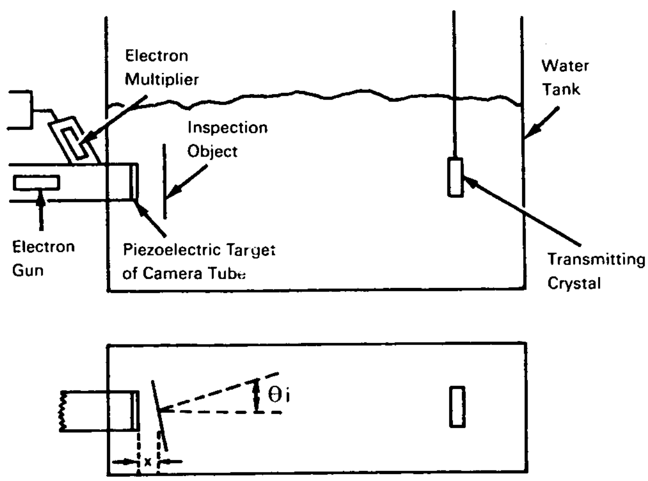
AEC-NASA TECH BRIEF

Improved Ultrasonic TV Images Achieved by Use of Lamb-Wave Orientation Technique



Partial Views of the Television Imaging System (side view, upper; top view, lower), Showing Angulation of Flat Inspection Objects

The problem:

To minimize the interference from standing waves in continuous wave ultrasonic television imaging techniques used with thin metallic samples. Ultrasound, which reflects back and forth between the object being observed and the detector, clouds the TV image display, causing confused images of the sample being tested.

The solution:

The use of the Lamb-wave sample orientation technique, in which the sample under investigation is oriented such that the wave incident upon it is not normal, but slightly angled.

How it's done:

The inspection technique utilizes a commercially available ultrasonic television imaging system and a Lamb-wave approach, in which the sample is placed in the inspection position at an angle θ, other than the normal angle of incidence. The illustration shows a typical Lamb-wave sample orientation test setup using an ultrasonic television imaging system. The samples were oriented to produce a first order Lamb-wave mode. The angle for proper orientation depends upon the ultrasonic frequency and the sample material.

A two-fold advantage results from the Lamb-wave orientation technique. First, angling the thin, flat

(continued overleaf)

inspection object at an angle larger than a few degrees tends to eliminate the interference of standing waves in the ultrasonic image. Ultrasound, which would otherwise reflect back and forth between the object and the detector, is essentially removed from the image area. Secondly, in the case of relatively thin, metallic inspection objects, placement of the sample at the angle for the generation of a first-order Lamb-wave mode can improve the results by increasing ultrasonic transmission and improving sensitivity to a sample's internal flaws.

The introduction of a thin film ultrasonic absorber between the sample and the detector can also be used to reduce the standing wave reflection problem to allow good resolution presentation of bonding flaws, inhomogeneities, and grain-size variations within the test specimen.

Notes:

1. Additionial details are contained in: *A Television System for Ultrasonic Imaging,* by Harold Berger, ANL-7042, Argonne National Laboratory, Argonne, Illinois, January 1966. This comprehensive report explores the state-of-the-art of ultrasonic television imaging with particular emphasis placed on the Lamb-wave sample orientation technique. The report is available from the Clearinghouse for Scientific and Technical Information (CFSTI), Virginia 22151, $3.00 each (microfiche $0.65).
2. Tests were conducted on various samples, which included:
   a. Holes as small as 1 mm in diameter were observed in a rubber sheet, approximately 0.6 cm thick and containing several through-holes of various sizes.
   b. Wires as small as 0.2 mm in diameter were observed by shadowing the ultrasound beam with the wires in front of the receiving transducer.
   c. Blistered sections of BORAX-V superheated fuel plates were examined with this system and compared with radiographs of the same sample. The high resolution of the ultrasonic television imaging system using the Lamb-wave technique was quite evident.
3. Inquiries concerning this innovation may be directed to:

   Office of Industrial Cooperation
   Argonne National laboratory
   9700 South Cass Avenue
   Argonne, Illinois 60439
   Reference: B67-10295

Source: Harold Berger,
Metallurgy Division
(ARG-203)

Patent status:

Inquiries about obtaining rights for commercial use of this innovation may be made to:

Mr. George H. Lee, Chief
Chicago Patent Group
U.S. Atomic Energy Commission
Chicago Operations Office
9800 South Case Avenue
Argonne, Illinois 60439