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ULTRASONIC PHASE MEASUREMENT *

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Acoustic methods are extremely effective in examining and monitoring the physical properties of materials, in particular, in heat and mass transfer. One can monitor thermophysical processes very efficiently via the relationships between the speeds of longitudinal, shear, surface, and normal waves. This can provide for effective control of an automatic process and optimization of conditions, because there are relationships between the thermophysical parameters and the acoustic ones, which enables one to design an electronic system with automatic measurement.

However, in some other branches of science and technology there is still a substantial discrepancy between the theoretical scope for use of acoustics and the actual state of the art, which is due to no small extent to insufficient acquaintance of those concerned with the most promising trends in acoustic monitoring methods, including phase ultrasonic ones.

This gives considerable interest to this book, which is the first monograph on a major trend in this field of acoustics.

The book deals reasonably completely with earlier Russian and other studies, with particular attention to the theory of phase methods in ultrasonics for monitoring parameters, together with designs for electronic and acoustic devices for use in such apparatus.

The first chapter gives a condensed exposition of the basic trends in ultrasonic phase measurement and the relationship between propagation velocity and physicochemical properties.

The second chapter deals with the widely used electronic vector phase method as used in many devices; here the theoretical material is accompanied by a description of various designs of electronic phase meter developed by the author, together with details of acoustic equipment for exact velocity measurement, automatic concentration monitoring, density and temperature recording, flow speed measurement, etc.

The third chapter is the largest one, and this deals with the main methods of examining and monitoring ultrasonic speed in media; one finds here the first systematic survey of phase measurements, together with a classification of phase methods based on features of the apparatus or technique, and in addition schemes for realizing the methods and technological details. Much attention is given to the theory and to the design of the basic measuring units, including a design of multilayer transducer due to the author which makes it possible to monitor physical parameters under various industrial conditions without contact with the medium.

The major phase methods of velocity measurement are well illustrated by outline electronic circuits for various acoustic devices, together with detailed designs of particular parts.

The fourth chapter deals with flaw detection by phase methods, as well as structure monitoring for materials, component size measurement, and liquid level monitoring in vessels. Here it is pointed out that further work is needed on phase ultrasonic devices for nondestructive testing of materials and components, since these methods are not yet sufficiently widely used in industry.

*Energiya, Moscow-Leningrad, 1968.

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In the final (fifth) chapter there are details of phase methods for monitoring flow speed in liquids; the chapter deals with the propagation of ultrasonic waves in a moving liquid, together with the acoustic and hydrodynamic sources of errors of measurement and methods of dealing with these, and also some engineering methods of designing the components of the flowmeters, which involves a unified classification of single-channel and two-channel ultrasonic flowmeters; this requires a consideration of detailed designs.

The list of references runs to 209, of which about half are from foreign sources.

It is regrettable that the number of copies printed was small, and many of these are going to meet orders from abroad, so the book is already difficult to obtain for many readers. For this reason, it should be reprinted.

It will be desirable for a new edition of the book to deal with the monitoring of gaseous media, with more details of the author's numerous devices for ultrasonic phase measurement, many of which he has omitted from this book, evidently on account of the need for patent protection.

As a whole, this book is of considerable value and forms a valuable source for many specialists concerned with the use of ultrasonics in various branches of science and technology, including heat and mass transfer.