# Contents

#### Part I

## SUPERCONDUCTIVITY AND ITS APPLICATIONS

Chapter 1. The future of superconductivity in modern	
technology.	3
1.1. Introduction	3
1.2. Superconducting magnetic systems	4
Chapter 2. The nature of superconductivity	9
2.1. General principles	9
2.2. Superconductors of the first and second kinds .	14
2.3. Creep and jumps in magnetic flux in nonideal	
superconductors of the second kind	29
2.4. Resistive state of nonideal superconductors of	
the second kind	35
Chapter 3. Protection of superconducting magnetic	
systems	45
3.1. General principles	45
3.2. Transformer method	48
3.3. Discharge into an external load	55
3.4. Reasons for the development of a normal zone.	61
3.5. Stabilization of superconductors in their various	
forms	65

xi

#### CONTENTS

## Part II

## METHOD OF THERMAL STABILIZATION

Chapter 4. Equilibrium of the normal zone in combined	
conductors under isothermal conditions	71
4.1. Stekly model of a stabilized superconductor 4.2. Influence of contact thermal resistance at a	71
<ul> <li>4.3. Influence of the finite thermal conductivity of a superconductor on the stability of combined</li> </ul>	90
conductors	<b>9</b> 3
combined conductor	100
normal state	114
ductors	119
4.7. Method of the low-resistance shunt	122
4.8. Experimental results	128
Chapter 5. Equilibrium of the normal zone in combined conductors in the presence of a longitudinal tem-	
perature gradient	13 <b>9</b>
5.1. General principles	139
perature gradient	140
$\operatorname{conditions}$	147
<ul><li>5.4. Effect of electrical contact resistance</li><li>5.5. Stability of a combined conductor for an arbitrary longitudinal temperature dis-</li></ul>	163
tribution	166
5.6. Experimental results	171
Chapter 6. Propagation of the normal zone in a super-	
conducting coil	185
6.1. Method of studying the propagation of the normal	J
zone	185

#### CONTENTS

6.2. ]	Propagation of the normal zone in a thinly	
p	backed coil 1	89
6 <b>.</b> 3. I	Influence of cooling the coil with superfluid	
h	nelium	08
6.4. I	Rate of propagation of the normal zone along a	
C	combined conductor 2	11
Chapter 7	Combined conductors with forced cooling 2	17
7.1.0	General principles	17
7.2. 7	Theory of the combined conductor with forced	
c	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	18
7.3. (	Conditions of thermal equilibrium of the normal	
Z	zone	24
Chaptor 8	Fauilibrium and propagation of the normal	
	in a close mached superconducting soil	07
zone	in a close-packed superconducting coll 22	27
8.1.1	Principal characteristics of close-packed	
s	superconducting coils	<b>27</b>
8.2. H	Experimental results	33
8.3. 7	Transition of a superconducting solenoid into	
t	the normal state.	38
8.4. (	Comparison of the parameters of transient	00
~~~~ r	processes in close and thinly packed coils	11
4	Processes in crose and mining packed cons 2	11

## Part III

## COMBINED CONDUCTORS WITH INTERNAL STABILIZATION

Chapter 9. Stability of superconductors of the second kind	
with respect to flux jumps	255
9.1. General principles	255
9.2. Magnetization of nonideal superconductors of	
the second kind	256
9.3. Stability of the screening currents in a super-	
conductor of the second kind	261
9.4. Criterion of adiabatic stability in the presence	
of a transport current	272
9.5. Stability of the transport current in relation to	
finite flux jumps	276

#### CONTENTS

Chapter 10. Multiple-core straight conductors	283
10.1. Model of a multiple-core straight conductor 10.2. Criteria of the adiabatic stability of a straight	283
combined conductor	285
bined conductors	289
Chapter 11. Twisted and coiled combined conductors	299
11.1. Penetration of a magnetic field into a coiled	
combined conductor	299
conductors and the stability of the latter	303
<ul><li>11.3. Plaited (transposed) combined conductors</li><li>11.4. Combined conductors for obtaining rapidly-</li></ul>	310
varying magnetic fields	312
Appendix: Dimensionless volt-ampere charac-	
teristics of combined conductors	325
Referances	333
Index	337

xiv