1.10 ULTRSONIC TESTING METHODS

There are three methods used in ultrasonic testing. They are,

i. Pulse echo method
ii. Through transmission, and
iii. Resonance method

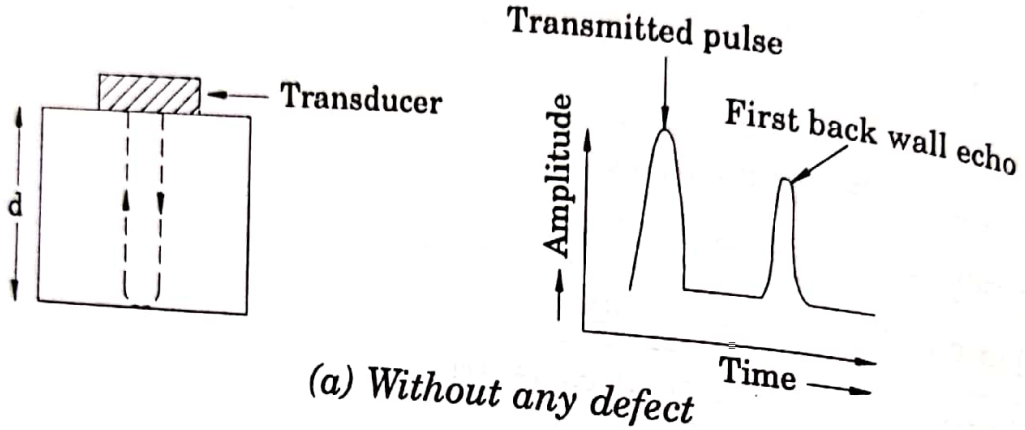
In pulse echo method, the reflected ultrasonic waves are used to identify and characterize the flaw. In through transmission method, the transmitted beam will be used to identify and characterize the flaw. The above three methods are normally employed in industries for ultrasonic testing.

(i). Pulse echo (PE) method

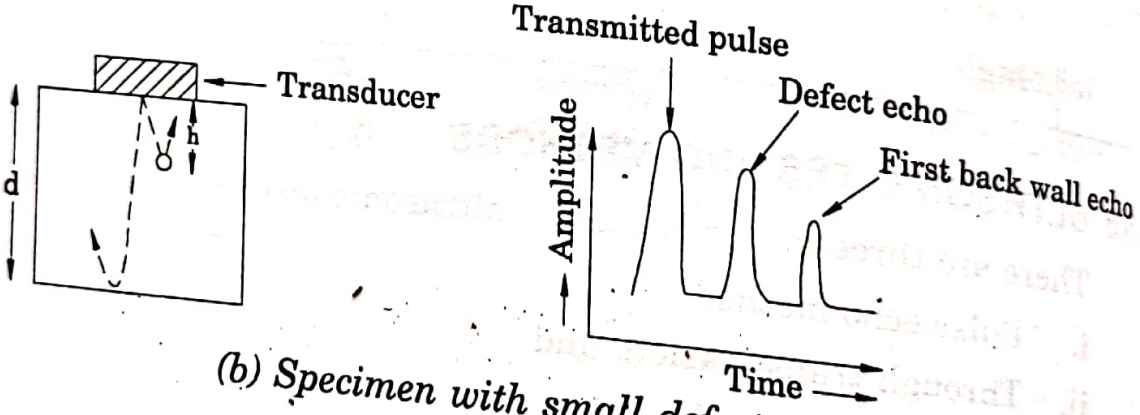
Pulse echo method is the most popular and commonly used method. In this method, a single probe is used for the transmission and reception of the ultrasonic signal. The working of pulse echo method is as shown in Fig.(1.21).

For the purpose of identifying the defects in the specimen, the CRT screen is first calibrated between the transmitted pulse and the time of arrival of the first back wall echo. When there is no defect in the specimen, the transmitted

