

TABLE OF CONTENTS

LECTURES	1
POWER RECOVERY TURBINES FOR THE PROCESS INDUSTRY	3
<i>S. Gopalakrishnan, Manager of Research and Development, Byron Jackson Pump Division, Borg Warner Industrial Products, Incorporated, Long Beach, California</i>	
GAS-LIQUID FLOW THROUGH CENTRIFUGAL PUMPS—CORRELATION OF DATA	13
<i>Jim L. Turpin, Professor, Chemical Engineering Department, University of Arkansas, Fayetteville, Arkansas, James F. Lea, Research Associate, Amoco Production Company, Tulsa, Oklahoma, and John L. Bearden, Manager of Mechanical/Hydraulic Engineering, Houghes Tool Company, Centrilt Hughes Division, Claremore, Oklahoma</i>	
SYSTEM PROBLEM EXPERIENCE IN MULTIPLE RECIPROCATING PUMP INSTALLATIONS	21
<i>William W. Parry, Jr., Design Engineer, Ingersoll-Rand Standard Pump Division, Allentown, Pennsylvania</i>	
ANALYTICAL AND EXPERIMENTAL TECHNIQUES FOR SOLVING PUMP STRUCTURAL RESONANCE PROBLEMS	27
<i>Robert E. Cornman, Manager Utility Pump Engineering, Engineered Pump Division, Ingersoll-Rand Company, Phillipsburg, New Jersey</i>	
DESIGN OF PUMP SHAFT TRAINS HAVING VARIABLE-SPEED ELECTRIC MOTORS	33
<i>Arno Frei, Head, Mechanical Development Group, Sulzer Brothers Limited, Winterthur, Switzerland, Andrej Grgic, Supervisor, Department of Applied Mechanics for Rotating Electrical Machines, Werner Heil, General Manager, Department AD and DC Machines for Industrial Application, Brown Boveri & Company, Baden Switzerland, and Armin Luzi, Research Engineer, Sulzer Brothers Limited, Winterthur, Switzerland</i>	
ROTOR DYNAMIC DEVELOPMENTS FOR HIGH SPEED MULTISTAGE PUMPS	45
<i>Stanley E. Pace, Project Engineer, Steam Turbines and Related Auxiliaries, Electric Power Research Institute, Palo Alto, California, Stefan Florjancic, Development Engineer, Pump Division, and Ulrich Bolleter, Head, Laboratory for Vibrations and Acoustics, Sulzer Brothers Limited, Winterthur, Switzerland</i>	
THE EFFECT OF SPECIFIC SPEED ON THE EFFICIENCY OF SINGLE STAGE CENTRIFUGAL PUMPS	55
<i>Eugene P. Sabini, Engineering Product Manager, Worthington Pump Division, Dresser Industries, Incorporated, Harrison, New Jersey, and Warren H. Fraser, Consulting Engineer, Mountainside, New Jersey</i>	
VISUAL STUDIES OF CAVITATION IN PUMPING MACHINERY	61
<i>Ronald Palgrave, Chief Engineer, Ingersoll-Rand Company Limited, Gateshead, England, and Paul Cooper, Director, Hydraulic Technology, Pump Group Research and Development Department, Ingersoll-Rand Company, Phillipsburg, New Jersey</i>	
ANALYSIS OF NOZZLE LOADS FOR PROCESS PUMPS	69
<i>Takio Shimizu, Senior Research Engineer, Ebara Research Company, Limited, and Hironori Teshiba, Senior Engineer, Ebara Corporation, Tokyo, Japan</i>	
DEVELOPMENT OF AN ADVANCED GAS TURBINE DRIVEN HIGH-SPEED CENTRIFUGAL PUMP FOR INJECTION SERVICES	77
<i>Erio Benvenuti, Manager, Research and Development, Nuovo Pignone, Florence, Italy, and Robert T. Ross, Vice President and Chief Engineer, United Centrifugal Pumps, San Jose, California</i>	
SPECIAL PAPERS	
AN OVERVIEW OF HARDFACED COATINGS FOR INDUSTRIAL USE	91
<i>Edward R. Buchanan, President, Holtgren, Incorporated, Kenilworth, New Jersey</i>	
PUMP-PRO—A CENTRIFUGAL PUMP DIAGNOSTIC EXPERT SYSTEM	97
<i>Thomas J. Fritsch, Consulting Engineer, Consulting Group, Stone & Webster Engineering Corporation, Boston, Massachusetts</i>	

TUTORIAL SESSIONS

COATINGS AND SURFACE CONVERSIONS FOR PUMPS	105
COATINGS FOR CENTRIFUGAL PUMP COMPONENTS	107
<i>Robert C. Tucker, Jr., Union Carbide Corporation, Indianapolis, Indiana</i>	
BASEPLATES AND FOUNDATIONS	111
API 610 BASEPLATE AND NOZZLE LOADING CRITERIA	113
<i>James E. Steiger, Lead Design Engineer, United Centrifugal Pumps, San Jose, California</i>	
PRACTICAL CONSIDERATIONS FOR PUMP BASEPLATES, GROUTING AND FOUNDATIONS	131
<i>Malcolm G. Murray, Jr., Owner, Murray & Garig Tool Works, Baytown, Texas</i>	
PANEL SESSION	
PREDICTIVE MAINTENANCE: METHODS AND APPROACHES	137
DISCUSSION LEADERS	141
SPECIAL EVENTS SPEAKERS	165
PUMP SYMPOSIUM ADVISORY COMMITTEE	167
EXHIBITORS	175
TURBOMACHINERY LABORATORIES STAFF	183
TURBOMACHINERY LABORATORIES	189