ULTRASONIC TESTING

Ultrasonic testing is based on the fact that solid materials are good conductors of sound waves. These waves are reflected not only at the interfaces but also by internal flaws (material separations, inclusions etc). The smaller the wavelength, the higher the frequency of the wave, and the more sensitive it is to flaws but the faster they are scattered during transit. Thus for flaw detection, ultrasonic waves in a frequency range between about 0.5 MHz and 25 MHz are used.

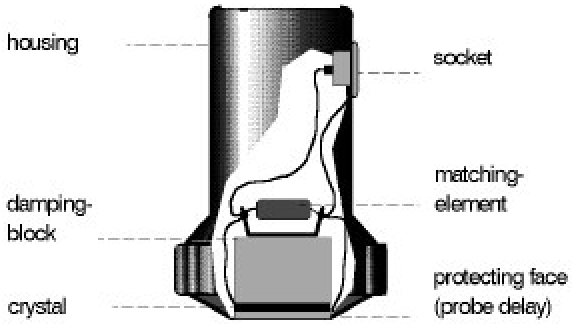

Fig. 1a Straight-beam probe (section)

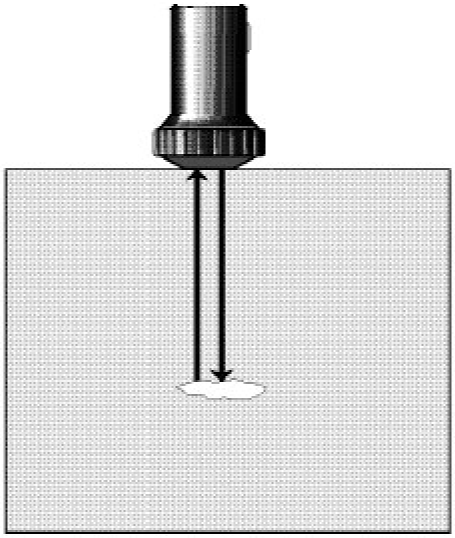

Fig. 2a Plane flaw – straight-beam probe

The section of an Ultrasonic Probe is shown in figure 1a. When the piezoelectric element is excited by an extremely short electrical discharge, it generates an ultrasonic pulse. The probe is placed over the surface of the test object. A liquid or coupling paste is applied between the probe and the surface so that the majority of sound waves from the probe are transmitted into the test object. The wave is reflected back from the far surface or any discontinuities within the test object. This reflected signal is captured by the piezoelectric element and a voltage is generated by it. The operator scans the test object, i.e. he moves the probe evenly to and fro across the surface, to detect any flaws. In doing this, he observes an instrument display for any signals caused by reflections from internal discontinuities, fig 2a. The amount of reflection (echo) from a discontinuity depends on its size as well as its orientation with respect to the probe. If the velocity of sound in the object is known, the distance to the discontinuity can be calculated by measuring the time between the initial pulse generation and detection of the

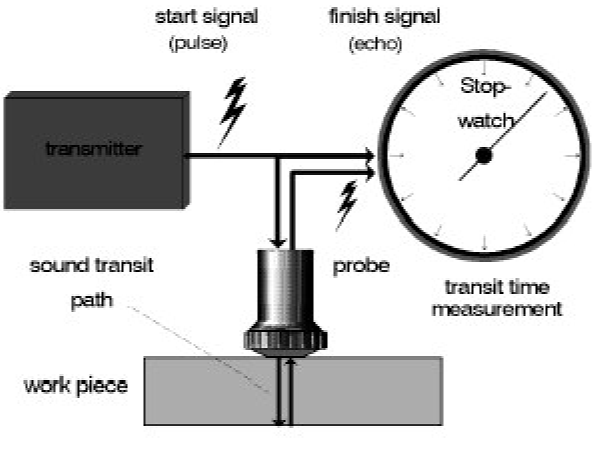

Fig. 13 Block diagram: Pulse Echo Method

reflection. This is the basis of the commonly used pulse echo method for Ultrasonic Testing, see fig 13. The voltage signals are fed to a CRT. At the same time the electrical transmission pulse triggers the sound pulse at the probe crystal, this voltage pulse is fed to the input of the amplifier so that the high voltage causes a vertical deflection of the display sweep which is called the initial pulse. With the initial pulse, the sweep starts in the lower left corner of the display and moves along the base line at a constant speed to the right. The sweep speed of the instrument's display can be varied within wide limits. Reflections from the back wall and flaws cause screen deflections as shown in fig. 21a. The position of the backwall echo is adjusted by the process of calibration. The reference piece used for calibration is called the Calibration Block. The Standard Calibration Block 1, also simply referred to as V1 block has a thickness of exactly 25 mm and is made of low-alloyed fine grained steel so that it can be used for nearly all types of calibration when similar steels are to be tested.

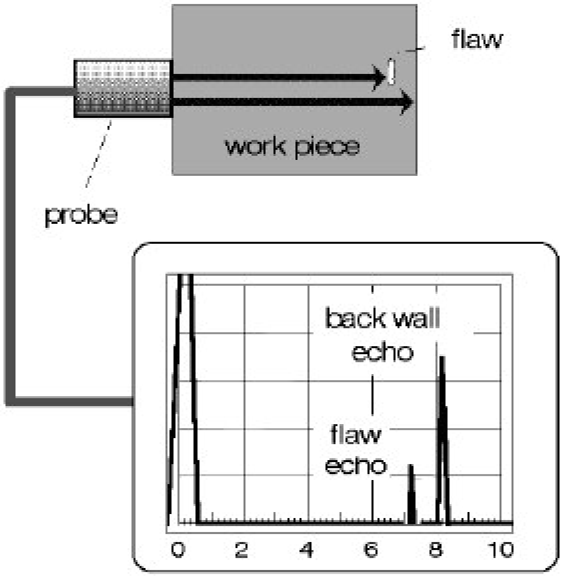

Fig. 21a Discontinuity in front of the backwall