

CONTENTS

Foreword	xi
Russell B. Scott Memorial Award	xii
1973 Cryogenic Engineering Conference Board	xiii
Awards Committees	xiii
Acknowledgments	xiv
S. C. Collins Award	xv

Energy Systems

A—1 Cryogenic H ₂ and National Energy Needs, J. HORD, <i>NBS Institute for Basic Standards</i>	1
A—2 The Economics of Liquid Hydrogen Supply for Air Transportation, J. E. JOHNSON, <i>Union Carbide Corporation, Linde Division</i>	12
A—3 The UCLA Hydrogen Car, A. F. BUSH and W. D. VAN VORST, <i>University of California at Los Angeles</i>	23
A—4 Cryogenic Engineering and Fusion Power, C. E. TAYLOR, <i>Lawrence Livermore Laboratory, University of California</i>	28

Applied Superconductivity Machinery and Magnets

B—1 Superconducting Electrical Generators for Central Power Station Use, T. M. FLYNN, R. L. POWELL, D. B. CHELTON, and B. W. BIRMINGHAM, <i>NBS Institute for Basic Standards</i>	35
B—2 Cryogenic Considerations in the Development and Operation of a Large Superconducting Synchronous Generator, C. K. JONES and D. C. LITZ, <i>Westinghouse Electric Corporation</i>	44
B—3 Superconducting Alternator Test Results, A. BEJAN, T. A. KEIM, J. L. KIRTLEY, JR., J. L. SMITH, JR., P. THULLEN, and G. L. WILSON, <i>Massachusetts Institute of Technology</i>	53
B—4 Alternating Field Losses in the Superconductor for a Large High-Speed AC Generator, M. S. WALKER, J. H. MURPHY, Y. W. CHANG, and H. E. HALLER III, <i>Westinghouse Electric Corporation</i>	59
B—5 A Review of Superconducting Magnetic Systems for Generating Transverse Magnetic Fields, V. V. SYTCHEV, <i>Institute for High Temperatures, Moscow</i>	67

Applied Superconductivity Electrical Transmission and Storage

C—1 European Progress in Cryopower Transmission, G. BOGNER, <i>Siemens AG, Erlangen</i>	78
C—2 Research on a Laboratory Model of Superconducting Test Cable, D. V. RAZEVIK, Y. L. BLINKOV, and Y. S. GOLDENBERG, <i>G. M. Krzhizhanovsky Power Research Institute, Moscow</i>	92

C—3	Development of a Rigid AC Superconducting Power Transmission Line, R. W. MEYERHOFF, <i>Union Carbide Corporation, Linde Division</i>	101
C—4	A Supercritical Helium Facility for Measuring High-Voltage Break-down, E. B. FORSYTH, R. B. BRITTON, J. DEAN, J. E. JENSEN, and K. MINATI, <i>Brookhaven National Laboratory</i>	109
C—5	Superconducting Energy Storage, R. W. BOOM, H. A. PETERSON, and W. C. YOUNG, <i>University of Wisconsin</i> , and G. E. MCINTOSH, <i>Cryenco</i>	117

Applied Superconductivity Transportation

D—1	High-Speed Transportation Levitated by Superconducting Magnet, K. OSHIMA, <i>University of Tokyo</i> , and Y. KYOTANI, <i>Japanese National Railways</i>	127
D—2	SRI Magnetic Suspension Studies for High-Speed Vehicles, H. T. COFFEY, <i>Stanford Research Institute</i>	137
D—3	AC Losses in Multifilamentary Superconducting Composites for Levitated Trains under AC and DC Magnetic Fields, T. SATOW, M. TANAKA, and T. OGAMA, <i>Mitsubishi Electric Corporation</i>	154
D—4	Shaped Field Superconductive DC Ship Drive Systems, T. J. DOYLE, <i>Naval Ship Research and Development Center</i>	162

Applied Superconductivity Operational Characteristics

E—1	Alternating Current Losses in Superconducting Conductors for Low-Field Applications, M. A. JANOCKO, D. W. DEIS, and W. J. CARR, JR., <i>Westinghouse Electric Corporation</i>	171
E—2	The Application of Loss Models to Superconducting Solenoids, J. T. BROACH and W. D. LEE, <i>U.S. Army Mobility Equipment Research and Development Center</i>	181
E—3	Investigation of the Dynamic Processes Occurring in Superconducting Windings, V. A. ALTOV, M. G. KREMLEV, V. V. SYTCHEV, and V. B. ZENKEVITCH, <i>Institute for High Temperatures, Moscow</i>	186
E—4	Analysis of Cryogenic Current Leads with Normal Conductors and Superconductors in Parallel, B. B. GAMBLE, <i>General Electric Company</i> , and J. L. SMITH, JR. and P. THULLEN, <i>Massachusetts Institute of Technology</i>	193

