Turbulence

Turbulence. By J. O. Hinze. McGraw-Hill Book Company, Inc., New York, N. Y., 1959. Cloth, 9 × 6 in., lx and 586 pp. $15.

REVIEWED BY M. S. UBEROI[5]

PHYSICAL properties of turbulence, statistical averages, and techniques used to measure them are described in the first two chapters. Hot-wire anemometry is fully discussed. The next two chapters deal with the kinematics and dynamics of isotropic turbulence, isotropic scalar fields, pressure fluctuations, and anisotropic turbulence. The last three chapters are devoted to transport processes in turbulent flows, free shear flows (jet and wakes), and wall shear flows (channel flows and boundary layers). Any statistical theory consists of two parts. The first is devoted to defining suitable averages which invariably exceed the number of equations relating them. In the second part one complements the equations by assuming certain relations among the average quantities so that the determinate set of equations can be solved. The main difficulty is in finding these relations guided by experimental facts or intuition. Some have confused statistical formalism with real progress in turbulence. The author avoids this pitfall to a large extent.

Throughout the book, basic concepts are clearly explained and analysis compared with latest experimental results. The author includes older inexact but irreplaceable mixture length theories of shear flows which have fallen into contempt with some of the elite. A fairly complete set of references is given at the end of each chapter. The book is of real interest to workers in the field of turbulent flows, heat transfer, and diffusion.

Combustion

Design and Performance of Gas Turbine Power Plants. W. R. Hawthorne and W. T. Olson, Editors. Princeton University Press, Princeton, N. J., 1960. Cloth, 9½ × 6 in., xiii and 563 pp., illus. $15.

REVIEWED BY A. G. SMITH[6]

VOLUME XI of the Princeton "High Speed Aerodynamics and Jet Propulsion," the book under review, is a very useful volume saddled with a slightly misleading title. The book deals with only a part of the field implied by its title, and the Editor's preface shows that vol. X, "Aerodynamics of Turbines and Compressors," is intended as a "companion piece." Readers will possibly want to survey parts of vol. XII as well, before they feel that they have covered "Design and Performance of Gas Turbine Power Plants."

The present volume devotes 342 of its 563 pages to Combustion. The book is laid out in 4 "parts." 1—Introduction, 4 pages; 2—Combustion chamber design, 342 pages; 3—Mechanical and metallurgical aspects, 107 pages; 4—turbine powerplants, 90 pages.

Nine authors have contributed "sections" to part 2, treating "Requirements and Processes" (Peter Lloyd); "Experimental Techniques" (Hoyt C. Hottel and Glen C. Williams); "Fuel Injection" (Alec Radcliffe); "Flame Stabilization" (J. Howard Childs); "Mixing Processes" (Charles C. Graves and Wilfred E. Scull); "Fuels for Aircraft Gas Turbine Engines" (Louis C. Gibbons); and "Combustion Chamber Development" (Walter T. Olson).

This part of the book cannot fail to be valuable to combustion engineers and research workers. The 398 cited references, with few exceptions, date up to 1956, which is about as late as can be expected for an authoritative book with a large number of contributors.

Part 3 has two sections: "Mechanics of Materials for Gas Turbine Applications" (Egon Orowan and C. Richard Soderberg), and "Flutter Problems in Gas Turbines" (Jan R. Schnittger). The first of these sections provides both a conventional introduction to basic dislocation ideas, which cannot be said to do justice to modern thought on the application of the theory to creep and fatigue, and also a review of the engineering formulation which, though of some value, omits reference to the important cases of varying stress and temperature. The Flutter section is a useful survey of work up to about 1957, and the author has made the best of the unenviable task of explaining the diverse and intractable phenomena of blade flutter. As the author prudently predicted, important contributions have been made since he concluded his survey.

Part 4 has a single section titled "Performance" by Dennis H. Mallinson and Sidney J. Moyes. After a treatment of the thermodynamics of the compressor-combustor-turbine "gas generator" on a semiperfect gas basis, the section proceeds to an exposition of the complex interactions of intake, compressor, combustor, turbine, and propelling nozzle in producing the equilibrium running condition. Engines up to "double-compound" complexity are considered.

The book as a whole is very useful and obviously an essential acquisition to any library with "gas turbine" customers.

Gas Dynamics

Handbook of Supersonic Aerodynamics, Section 16, Mechanics of Rarefied Gases. By S. A. Schaaf and L. Talbot. Aerodynamics Handbook Staff of The Johns Hopkins University, Baltimore, Md., 1959.

REVIEWED BY G. N. PATTERSON[7]

THIS section of the new edition of the Handbook of Supersonic Aerodynamics has been prepared by two authors whose outstanding contributions to the subject of rarefied gas dynamics make them well qualified to prepare a review. The subject is introduced by a quantitative description of the flow regimes and a discussion of the present state of our knowledge of the interaction of gas molecules with surfaces in so far as the requirements of the aerodynamicist are concerned. Emphasis is naturally placed on free-molecule flow for which an extensive literature now exists. The authors then proceed with a consideration of slip flow, the regime of moderate rarefaction, leaving out the little-understood transition region. The article is well illustrated with curves showing such data as aerodynamic forces and heat transfer for simple geometrical shapes in both free-molecule and slip flow.

It is possible that some empirical data from the transition regime might have been included. However, the authors do provide references to research in near-free-molecule flow, a recent development of considerable importance to the designer.

No mention is made of the important subject of free-molecule probes. It is likely that this subject has been left to other sections of the Handbook although it properly forms part of the theory of free-molecule flow and should be of considerable interest to designers. This criticism is relatively minor, however, and does not detract from the excellence of this section of the Handbook.

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