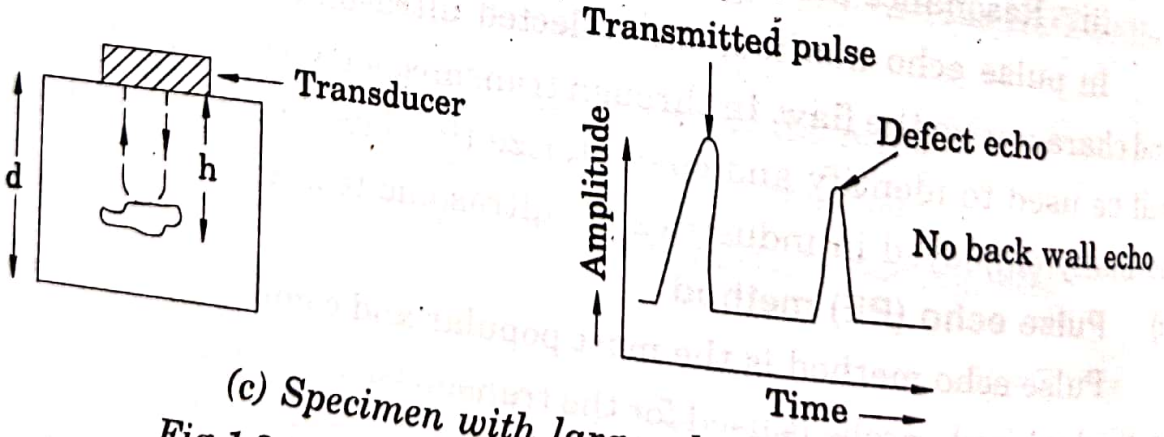
and back wall echo will appear as shown in Fig.(1.21 a). If there is any defect at a depth 'h' from the top surface of the specimen, a part of the ultrasonic wave gets reflected from the defect and a part at the back of the specimen. The time domain traces obtained in this case is as shown in Fig.(1.21 b). The reflected signals from the defect appear in between the transmitted pulse and back wall echo. By measuring the distance of the defect echo from the initial pulse, the depth of the defect is determined. When the defect is larger, the entire signal is reflected by the defect and hence there is no back wall echo. The observed time domain traces is as shown in Fig.(1.21 c).



(a) Without any defect



(b) Specimen with small defect



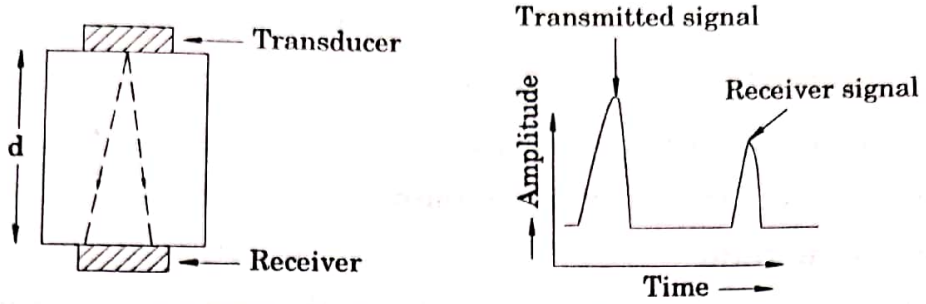
(c) Specimen with larger defect

Fig.1.21 Principle of pulse echo method

(ii). Through transmission method

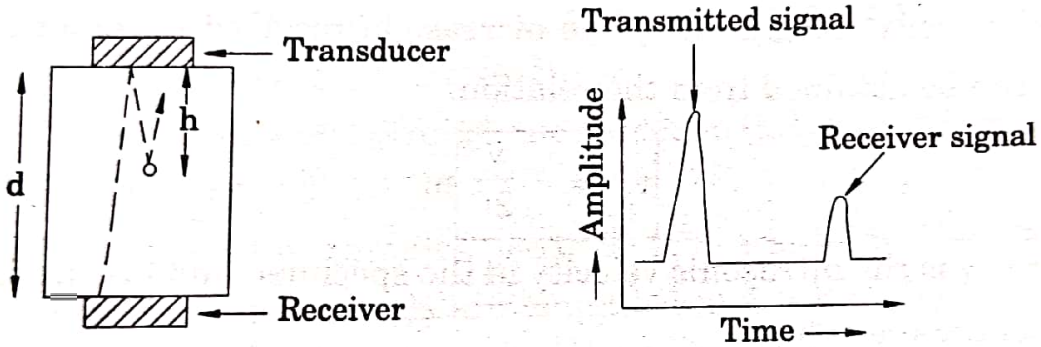
This method consists of two probes. The first probe generates the ultrasonic signals and is known as transducer. The second probe receives the signal and is

known as receiver. The positions of the transmitter and receiver probes are as shown in Fig.(1.22). Let 'd' be the thickness of the material. Consider a defect in the material, at a depth of 'h' from the top surfaces.