Refrigeration

F—1	A Decade of Involvement with Small Gas-Lubricated Turbines, M. E. CLARKE, <i>British Oxygen Company Limited</i>	200
F—2	Gas Bearing Cryogenic Expansion Turbines, J.-C. VILLARD and F. J. MULLER, <i>L'Air Liquide—Centre d'Etudes Cryogéniques</i>	209
F—3	Pneumatically Driven Split-Cycle Cryogenic Refrigerator, S. B. HORN, M. E. LUMPKIN, and B. T. WALTERS, <i>U. S. Army Night Vision Laboratory</i>	216

F—4	Theoretical Analysis of Pneumatically Driven Split-Cycle Cryogenic Refrigerators, S. B. HORN and M. E. LUMPKIN, <i>U. S. Army Night Vision Laboratory</i>	221
F—5	Refrigeration for the Culham Superconducting Levitron, D. N. CORNISH and R. E. BRADFORD, <i>Culham Laboratory</i> , and A. J. STEEL, <i>British Oxygen Company Limited</i>	231
F—6	Heat Load Due to Ortho-Para Conversion in a Closed-Loop Hydrogen Refrigerator, R. L. PUBENTZ and D. A. VANGUNDY, <i>Argonne National Laboratory</i>	239
F—7	Prototype Tests on a 200-W Forced Convection Liquid Hydrogen/Deuterium Target, K. D. WILLIAMSON, JR., J. E. SIMMONS, F. J. EDESKUTY, J. H. FRETWELL, J. T. MARTIN, and H. FICHT, <i>Los Alamos Scientific Laboratory, University of California</i>	241
F—8	Liquid Hydrogen Pumping for Hydrogen Targets, J. W. MARK, <i>Stanford Linear Accelerator Center</i>	248

LNG Storage and Transport

G—1	Effect of Weathering of LNG in Storage Tanks, J. M. SHAH and J. J. AARTS, <i>Chicago Bridge and Iron Company</i>	253
G—2	Design of LNG Receiving Terminals, D. B. CRAWFORD and C. A. DURR, <i>The M. W. Kellogg Company</i>	261
G—3	Some Important Factors in LNG Tanker Design Selection, R. C. FFOOKS, <i>Conch Methane Services Limited</i>	269
G—4	Near-Term Trends in LNG Tankship Design, J. L. HOWARD, <i>Kvaerner-Moss, Inc.</i>	276
G—5	Status Report on LNG Tanker Designs, A. PASTUHOV, <i>Gazocean USA, Inc.</i> , and M. GONDOUIN, <i>American Technigaz, Inc.</i>	282

LNG Related Fluid Properties

H—1	Phase Equilibria for Systems Containing Nitrogen, Methane, and Propane, D. P. L. POON and B. C.-Y. LU, <i>University of Ottawa</i>	292
H—2	Liquid-Vapor Equilibria in the Nitrogen-Methane System between 95 and 120 K, W. R. PARRISH and M. J. HIZA, <i>NBS Institute for Basic Standards</i>	300
H—3	Gas-Liquid Equilibria of the CO ₂ -CO and CO ₂ -CH ₄ -CO Systems, L. J. CHRISTIANSEN and A. FREDENSLUND, <i>Instituttet for Kemiteknik, Denmark</i> , and N. GARDNER, <i>Case Western Reserve University</i>	309
H—4	Solubility of Solid Benzene, Toluene, <i>n</i> -Hexane, and <i>n</i> -Heptane in Liquid Methane, G. P. KEUBLER and C. MCKINLEY, <i>Air Products and Chemicals, Inc.</i>	320
H—5	Phase Behavior of the Methane-Carbon Dioxide System in the Solid-Vapor Region, G. M. AGRAWAL and R. J. LAVERMAN, <i>Chicago Bridge and Iron Company</i>	327
H—6	Calculation of LNG Excess Volumes by a Modified Hard-Sphere Model, J. B. RODOSEVICH and R. C. MILLER, <i>The University of Wyoming</i>	339

