BOOK REVIEWS

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CALCULATIONS OF THERMAL CONDITIONS FOR SOLID BODIES*

Reviewed by Sh. N. Plyat

The book "Calculations of Thermal Conditions for Solid Bodies" was first published in 1968. As was noted in the review [Inzhenerno-Fizicheskii Zhurnal (Journal of Engineering Physics), 15, No.6, 1135-1136 1968], the book proved to be "very interesting and useful for wide circles of scientific and technological engineering workers." The second edition has remained the same in structure, but it is considerably revised and supplemented in content. Chapters III, V, and VI are the most significant supplement.

The fundamentals of the application of the equivalence and duality principles to the solution of heat-conduction problems are expounded in Chap. III. It is shown how, using these principles, one can considerably expand the circle of problems solvable with the help of the methods presented in the book. For example, on the basis of the duality principle it is established that the transfer of a layer of turbulent fluid from one surface of a plate to the other does not affect the time dependence of the temperature at an adiabatic surface with an arbitrary law of variation of the heat flux at the opposite surface. The duality principle also allows one to use known solutions to problems with boundary conditions of the second kind to seek the temperature fields of bodies with internal heat sources.

Problems on established conditions are discussed in Chap. V. Here analytical expressions are given which determine the thermal resistances in 45 cases for bodies of a number of geometrical shapes with different schemes of distribution of heat sources (sinks) within the bodies and over their surfaces. Numerous connections between the solutions of the problems are revealed and cases of the degeneration of solutions of some problems into the solutions of others are given. For example, it is shown that the thermal resistance of bodies in a semiinfinite region R is connected with the thermal resistance of bodies in an infinite region R_0 by the simple expression

$$R = R_0(1 \pm k),$$

where k is some coefficient; the plus sign corresponds to the case of an adiabatic surface of the body and the minus sign to the case of an isothermal surface.

Simple relationships are established between the thermal resistances of spheres and cubes of different volumes in an infinite region and the conditions are shown under which the thermal resistances are practically equal for a round ring and a disk, for plates or disks, placed parallel or perpendicular to the surface of a semiinfinite body, etc.

In Chap. VI a calculation is presented for the thermal conditions of bodies upon a change in the aggregate state. Solutions are given for 20 problems of the solidification (melting) of bodies of different geometrical shapes with different boundary conditions. As in the entire book, the analytical solutions are given in criterial form and are accompanied by calculating graphs, which make it easy to determine the rate of movement of the solidification (melting) boundary. A structural analysis of the solution of the solidification problems showed, in particular, that the solidification times for a semiinfinite region and for a plate are equal to the sums of the solidification times for the bodies without thermal insulation and an additional time.

A considerable expansion of the catalog of problems on nonsteady conditions with the corresponding calculating equations and graphs could also be mentioned among the new materials. Solutions of problems for hollow cylinders and spheres and for plates with a turbulent fluid layer at the surface are added. In the second edition the catalog contains 78 problems in place of 59 in the first.

The absence of a number of examples of calculations and solutions which were contained in the first edition is a certain disadvantage.

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