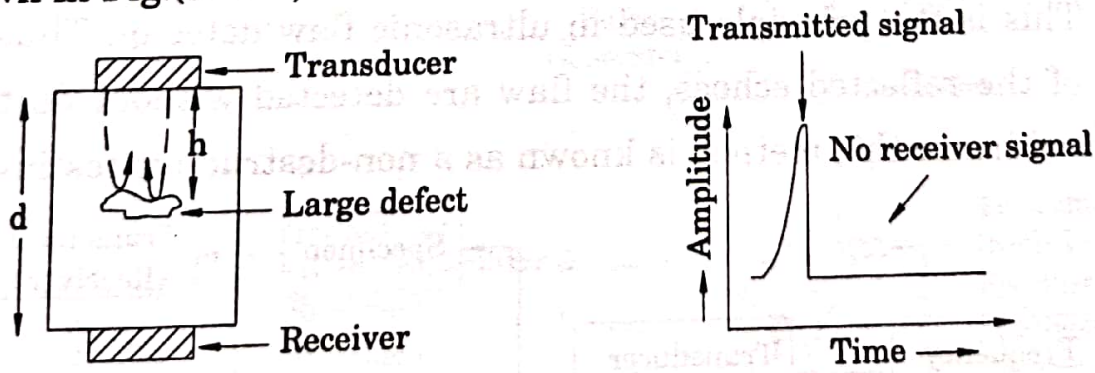
(a) Without any defect in the specimen

When there is no defect in the specimen, the time domain trace obtained in the CRT is as shown in Fig.(1.22 a). If there is any defect at a depth 'h', the time domain trace obtained is as shown in Fig.(1.22 b). the amplitude of second signal reflects the nature of the defect.



(b) Specimen with small defect

When the ultrasonic waves are completely reflected by the defect, the transmitted signal is completely lost. In this case the defect is large. Therefore, the receiver does not receive any signal and the corresponding time domain trace is as shown in Fig.(1.22 c).



(c) With large defect in the specimen

Fig. 1.22 Principle of through transmission method

1.11. ULTRASONIC FLAW DETECTOR

Principle

Ultrasonic waves travels in different medium with different velocities *Whenever there is a change in the medium, then the ultrasonic waves will b reflected.* This is the principle used in ultrasonic flaw detector. Thus, from th intensity of the reflected echoes, the flaw are detected without destroying th material and hence this method is known as a non-destructive testing method.

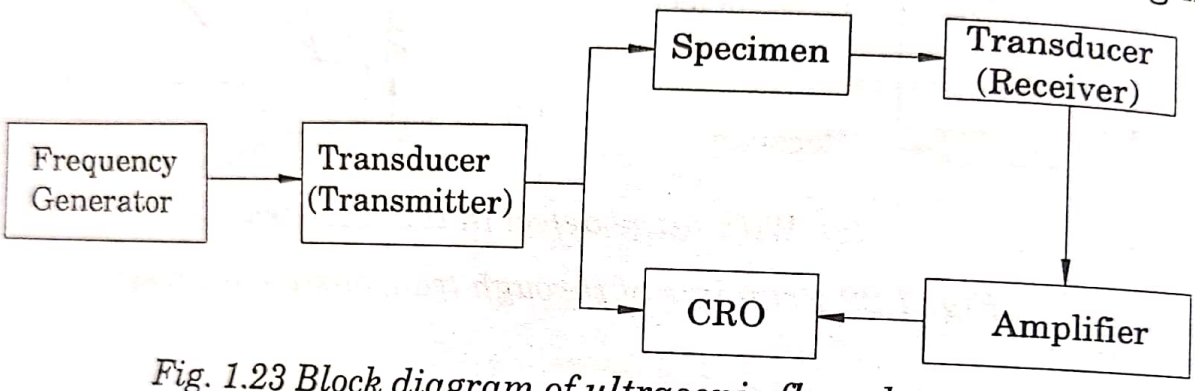


Fig. 1.23 Block diagram of ultrasonic flaw detector

Description

It consists of a piezo electric transducer coupled to the upper surface of the specimen (metal) without air gap between the specimen and the transducer. A frequency generator is connected to the transducer to generate high frequency pulses. The total set up is connected to the amplifier and to a cathode ray oscilloscope as shown in block diagram Fig.(1.23).

Note : *A transducer is a device which converts a non electrical signal to an electrical signal and vice-versa. For example, Piezo crystal can be used both for generating and detecting the Ultrasonic waves.*

Working

i. The pulse generator generates a high potential difference and is applied to the piezo electric transducer.

ii. The piezo electric crystals are resonated to produce ultrasonic waves.

iii. These ultrasonic waves (pulse) are recorded in CRO and is transmitted through the specimen

iv. These waves travel through the specimen (metal) and is reflected back by the other end.

v. The reflected ultrasonics (pulse B) are received by the transducer.

vi. These reflected signals are amplified and if it is found to be almost the same as that of the transmitted signals as shown in Fig.(1.24 a) then there is no defect in the specimen.

