The chapter contains basic information necessary for experiments on heat transfer at boiling liquid metals.

Chapter II is devoted to boiling heat transfer of alkali metals and also to the analysis of experimental data on boiling heat transfer for mercury and amalgams.

There are presented summary tables on experimental results reported in literature on boiling heat transfer for the heat-transfer agents, mentioned above including the pressure and heat flux ranges, characteristics of the working sections and empirical formulae for heat transfer.

The chapter reports in detail the experimental results of the authors in boiling heat transfer for sodium, potassium and cesium over a flat horizontal disc, 38 mm dia., heated by electron bombardment. The heat fluxes ranged approximately from 10^5 kcal/m^{2}h to critical heat fluxes.

Three heat release regions are considered for vaporization under natural convection: heat release due to convection with the subsequent removal of heat by evaporation from free surface; developed boiling heat release; heat release at transition boiling which is most characteristic for boiling alkali metals over a wide range of pressures and heat fluxes. There are analysed the following factors which determine the existence of this or that heat release region: heat flux and pressure, material and finish of the heat transfer surface, the contact time with heat-transfer fluid and presence of inert gas.

Experimental results on developed boiling heat transfer for alkali metals are compared with the known generalized relationships for prediction of coefficients for boiling heat transfer of non-metallic liquids. Predictions by these formulae, in general, do not agree with experimental data on boiling alkali metals.

The authors recommend two generalized relationships satisfactorily describing experimental data on heat transfer in developed boiling of sodium, potassium and cesium in certain ranges of reduced pressures.

Chapter III is given over to experimental results of the authors on critical heat fluxes in boiling sodium, potassium and cesium over a horizontal disc, 38 mm dia. The experiments are run at reduced pressures of $4 . 10^{-5}$–$3 . 10^{-2}$, i.e. at those which may be of use in modern technique. The appropriate graphs represent scanty available experimental data on critical heat fluxes vs. pressure at boiling sodium, potassium and rubidium over horizontal tubes. A satisfactory agreement with the authors' results for the same heat release region may be found. The authors have investigated critical heat fluxes at steady and transient boiling. Critical heat fluxes for transient boiling involving high values of low-frequency fluctuations of a wall temperature have appeared to be lower than those for steady boiling. Generalized formulae for critical heat fluxes at boiling non-metallic liquids in the case of boiling alkali metals are shown to be not valid. For critical heat fluxes in boiling sodium, potassium, cesium and rubidium at pressures from hundredths of fractions of an atmosphere up to several atmospheres, the formula is suggested

$$q_{kp} = \left[1 + \frac{c}{p_{kp}}\left(\frac{p_H}{p_{kp}}\right)^{-m}\right] B \, . \, r(g\gamma'')^{\frac{1}{2}} \left[\sigma(\gamma' - \gamma'')\right]^{\frac{1}{4}}.$$

This is Kutateladze's formula including a new group suggested by the authors to allow for heat flux removal from the heated liquid surface.

There are presented experimental results for boiling mercury and magnesium amalgams and formulae are given which satisfactorily describe experimental results in the range of pressures investigated.

The last chapter treats some physical aspects of boiling metals. In general, an analysis of local characteristics of boiling liquid metals is done on the basis of works on these characteristics at non-metallic liquid boiling under comparable conditions and scanty available works on metallic boiling.

Some aspects of vapour-bubble growth and the separation frequency are considered for the case of boiling metals and non-metallic liquids. The predicted and experimental values obtained have allowed the authors to conclude that a majority of formulae for prediction of bubble growth rates in boiling non-metallic liquids are not valid for the case of boiling metals, particularly at low pressures.

In the summary for this chapter the main differences are formulated between local boiling characteristics of non-metallic and metallic liquids, which, in their turn, may lead to a difference between integral characteristics.

However, available information is insufficient for a complete description of boiling heat transfer not only of metals but of non-metallic liquids as well.

This book may be considered the first experience in generalization of investigation results on heat transfer of boiling metals under natural convection.

The book is well written and eminently readable. It will be of benefit to many involved in a research of boiling and application of metals and their vapors as heat-transfer agents.

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A. S. Ginevsky, **The Theory on Turbulent Streams and Wakes.** Moscow, Mashinostroenie (1964).

The monograph presents theoretical and experimental results on turbulent jets with constant and variable density. The book contains five chapters.

Chapter I is given over to derivation of turbulent boundary layer equations in differential and integral forms. The errors in semiempirical turbulence theories for similar and non-similar jet flows are estimated; the microstructure of turbulent incompressible jet flows is investigated.

Chapter II treats approximate integration methods on calculation of plane and axisymmetric submerged jets and also of jets and wakes in a cocurrent flow. Herein is presented an approximate theory of a transient jet region and is given the calculational method on non-vortex flow for turbulent jets issuing into finite and non-finite space.

Chapter III compres exact solutions for similar laminar jet flows and numerical solutions for the corresponding non-similar flows with approximate solutions, obtained in Chapter II. The results are confronted with the experimental data, and the experimental constant entering into the predicting formulae is determined.

