1.3.74. TECHNOLOGIES AND EQUIPMENT FOR ULTRASONIC TESTING OF WELDED JOINTS WITH MONITORING OF ACOUSTIC CONTACT AND EVALUATING THE NATURE AND ACTUAL PARAMETERS OF DEFECTS

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1. The SP5-75 KYS double angle-beam transducer probe uses a "double-tandem" type scheme that, with the separation of transmission and reception at a fixed distance (b = const) and with the use of high angles of incidence in steel ($75^{\pm 2}$°), provides for:

a) uniform sensitivity across the entire width and depth of a welded joint (thickness up to 11 mm), and hence allows performing an inspection without transverse scanning;

b) detection of planar as well as volumetric and wormhole-like defects, with higher sensitivity of detection of planar defects than volumetric ones;

c) estimation of nature of a defect using both amplitude and shape of an echo-signal;

d) significant reduction of acoustic interference caused by sagging of welded joint or by reinforcing bead.

2. An acoustic contact pulse is used for monitoring a level of acoustic contact. This pulse is generated by a third piezoelectric plate installed on the first transducer probe prism. The acoustic contact pulse passes through the prism of the first transducer probe and through an item under inspection (in form of an oblique transverse wave) and after being reflected from the item bottom and passing through the second transducer probe prism is received by the second (receiving) piezoelectric plate. Parameters of the third piezoelectric plate are selected with consideration for specified conditions such as to ensure similarity of changes in acoustic signal and operational sensitivity levels. Echo signal amplitude (A_{ac}) changes proportionally to a change of sensitivity level caused by local changes in a state of external and/or internal surfaces of an item under inspection. The value of $\Delta A = A_{def} - A_{ac}$ depends neither on a state of surfaces of an item under inspection nor on other factors that cause partial loss of acoustic contact.

3. A built-in variable resistor adjusts (up to 16 dB) the value of amplitude of acoustic contact signal, which allows setting the A_{ac} amplitude equal, for example, to the "reject" sensitivity level, while the use of automatic gain control (AGC) system in the UIU SCANNER ultrasonic flaw-detector in a pulse gating region makes it possible to automatically maintain a selected level of sensitivity.

Thus, monitoring of a level of acoustic contact allows inspecting welded joints and base metals including items with sound-conducting coatings such as enamel, paint and lacquer coatings, pipe insulation, etc. with a given sensitivity level.

4. The design of the transducer probe that incorporates two spring suspensions of a piezoelectric transducer allows inspecting circular seams of pipelines being 57 mm and larger in diameter, while magnets that keep the probe on a surface of an object under inspection makes the transducer probe easy-to-use.

5. Correlation between echo-signal amplitude and defect height (defect growth in depth) is established for vertically oriented extended planar defects. If two SP5-75 KYS transducer probes are installed at the opposite sides of a welded joint with the additional application of a mirror-shadow method (MSM) for monitoring acoustic contact under each SP5-75 KYS transducer probe the correlation is linear and does not depend on orientation (angle of inclination) of a planar defect.

6. A similar principle of acoustic contact monitoring is used in the SKARUCH ultrasonic inspection system that makes it possible to detect defects of welded joints and allows evaluating the nature and actual parameters of detected extended defects.