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BOOK REVIEWS

J. E. ANDERSON, **Transfer Phenomena in Thermal Plasma.** Energiya, Moscow (1972).

THERMAL plasma obtained with electric-arc heaters finds still wider application in industry. Electric-arc heaters are effective devices for realization of some chemical processes in plasma, treatment of refractory materials, etc.

This required vast experimentation and theoretical investigation of the propertics of thermal plasma, interaction of electric-arc column with a gas flow, electrode phenomena, energy transfer from a plasma flow to channel walls and so on.

The theory to the problem on interaction of electric-arc column with a gas flow and external magnetic field is given in the book by Prof. J. E. Anderson, Minnesota University, U.S.A.

At present intense developments of calculation methods for investigation of electric arc in a gas flow which are more economic than experimental ones are carried out. Therefore the publication of Prof. J. E. Anderson's book in Russian edited by Acad. A. V. Luikov is up to the time.

In the first chapters of the book the concepts of magneto-gas dynamics are introduced, and balance equations are discussed in application to thermal plasma with account taken of all the main effects. The generalized Ohm law is particularly derived which allows for the effect of a magnetic field (Hall's current), difference between ion and electron velocities (ion slip) and electronic pressure gradient. The estimation of the terms of equations from laboratory experiments with thermal plasma show that the displacement current may be neglected, plasma is neutral and magnetic Reynolds number is small. In the equation of momentum conservation the term of magnetic pressure may be significant. These and a number of other estimations allow the system of equations describing the behaviour of electric arc in a gas flow in the presence of a magnetic field to be simplified.

Next chapters deal with three particular problems.

In Chapter 6 consideration is given to solution of the problem on axisymmetric d.c. arc column in a longitudinal developed laminar gas flow with account for a proper magnetic field. Estimation shows that the radial pressure drop due to magnetic field may be neglected; at moderate Mach numbers the viscosity term in the energy equation is small compared to the Joule heating. It is assumed that the gas properties σ, U_r are independent of the pressure (its changes being slight); the intensity of radiation per unit volume is determined in a single way by the temperature and the arc radius (the column is optically thin).

Before treating the solution, the author gives an approximate estimation of the characteristic values. In particular, useful expression $r_e \approx I^2/70$ is obtained for the radius of arc column. An expression is derived for estimation of limit temperatures at the axis. Solution of the energy equation neglecting convection is sought by a numerical method. A linear relation between the function of the thermal conductivity $\varphi = \int_{TP}^{T} \lambda \alpha T$ and the variable $x = r^2/r_w^2$ is assumed as a first approximation.

An inverse problem is considered and it is shown how to calculate the thermal and electric conductivity and intensity of radiation per unit volume using the solution of the energy equation, and electric characteristics and radial temperature distribution found experimentally.

Chapter 7 deals with electric arc in the presence of axial and radial gas flows. The case under consideration corresponds to a possible design of an electric heater in which the walls of a channel with a discharge are cooled by transpiration. A condition is introduced for an ideal porous wall that all the heat supplied to the wall by radiation or convection should return to the channel with a radial gas flow.

The length of the channel section is estimated where the stagnation enthalpy of heated gas achieves an approximately constant value. Equations for a developed flow are considered and then reduced to ordinary differential equations using the similarity conditions. The numerical procedure of solving the equations and the range of validity are shown.

In Chapter 8 free arc column is considered, expressions for estimation of the radius of arc column, equilibrium conditions and curvature radius in the presence of a transverse gas flow are obtained.

The book gives a detailed consideration to some particular problems of arc column in a gas flow.

The book may serve as a text-book for university students.

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L. S. TONG, **Boiling Crisis and Critical Heat Flux.** AEC Critical Review Series. 82 pp. $3.

THIS book is a monograph on critical heat flux by one of the pioneer water-cooled, nuclear reactor designers. It is one of a series of AEC sponsored monographs on various topics concerning nuclear reactor design.

The material in the book can be divided into two categories: a discussion of the mechanisms of critical heat flux and a presentation of the empirical equations. We shall open this review with a discussion of Tong's treatment of the mechanisms of critical heat flux then turn to a discussion of the empirical equations used for design.

The great mass of CHF data and theory have been broken down into a small number of distinct mechanisms and these discussed from the point of view of the limiting process leading to CHF. The choice of mechanisms which Dr. Tong has made in order to describe the field is excellent. Neither too much detail nor unnecessary empiricism is included in the