Chapter IV is devoted to the theoretical and experimental research of some complicated turbulent jet flows such as cocurrent streams and wakes with a longitudinal pressure gradient, radial slotted converging and diverging streams and those in a counter-flow.

In Chapter V the approximate integral methods, discussed in the previous chapters, are used for the solution of problems on propagation of turbulent nonisothermal gas jet flows of a variable composition. The solution is presented for turbulent gas jets of variable composition for two cases: (1) when the turbulent and diffusional Prandtl numbers are equal to unity and (2) when they are equal to each other, but differ from unity.

In the monograph the results of new works of the author and his co-workers are reported, the available data of the theoretical and experimental investigations of turbulent jet flows are also summarized. By the integral methods, the author from a general standpoint manages to solve a wide range of problems on isothermal and nonisothermal streams of incompressible liquids and gases, both known and still having no satisfactory solution. For most solutions numerical results are obtained which are given in the form of graphs and tables. For some problems just tentative solutions are presented and only the initial prediction formulae are suggested. As a whole, the integral methods on prediction of turbulent jets and wakes considered in the monograph represent a general procedure for a solution of basic problems, arising when investigating various jet flows. The results obtained together with those from other works in the same field are of use for practical calculations of turbulent jets and wakes. The book contains an extensive list of 264 references.

The monograph may be recommended for research workers and engineers engaged in aerodynamics.

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Proceedings of the 1970 Heat Transfer and Fluid Mechanics Institute (Edited by T. SARPKAYA). Stanford University Press, Stanford, California, 1970, 370 pp.

EXCEPT for the necessary changes in names and titles, the review of the 1968 Proceedings of this Institute by P. Bradshaw (*Int. J. Heat Mass Transfer* **12**, 981, 1969) applies as well to the current volume, particularly as he remarked it to be "simply a collection of research papers covering a rather wider field than one would find in any one journal". The diversity is greater than ever, and it perhaps implies the dilemma of attempting to select papers on the basis of quality at the expense of any unifying theme. In the face of this heterogeneity this review is essentially limited to a citation of the content of the proceedings.

Kearney *et al.* present the effect of free stream turbulence on heat transfer to a strongly accelerated turbulent boundary layer which is in the laminarizing regime; the effects of the laminarization parameters strongly reduce the heat transfer but the free stream turbulence effect is unimportant. Azer considers analytically the ratio of the diffusivities for heat and momentum for flow in an annulus by the use of an eddy model; most of the details are contained in a referenced paper. Liu presents a method for the calculation of simultaneous radiation and conduction in the entrance region of a channel; the theory applies, however, only for constant density and the computed results consider a transparent gas so that the radiation effect enters only through the asymmetric wall temperatures.

McCoy presents experimental results on pool boiling with an oscillatory system pressure and demonstrates interaction when the oscillation is of the magnitude of the bubble release frequency to produce higher fluxes at the same temperature difference. Remenyek considers the streaming of the adjacent fluid by oscillating bubbles and the development of bubbles in oscillating fluids. Abdelmessih measured mean and instantaneous surface temperature with dropwise condensation; the fluctuations of temperature are shown to be high compared to the vapor to average surface differences. Zakkay presents film cooling for a supersonic turbulent boundary layer and indicates greater relative effects than are indicated by the usual predictions for subsonic flow.

Bradley presents integral analyses for turbulent internal flows and shows good results for ducts, pipes, and conical diffusers. Ziemiak applies the finite difference form of the Navier–Stokes equations for two dimensional turbulent flows and illustrates the entrance region of a parallel plate channel; the methods used are of the same nature as those proposed by Spalding's group, essential details relative to the maintenance of iterative stability are not included in the paper. Zelazny considers momentum and mass transfer in co-flowing streams; the turbulent Schmidt Numbers, from 0·6 to 0·8, appear to be higher than expectation for mixing phenomena such as considered. Powell gives a variation of the Patankar and Spalding calculation for turbulent boundary layers, with some modifications of mixing length near the wall to account for blowing at the wall; good results are indicated by comparison to existing data. Mayne uses the same Patankar method for turbulent boundary layers at hypersonic conditions and shows good agreement with measured heat transfer. Ehlers presents an analysis for flow through a cylindrical tube in the slip flow regime and shows agreement with existing results for the pressure distribution.

Reddy presents a new similarity parameter for nonequilibrium nozzle flows. Davy evaluates approximations in the analyses of reacting stagnation boundary layers with injection and demonstrates some agreement with measured wall heating rates. Emanuel uses matched asymptotic expansions to calculate radiative transfer in an optically thick gas between concentric spheres. Finkleman analyzes radiative flows about pointed bodies. Chien analyzes flow in a cylindrical shock tube with radiative energy loss evaluated on a spectral basis and shows agreement with experiment.

Owens presents an analysis for transient heating by periodic electrical dissipation in plates and cylinders. Otterman analyzes for particulate velocity and concentration profiles for the flow of a suspension over a flat plate. Dawson presents a slightly different numerical approximation for the convective terms in the numerical solution of the Navier–Stokes equations; time dependent solutions are given for the flow around a cylinder at low Reynolds num-