Contents

PART I – ABSORPTION OF FINITE-AMPLITUDE WAVES

K. A. Naugol'nykh

Introduction	3
Chapter 1 – Plane Waves of Finite Amplitude 1. Absorption of a Low-Intensity Sound Wave	5 5
 Qualitative Description of the Propagation of Finite-Amplitude Waves	7 10
Sound Wave	15
 5. Variation of the Spectral Composition of a Finite-Amplitude Wave during Propagation 6. Absorption of a Finite-Amplitude Wave 	23 30
Chapter 2 - Spherical and Cylindrical Waves of	
Finite Amplitude	35
Spherical Waves	35
Spherical and Cylindrical Waves	42
3. Absorption of Spherical and Cylindrical Waves of Finite-Amplitude	45
Chapter 3 – Dependence of the Gain of a Focusing	
System on Sound Intensity	51
1. Introduction	51

	oherical Concentrator	52
3. Cy	ylindrical Concentrator	56
	- Absorption of Finite-Amplitude Waves in	
Relaxing	Media and in Solids	59
	ound Absorption in Relaxing Media	59
2. Tl	he Absorption of Finite-Amplitude Sound	
i	n Solids	65
Reference	es	67
PART II – AC	OUSTIC RADIATION PRESSURE	
Z.A.Gol'dber	cg	
introducti	on	75
	- The Initial Equations	77
	itial Equations in Euler Variables	77
2. In	itial Equation in Lagrange Variables	81
Chapter 2	– The Radiation Pressure	85
1. Ge	eneral	85
	he Rayleigh Radiation Pressure	88
	he Langevin Radiation Pressure	94
Chapter 3	- Problems Associated with the Radiation	
Pressure		99
1. Tl	he Energy of Sound Waves	99
2. M	omentum Flux in Sound Waves	103
Chapter 4	- Radiation Forces Acting on a Particle	
in a Sound	d Field	109
1. De	erivation of the Initial Equation	109
2. F	orces Acting on a Spherical Obstacle	113
3. F	orces Acting on a Disk	117
Chapter 5	- Radiation Pressure Effects and Their	
Applicatio	ons	121
1. T	he Fountain Effect	121
2. Al	bsolute Measurement of the Field Intensity	121
	onlinear Properties of a Medium	125
	coustic Streaming Velocity and the	
(Coefficient of Sound Absorption	126
Reference	28	127

PART III - ACOUSTIC STREAMING

L. K. Zarembo	
Introduction	137
 Chapter 1 - Theory of Stationary Streaming in a Sound Field	141 142 147 156 159
Chapter 2 — The Experimental Investigation of Acoustic Streaming	171
 Methods for the Observation of Streaming and Measurement of Its Velocity	171 176 190 197
PART IV – PULSATIONS OF CAVITATION VOIDS	
V. A. Akulichev	
Introduction	203
 Chapter 1 - Fundamental Equations for the Pulsations of a Cavitation Void 1. Pulsations of a Void in an Incompressible Liquid 2. Pulsations of a Void with Regard for Compressibility of the Liquid 	205 205 208
Chapter 2 – Investigation of the Pulsations of	015
Cavitation Voids 1. Similarity of the Solutions of the Equations for Different Frequencies of the Ultrasonic Field	215 215
2. Structure of the Solutions; Structural Stability	221
3. Collapse of Cavitation Voids	221 227

CONTENTS

 Analysis of the Solutions of the Equations in the Phase Plane Experimental Investigation of the Pulsations of Cavitation Voids 	230 233
Chapter 3 - Relationship of the Pulsations of Cavitation Voids to the Emission of Shock Waves and Cavitation Noise 1. Shock Waves in Cavitation 2. Discrete Spectral Components of Cavitation Noise 3. The Continuous Cavitation Noise Spectrum Conclusion	239 239 245 250 257 257
PART V – EXPERIMENTAL INVESTIGATIONS OF ULTRASONIC CAVITATION	
M. G. Sirotyuk	
Introduction	263
Chapter 1 – The Strength of Liquids1. Theoretical and Actual Strength2. Cavitation Nuclei3. The Cavitation Strength4. Size Distribution of the Nuclei	265 265 267 273 280
Chapter 2 – Characteristics of Cavitation Bubbles and Properties of the Cavitation Zone 1. Oscillations of Cavitation Bubbles in a	285
Sound Field	285 290 294
 Collapse; the Gas Content Parameter 5. The Collapse Time 6. The Cavitation Zone and Number of 	299 302
Cavitation Bubbles	306
Chapter 3 – Energy Balance of the Sound Field in Cavitation 1. Cavitation Formation Energy; Streaming	315 315

2. Cavitation Energy 3. Cavitation Efficiency	320 32 1
Chapter 4 — Influence of the Acoustic Pressure and Characteristics of the Liquid on the Shock Wave	
Intensity	325
1. The Acoustic Pressure	326
2. Temperature and Gas Content of the Liquid	328
3. The Hydrostatic Pressure	333
Conclusion	339
References	340
PART VI – THE CAVITATION ZONE	
L. D. Rozenberg	
Introduction	347
Chapter 1 – Phenomenological Treatment	349
1. The Cavitation Index	349
2. Uniformity of the Cavitation Zone	350
3. Energy Losses in the Formation of the	
Cavitation Zone	353
4. The Loss Function and Its Application	356
5. The Developed Cavitation Zone (in a High-	
Intensity Focusing Concentrator)	359
6. Experimental Determination of the	
Cavitation Index	363
Chapter 2 – Oscillations of a Bubble in a Cavitation	
Zone	369
1. Statement of the Problem	369
2. On the Interaction of Adjacent Bubbles	371
3. Experimental Estimation of the Interaction	
Criterion	373
Chapter 3 – Variation of the Average Acoustical	
Characteristics of the Medium	377
1. The One-Dimensional Cavitation Zone	377
2. Experimental Investigations of the Equivalent	
Wave Resistance in Cavitation	380
3. Compressibility of Cavitation Bubbles	384
Chapter 4 - The Cavitation Efficiency	389

1. Fundamental Definitions	389
2. Experimental Determination of \varkappa	392
3. On the Measurement of the Acoustic Energy	
Cavitation Efficiency	395
4. Estimation of T/T_0	398
Chapter 5 – Analysis of Bubble Oscillations	403
1. Introductory Considerations	403
2. The Cavitation Zone in a Plane Wave	408
3. Cavitation in a Convergent Spherical Wave	411
4. Acoustic Streaming Induced by the Formation	
of Cavitation	415
References	417
Index	421