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AEC-NASA TECH BRIEF

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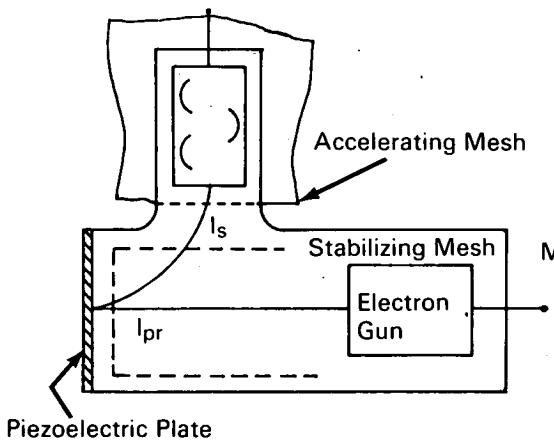
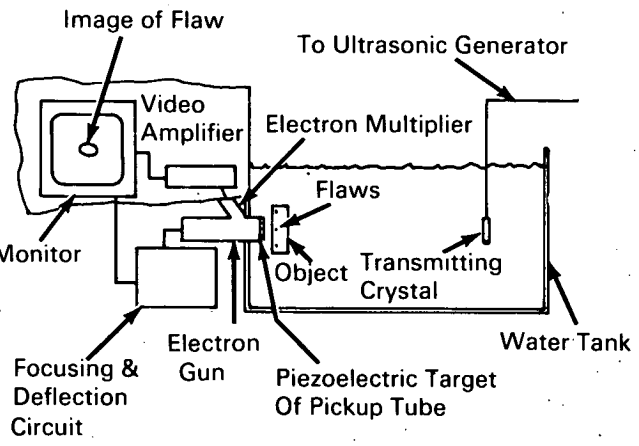
New Camera Tube Improves Ultrasonic Inspection System



ULTRASONIC CAMERA TUBE



ULTRASONIC INSPECTION SYSTEM

The problem:

To improve resolution and reduce noise sensitivity of an ultrasonic television inspection system used in the nondestructive testing of metals. In existing systems, the camera tube sensitivities are limited by the low input load resistance of the associated amplifiers. Also, interference patterns from the transmitter itself are common noise sources at a level of 10^{-8} ampere of signal current. Both factors combine, making effective shielding of equipment from spurious noises very difficult.

The solution:

An electron multiplier, incorporated into the camera tube of an ultrasonic imaging system, improves resolution, effectively shields low level circuits, and provides a high level signal input to the television camera. The electron multiplier provides amplification of the secondary electron beam within the camera tube. The signal currents are amplified 10^{-5} to 10^{-6} times greater than the threshold value. The tube sensitivity is set by the piezoelectric plate's ability to modulate the secondary emission electrons without the need for a great deal of shielding, as is the case for tubes without the multiplier. The multiplier also serves as a wide-band amplifier having extremely good noise characteristics.

The improved system is effective for inspection of metallic materials for bonds, voids, and homogeneity, which are not detectable by conventional methods. The system is currently being evaluated for application in medical diagnostics.

How it's done:

The improved ultrasonic camera tube is shown on the left. The accelerating potential of the electron gun is 1000 volts. I_{pr} is the primary electron current; I_s is the secondary emission current. The accelerating mesh is +400 volts relative to the stabilizing mesh. The electron multiplier has 10 stages with 100 volts/stage.

(continued overleaf)

The secondary electrons, produced on the 2-inch diameter, barium titanate piezoelectric target by the high velocity electron scanning beam, are accelerated into the electron multiplier by the accelerating mesh, producing high level output. The secondary electron beam is modulated on a point-to-point basis by the voltage generated by the piezoelectric target. The target is irradiated by an impinging ultrasonic field.

The diagram of the entire ultrasonic imaging inspection system set up for a through-transmission inspection is shown on the right. (Reflection techniques may also be used.) The far field ultrasonic pattern provides a uniform ultrasonic intensity for a shadow-type image.

Following detection and amplification in the pickup tube, the amplified video signal is presented by a conventional television system. The image of any discontinuity is then reproduced on the observation monitor.

Numerous tests were run, comparing this system with other ultrasonic methods and X-radiographic techniques. It was shown capable of detecting flaws within metals to a degree equal to or better than all other methods tested.

Notes:

1. Additional details are contained in: *An Evaluation of an Ultrasonic Inspection System Employing Television Techniques,* by Dr. J. E. Jacobs, W. E. Collis, and Harold Berger, Argonne National Laboratory, Argonne, Illinois. This article is published in the May 1964 issue of *Materials Evaluation.* The report includes a review of articles concerning research in the ultrasonic imaging field. Nondestructive test procedures are discussed.
2. This information would be of interest to users and manufacturers of nondestructive test equipment.
3. Inquiries concerning this innovation may be directed to:

   Office of Industrial Cooperation
   Argonne National Laboratory
   9700 South Cass Avenue
   Argonne, Illinois 60439
   Reference: B68-10088

Source: J. E. Jacobs and W. J. Collis
Northwestern University
and H. Berger
Metallurgy Division
Argonne National Laboratory
(ARG-90237)

Patent status:

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

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Chicago Patent Group
U.S. Atomic Energy Commission
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