

1.3.69. INFORMATIVE OPPORTUNITIES OF WAVE PROCESSES AT THE BOUNDARY OF SOLID MEDIUMS IN CONDITIONS OF BROKEN ACOUSTIC CONTACT

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Now one of leading places among physical methods of non-destructive tests is occupied with ultrasound research techniques and monitoring. The universal properties of a ultrasonics have provided a possibility of a successful solution of a wide spectrum of practical problems, the bound with discovery of the important aspects of industrial and operational imperfections, definition of their position and gauging of separate parameters. In due course the primal range of the problems solved with the help of non-destructive testing and having character of ascertaining of intolerable violations of a structure of substance, has considerably extended. With evolution of industrial problems there was a necessity for increase self-descriptiveness of methods of a non-destructive testing and passage from the strategy of search and discovery to the strategy of a pattern recognition and classification.

One of the base approaches in this direction is interlinked to making a complex of the universal physical and mathematical models, permitting to solve problems of interaction of elastic waves with the reference for structure of a material heterogeneities. The range of the plants used in the capacity of models for the indicated purposes, is strongly limited for different reasons. It includes plants of the elementary form as hindrances such as an orb, a disk, the barrel, a half-plane, a thin band. As practice of it explicitly insufficiently for exposition of all variety of properties of heterogeneities a natural technological origin in solid elastic mediums shows. The similar situation is the deterrent at definition of directions of perfecting of techniques for non-destructive testing.

In practice frequently there are imperfections which parameters cannot be modeled with required accuracy the elementary scatterers without taking into account their interior structure and character of interaction with them of elastic waves. At use of datas of models guess, that solid mediums were in contact are fused "rigidly" (components of displacement and pressure are continuous), or satisfied a condition the "sliding" fluid-flow contact stipulated by equality to zero of horizontal components of pressure. Similar boundary conditions not always fit to the actual contact existing in practice. In particular, in a master schedule origin of requirements at which the demarcation representing a flaw or connection of a material of a workpiece with plugging, is formed by a set of protuberances and cavities of a microrelief is possible. Thus the most successful exposition of similar violation of ultrasonic contact is the model of the "nonrigid" connection providing a continuity of gains of coupling and lack of fields of small transitions [1].

Discovery of imperfections outcropping a material as flaws, stratifications, pockholes, etc. is possible at use of existing methods of non-destructive testing. However connection of parameters of datas of heterogeneities with parameters of an ultrasound wave it is rather actual. Similar problems it is at present acute stand in situations, the bound with a plate iron, monitoring of pipeline systems and other workpieces and intermediate products. In this connection, for their solution use of the surface and boundary ultrasonic waves is possible. However application of the indicated types of waves requires study and making of the physical and mathematical models circumscribing such interaction with an imperfection. So, in preceding articles of authors, on a base of

the numerically – theoretical assaying the problem about advance of Stoneley waves near to a boundary of solid mediums is solved at violation of ultrasonic contact [2, 3]. Here it has been shown, that at particular combinations of physical properties of the mediums, spreading waves gain dispersing character that it is necessary to take into account at an estimation of their potential informative possibilities.

In the present operation the possibility of discovery of unit local imperfections as cracks with the help of surface waves of the Rayleigh and boundary Stoneley waves is considered. The solution of a similar problem is actual as for cases curvilinear, and a rectilinear surface when use of surface waves for monitoring is the most successful. In case of presence besides a surface wave, the additional waves radiated by “crossbar” of a crack it is possible to speak about presence of an imperfection. The solution of a problem, with definition of character of a scattered field in this case is difficult enough for the bound, as requires the account of an interference, reflecting of waves of “crossbar” of a crack, etc. In this connection the problem when the surface of a material of an a workpiece is rectilinear [4] was solved.

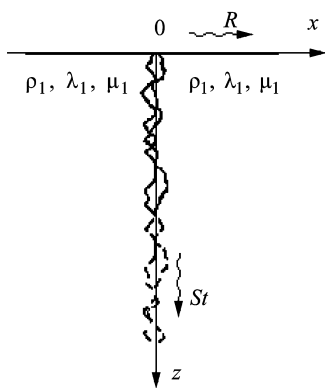


Fig. 1.

On fig. 1 the case of scattering of a Rayleigh wave on an imperfection such as a crack is shown within the framework of model of “nonrigid” connection in an approximation of “the linear sliding”. Considering, that in each of half-spaces the wave will consist of the total longitudinal and transverse waves, each of which is a solution of equation of motion with the relevant parameters of a denseness ρ and Lamé coefficients λ and μ meanings of reflectivity and passages have been obtained.

Datas coefficients allow to evaluate an expected level of informative signal in view of conversion of a part of energy of an incident wave in energy “quasi-surface” the waves spreading along an imperfection and waves, emitted from “crossbar” of a crack. Outcomes prove to be true experimental data that specifies reasonableness of a solution of a problem.

Thus, within the framework of the suggested model of “nonrigid” connection, problems about spreading surface waves along boundaries of a solid medium with crack imperfections are solved. The obtained outcomes can be used at modernizing procedures of an ultrasonic control, and also are introduced into development of hardware components of discovery and classification of imperfections.

References:

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