P. N. Romanenko

HEAT AND MASS TRANSFER IN GRADIENT FLUID FLOW*

Reviewed by P. K. Konakov and V. T. Kumskov

In connection with new engineering trends, intensive research is underway concerning the theory of convective heat transfer and friction in the particularly important case of gradient fluid flow. Much has been accomplished in this area by both Soviet and foreign scientists.

Various exact and approximate methods based on the boundary-layer theory have been used for the analysis of convective heat transfer and friction in gradient fluid flow.

A systematic survey of these methods is absolutely necessary, inasmuch as it would make them known to the very many scientists and allow their advantages as well as drawbacks to be comprehensively evaluated.

A considerable contribution here has been made by the Énergiya Publishing House, which issued several monographs on specific problems in heat transfer. Thus, the well known book by B. S. Petukhov "Hydraulic Drag and Heat Transfer in the Laminar Flow of Fluids through Pipes" was in 1971 supplemented with the second edition of the book by P. N. Romanenko "Heat and Mass Transfer and Friction in Gradient Fluid Flow." In this book the author outlines the basic theories and methods of calculating the convective heat transfer and the hydraulic drag in channels with variable sections, in pipes, and at the surface of bodies immersed in an incompressible fluid with high velocities and at high temperatures as well as under variable pressure and when the direction of flow changes.

Analyzed also is the flow of fluids at relatively impermeable and porous surfaces in the presence of other transverse streams under conditions which favor the development of a laminar or a turbulent boundary layer, respectively.

The second edition of the book by P. N. Romanenko is considerably modified in both scope and organization; it is easily distinguishable from the first edition.

Problems of convective heat and mass transfer and of hydraulic drag in gradient fluid flow are analyzed on the basis of the boundary-layer theory.

The book is made up of fourteen chapters and may be tentatively divided into a few parts. The general system of equations and the boundary-layer equations are considered first, then the methods of solving the latter for the case of a laminar flow of a fluid relative to an impermeable surface or a permeable surface, respectively. The book deals also with general properties of turbulent boundary layers in fluids flowing with a pressure gradient and describes methods of solving this kind of problem. For instance, the hydraulic drag and the heat transfer in a boundary layer are considered in the case of both an impermeable and a permeable surface.

It is quite appropriate that some basic mathematical and hydrodynamic concepts are presented at the beginning of the book, because they are necessary for the understanding of a wide range of complex problems.

Not only the methods of calculating the boundary layer are presented in the book, but also their accuracy and cost in computational effort are analyzed.

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Most interesting and practically valuable is the part of the book devoted to the heat transfer and the hydraulic drag during injection into and ejection from a laminar boundary layer.

The book contains information on latest studies concerning the convective heat transfer and the hydraulic drag during injection into and ejection from a laminar boundary layer; it lists 276 references which include works by the Soviet scientists L. G. Loitsyanskii, K. K. Fedyaevskii, S. S. Kutateladze, A. I. Leont'ev, and others, as well as the author's own works.

Having reviewed the positive aspects of the book by P. N. Romanenko, we will now make a few comments.

The book contains only inexcusably few results of experimental studies concerning the convective heat transfer and the hydraulic drag in gradient fluid flow. Not enough practical applications are given to the problems considered here. In a monograph of this kind it is very desirable to see various methods of analysis illustrated on practical examples. In this case there would have been more reasons for recommending the book to design and construction engineers. It is also desirable to provide a list of symbols and a subject index.

There are a few misprints in the book.

All these deficiencies do not detract, however, from the positive aspects of the monograph. It is outstanding in its penetrating analysis of our present knowledge about convective heat transfer and hydraulic drag in gradient fluid flow and it excellently sums up the various problems in this area.