- H—7 A New Correlation between Heating Values for LNG Custody Transfer, P. C. JOHNSON, *Distrigas Corporation*, J. P. LEWIS, *Transco Energy Company*, and G. M. WILSON, *Brigham Young University*. . . . 346

Pure Component Fluid Properties

- I—1 Scaled Parametric Equation of State for Oxygen in the Critical Region, J. M. H. LEVELT SENGERS, *National Bureau of Standards*, and W. L. GREER and J. V. SENGERS, *University of Maryland*. 358
- I—2 Superfluid Thermodynamic Transport Limits for Liquid Helium II, C. LINNET, R. C. AMAR, Y. G. WANG, and T. H. K. FREDERKING, *University of California at Los Angeles*. 365

Materials Technology

- J—1 A Simple Method for Charpy Impact Testing below 6 K, S. JIN, W. A. HORWOOD, J. W. MORRIS, JR., and V. F. ZACKAY, *University of California*. 373
- J—2 An Iron–Nickel–Titanium Alloy with Outstanding Toughness at Cryogenic Temperatures, S. JIN, J. W. MORRIS, JR., and V. F. ZACKAY, *University of California*. 379
- J—3 Compressive Load–Deflection Characteristics of Several Foam Materials at Room Temperature, 77 K, and 4.2 K, W. F. STEWART, D. T. EASH, and W. A. MAY, *Los Alamos Scientific Laboratory, University of California*. 385
- J—4 A Structural Plastic Foam Thermal Insulation for Cryogenic Service, R. B. BENNETT, *Amspec Inc.*. 393
- J—5 A Differential Thermal Analysis Apparatus for Use at Cryogenic Temperatures, E. CATALANO, J. A. RINDE, and J. C. ENGLISH, *Lawrence Livermore Laboratory, University of California*. 400

Heat and Mass Transfer

- K—1 Forced Convection Heat Transfer to Subcritical Helium I, P. J. GIARRATANO, R. C. HESS, and M. C. JONES, *NBS Institute for Basic Standards*. 404
- K—2 Vaporization Onset Heat Flux for Flat Plates in Saturated Liquid Helium II, D. W. B. MATTHEWS, *National Defence Headquarters, Ottawa*, and A. C. LEONARD, *Royal Military College of Canada*. 417
- K—3 Heat Transfer to Slush Hydrogen, C. F. SINDT, *NBS Institute for Basic Standards*. 427
- K—4 A Countercurrent Heat Exchanger that Compensates Automatically for Maldistribution of Flow in Parallel Channels, K. W. COWANS, *Kinergetics, Inc.*. 437
- K—5 Design and Selection of Cryogenic Heat Exchangers, K. D. TIMMERHAUS and R. J. SCHOENHALS, *National Science Foundation*. 445
- K—6 Separation of Nitrogen from Helium Using Pressure–Swing Adsorption, G. BIRD, *Petrocarbon Developments Limited*, and W. H. GRANVILLE, *University of Bradford*. 463

Space Technology

L—1	Cryocontamination of Optical Solar Reflectors and Mirrors, C.-K. LIU, <i>Lockheed Palo Alto Research Laboratory</i> , and C. L. TIEN, <i>University of California</i>	474
L—2	Thermal Performance Characteristics of a Combined External Insulation System under Simulated Space Vehicle Operating Conditions, F. J. MULLER, <i>L'Air Liquide—Centre d'Etudes Cryogéniques</i> , and P. L. KLEVATT, <i>McDonnell-Douglas Astronautics Company</i>	482
L—3	Multistage Radiative Coolers for Spacecraft Sensors, R. P. BYWATERS and M. C. KEELING, <i>Texas Instruments, Inc.</i>	490
L—4	RF Gauging Efforts with Liquid Hydrogen and Liquid Oxygen As Applicable to Subcritical Space Vehicle Systems, H. E. THOMPSON, <i>NASA Marshall Space Flight Center</i> , and W. OTT and N. STANLEY, <i>The Bendix Corporation</i>	500
L—5	Computed Wicking Rates of Cryogenes at Low Gravity for Selected Screens, R. A. MOSES, D. F. GLUCK, and W. J. HINES, <i>Rockwell International</i>	509

Indexes

Author Index	517
Subject Index	519