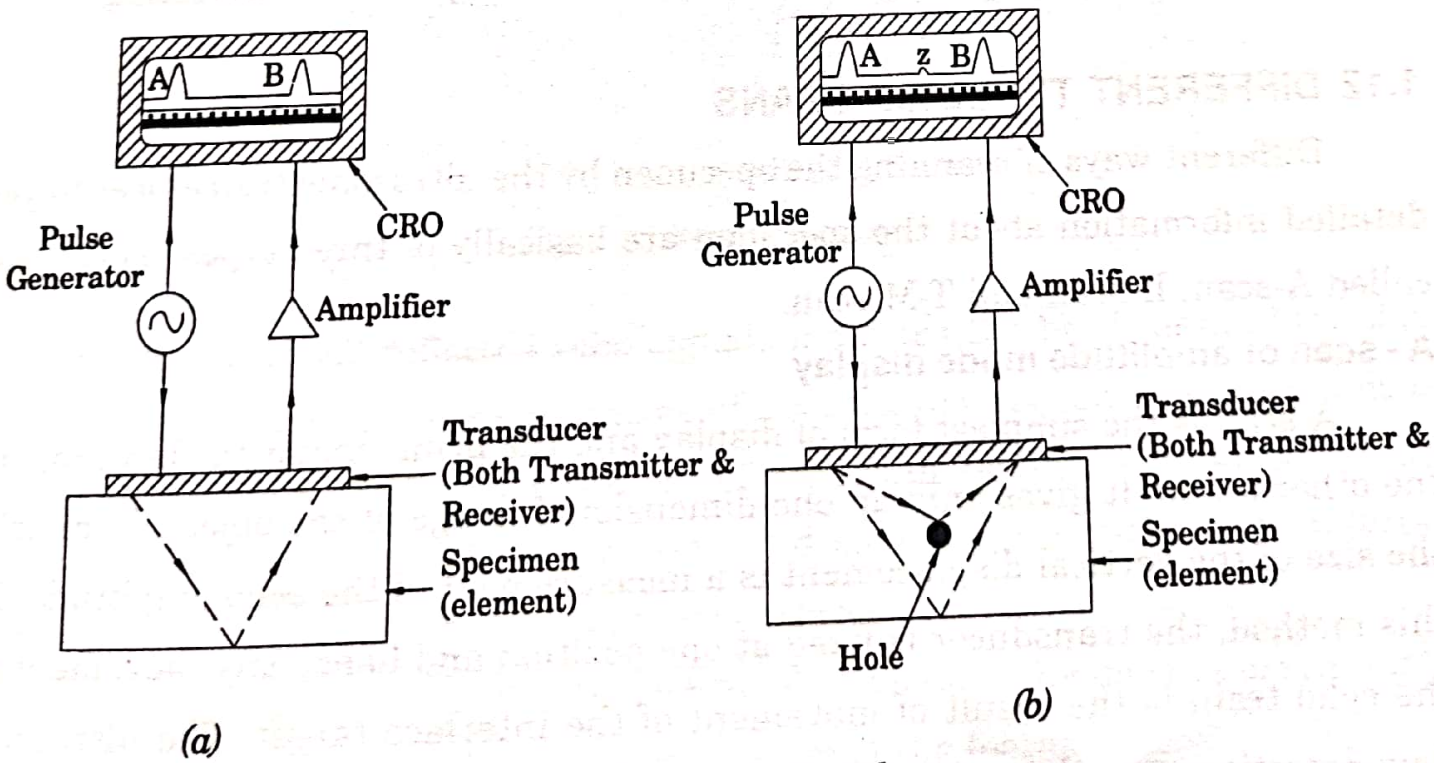


Fig. 1.24 Ultrasonic flaw detector

(iii). **Resonance method**

Generally, in any materials one can obtain the resonance condition when the thickness of the material is equal to half of the wave length of sound or any multiple there of. The wavelength of the ultrasonic wave depends on the frequency. Therefore, one can create the condition of resonance for the thickness of the plate under test by varying the frequency of the ultrasonic waves. The condition of resonance is easily recognised by the increase of received pulse amplitude. The thickness can be obtained from the relation.

$$t = \frac{v}{2f} m$$

where, v is the ultrasonic velocity in the specimen and f is the fundamental frequency of the resonance.