PREFACE TO THE 4th ENGLISH EDITION

Professor I. E. Idelchik's *Handbook of Hydraulic Resistance* has become widely known: its 2nd and 3rd editions were translated into the English, French, Chinese, and Czech languages. Each subsequent edition was enriched with new information and data, as well as with new entries to the bibliography. The present, 4th, English Edition of the Handbook, like the previous one, was prepared after the author's death, and appears only in its English version.

We shall list here the most essential additions and changes that we thought worthwhile to make in some of the chapters of this book. In particular, Chapter 2 dealing with stabilized steady-state flow in channels and tubes was supplemented with the following experimental results: unsteady flows with a sharp change in the turbulent velocity as well as on a smooth change in time and its resulting effect on the hydraulic resistance. This chapter has a new section on the stabilized turbulent flow in plane and annular channels when the flow is induced by longitudinal motion of one of the walls (Couette flow) or when the flow is driven by longitudinal motion of one of the walls and longitudinal pressure gradient (Couette–Poiseuille flow). The computed data and their agreement with experimental results are given. Such flows are typical of the systems of container piping pneumatic- and hydrotransport in which the containers move under the action of forced air or water flow (passive containers) or where a train moves in a tunnel due to the presence of draft (the so-called active containers).

The results of computational and experimental studies of the characteristics of a Couette forced turbulent flow in plane and annular channels (concentric and accentric) in the presence and absence of surface roughness are given. Examples of computed dependences needed to determine the velocity of motion of cylindrical passive and self-propelled containers in a tubing for given longitudinal pressure gradients, Reynolds numbers, length and their relative diameters and eccentricity are also furnished. Together with the equation of the balance of forces acting on a container of given length, these dependences can be used to determine the parameters of the container motion.

A description is given of the hydrodynamic paradox when the velocity of motion of a sufficiently long enough passive cylindrical container of neutral buoyancy in a turbulent water flow may exceed the maximum water flow velocity along the tube axis.

Chapter 3 presents the result of experimental studies of an oblique flow past a frontal air intake with a system of flow controls providing a separationless flow in a channel up to inflow angles of 90^{o}. The problem will be of interest to ground-level transport facilities and ships with frontal air intakes.

Chapter 4 describes the technique used to reduce the total pressure losses in channels with an abrupt expansion by breaking down vortices with the aid of transverse partitions as well as by blowing a jet from a slit to create the so-called jet diffuser. In the latter case, the loss coefficient with allowance for pressure losses on injection is decreased 1.5 times. This effect is enhanced by using the Coanda effect in the course of creating a jet diffuser (the phenomenon of adherence of a plane jet to a convex plane surface) when a jet is blown from a curvilinear slit; the loss coefficient is decreased here by a factor of 2–2.5.

Chapter 5 devoted to diffuser flows has been thoroughly revised in the present edition. This chapter presents the experimental results of plane and conical diffusers with different area ratios and divergence angles depending on Reynolds and Mach numbers at subsonic velocities and at different parameters of the initial flow nonuniformity and surface roughness. Examples of changes in the geometry of diffusers on replacing rectilinear by curvilinear walls to increase the efficiency of diffusers are given. The means of improving the characteristics of diffusers by installing different kinds of partitions and screens, finning the diffuser surface or installing generators of longitudinal vortices at the inlet to delay flow separation are also described.

In contrast to the previous editions of the Handbook, the methods of calculating a turbulent flow in diffuser channels and determining the total pressure losses on the basis of the boundary-layer approximation are briefly reviewed here. Moreover, the use of these methods in solving direct and inverse problems in calculating the diffuser channels is considered. In solving the direct problem, the coefficient of total pressure loss in a diffuser of a given geometry at fixed Reynolds and Mach numbers, initial flow nonuniformity at the inlet to the diffuser, surface roughness up to the section where flow separation occurs are calculated.

The solution of an inverse problem for the starting length of diffuser flow is aimed at determining the geometrical parameters of the diffuser at a fixed Reynolds number from the *a priori* specified velocity distribution along the channel axis or of the surface friction coefficient on its walls. Thus, for example, when specifying a virtually zero surface friction on the walls of a diffuser, the so-called preseparation flow develops in the latter. It appears that such diffusers possess a number of extreme properties. Calculations and experiments have shown that in such diffusers, at a given length, a marked decrease in the total pressure loss is ensured or, at a given area ratio, a substantial decrease in the diffuser length is possible.

Additional information is also given on aerodynamic methods of controlling the flow characteristics in diffusers with the aid of slit suction or tangential injection — both enabling the increase in the efficiency of a diffuser with allowance for energy losses in such cases.

Chapter 6 presents new data on the hydraulic resistance of pipe bends in the presence of cavitation in a stream of water and gas–liquid mixtures.

Chapter 8 contains results of calculations and describes experiments aimed at creating the initial flow nonuniformity in a channel with the aid of screens of variable resistance across the flow and of an array of cylinders. It also suggests a technique of creating a high-turbulent flow with a section-uniform turbulence intensity with the aid of a two-row array of cylinders with opposite motion of the rows.

Finally, Chapter 12 contains new data on heat transfer and hydraulic resistance in an in-line bank of tubes. It is shown that according to experimental results and of numerical simulation, the finning of their surface as well as indentation of staggered dimples on a smooth surface lead to a substantial enhancement of heat transfer that overtakes an increase in the hydraulic resistance. The chapter also contains data on the enhancement of heat transfer in round and annular tubes with the aid of different kinds of swirlers with continuous twisting along the flow as well as on the hydraulic losses and heat transfer of rotating channels (rotation of a tube around its own axis or around the axis which is perpendicular to that of the tube). These results are of interest in their application to heat transfer problems.

By having prepared this edition for publication we are paying tribute to the memory of Professor I. E. Idelchik — the author of this Handbook with whom we had the pleasure of first working in the same laboratory and then remaining all the time in close contact when he took up work at another institute. One of us reviewed the 2nd Russian edition of this book (1975) as well as his monographs "Aerohydrodynamics of Engineering Apparatus" and "Some of the Interesting Effects and Paradoxes in Aerohydrodynamics and Hydraulics" (1982).

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