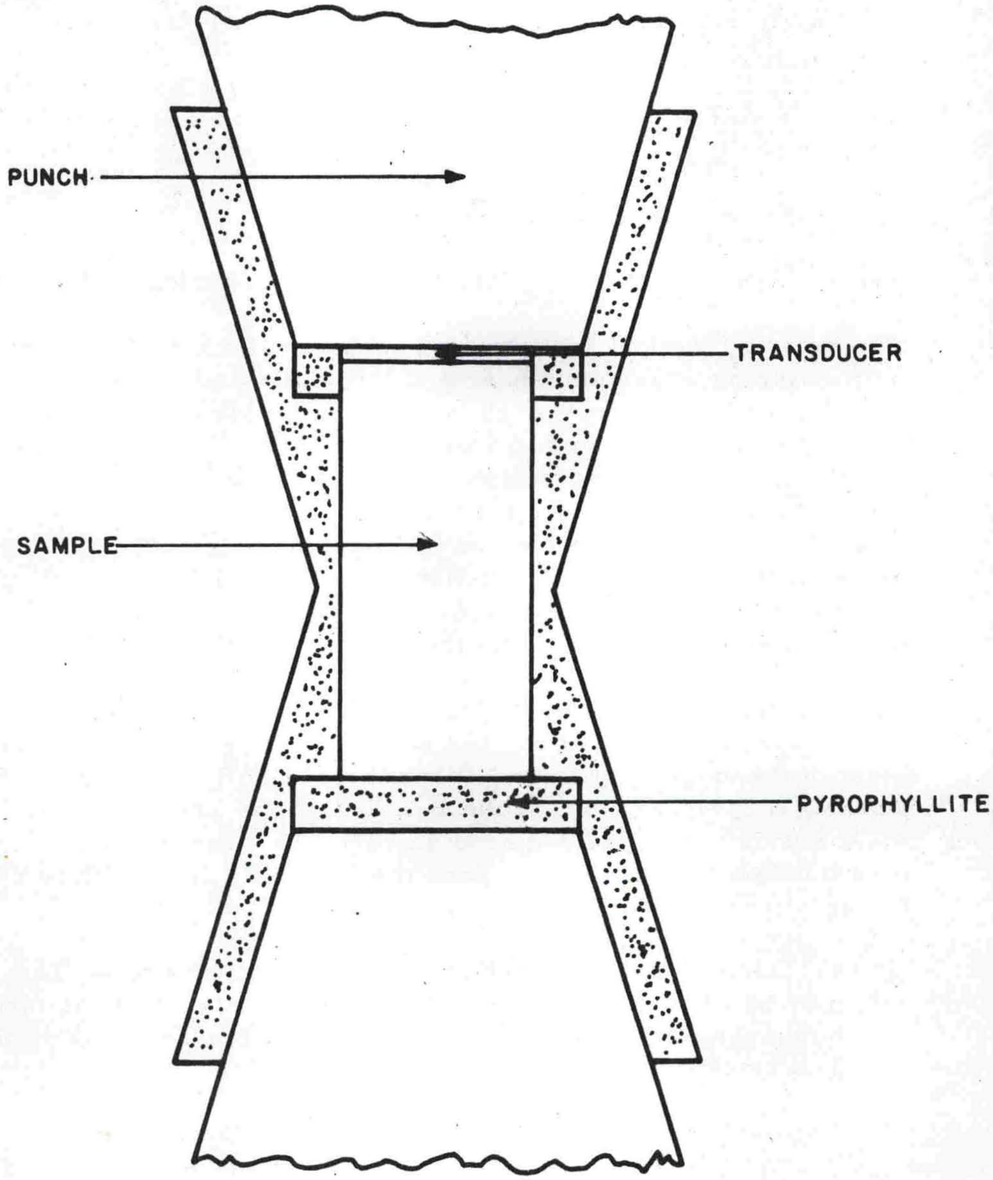

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Figure 18 SAMPLE DETAIL