A. S. Nevskii (Editor)

RADIATIVE HEAT TRANSFER IN FURNACES AND OVENS*

Reviewed by Ya. D. Rudakov, V. M. Melent'ev, and Yu. M. Ageev

A distinct merit of this book is the agreeable combination of a high scientific level with a clarity of explanation in treating complex problems of radiative heat transfer. These problems began to preoccupy the author in the nineteen thirties already, before the theory of radiative heat transfer had been developed as such. In his monograph A. S. Nevskii has summarized the vast experience of lifelong scientific effort. In addition to the results of his original scientific research, the author presents also all the major achievements of other scientists in this and foreign countries. All this, on the whole, distinguishes the book from its previous edition, where certain problems were not treated thoroughly enough, and justifies calling it the best and most authoritative Russian monograph available at this time on radiative heat transfer in furnaces and ovens.

The 440 pages monograph consists of an introduction and four parts with a total of fourteen chapters.

The introduction reviews chronologically the highlights in the development of design methods for radiative heat transfer in furnaces and ovens in thermal engineering plants, it also includes an abstract of the following four parts of the book.

Part I contains three chapters and familiarizes us with the basic concepts and laws of heat radiation. The author is very careful in defining the fundamental terms and, for instance, clearly distinguishes between brightness and directional radiation intensity — both of which are, for some reason, often considered the same. Analyzed are also the basic laws of radiant energy transmission through a nongray and a gray medium, with boundary conditions taken properly into account. Much attention is paid to the radiative properties of bodies, expressions are derived which describe the spatial brightness and intensity distribution of reflected radiant heat fluxes, and the latest achievements in the radiative properties of materials are critically reviewed.

Part II contains four chapters and is devoted to a factual presentation of the modern theory of radiative heat transfer between bodies without and with multiple reflections at surfaces taken into account, but without accounting for the dispersivity of the medium. A. S. Nevskii analyzes here the cases where the Law of Cosines is and is not obeyed. Very original is the generalization the author makes by introducing coefficients of mutual radiative heat transfer between a surface and a volume or between volumes and extending them to the cases of nongray and gray radiation. Much space is devoted here to an outline of effective integral and zonal methods of calculating radiative heat transfer, which take into account multiple reflections of radiant fluxes at isotropic and anisotropic boundary surfaces of media, much space is also devoted here to the determination of local and mean energy characteristics.

The concept of the radiation vector is very important for an understanding of the processes involved in radiant energy transmission. Its properties and ways of determining it are dealt with in Part III. Here are also described differential methods of analyzing the processes of radiant heat transmission, problems are tackled in calculating the radiation from gases at nonuniform temperature distributions, and examples are shown of applying the theory of the radiation field to practical thermal engineering problems.

*Izd. Metallurgiya, Moscow , 1971.

Translated from Inzhenerno-Fizicheskii Zhurnal, Vol. 23, No. 3, pp. 561-562, September, 1972.

Part IV is devoted to modern design methods for radiative heat transfer in industrial plants and to their comparative evaluation. The material which has been presented here does exhaustively reflect the state of the art and what can be found in the technical literature. Most of the problems raised here require, however, further study. The reason for this is the complex interrelation between radiation processes, concurrent combustion processes, motion of the medium, convection and heat conduction processes, etc. On the basis of his analysis, the author recognizes the importance of accounting for the selectivity of radiation.

Urgent practical problems call for still much more development of methods based on the theory of radiative heat transfer and, for this reason, they could not have been treated to the full extent in one single monograph, but this must not be blamed on the book. The book is among the best ones available today on radiative heat transfer and has become a rare item because of the insufficient number of printed copies.

The book "Radiative Heat Transfer in Furnaces and Ovens" should be of great interest to students and teachers specializing in thermal engineering and thermophysics, to workers in the heating power, electrical engineering, metallurgical, and lighting industries, also to scientists working in areas where radiative heat transfer plays an important role. The monograph "Radiative Heat Transfer in Furnaces and Ovens" by A. S. Nevskii is a much needed and useful book. It is very necessary to soon reissue it in a much larger edition, inasmuch as problems of radiative heat transfer attract much attention and are becoming very important.