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THE RELATION BETWEEN HEAT FLUX AND ACOUSTIC PRESSURE IN LIQUID BOILING

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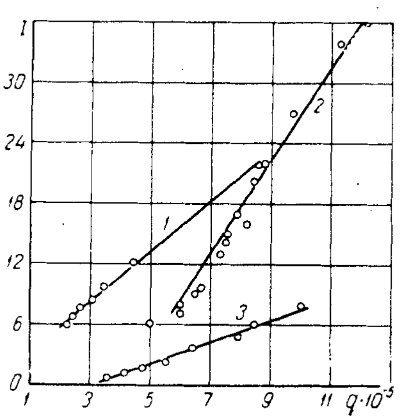
An investigation has been made of the dependence of noise intensity on superheat in local boiling of distilled degassed water and ethyl alcohol. The figure shows graphs of acoustic pressure I as a function of heat flux q for temperature differences $\Delta T = T_2 - T_1$ at various liquid temperatures. It can be seen from the graphs that at a given temperature of the medium T_0 there is a straight line relation between heat flux and noise intensity.



Dependence of acoustic pressure in boiling liquids on heat transfer: 1,2) Water at T_0 = 365° K and 338° K; 3) alcohol at T_0 = 307° K.

Since the heat flux in nucleate boiling is determined by the number of vaporization nuclei [1], it may be assumed that the noise intensity of a boiling liquid in the case T_0 = const also depends on the number of such nuclei. This conclusion agrees with Nesis' hypothesis [2], according to which the sound in boiling is associated with volume fluctuations of the vapor bubbles. The number of bubles emitting sound increases with the number of vaporization nuclei.

A platinum wire of diameter 0.19 mm and length 25 mm was used as the heating surface. The acoustic pressure in boiling was determined by an acoustic detector. The detector voltage was fed to a vacuum-tube voltmeter amplifier and then to a square-law voltmeter.

The wire temperature was measured using a bridge circuit, with a galvanometer of sensitivity 10^{-9} a/div as measuring instrument. The bridge and the heater were simultaneously supplied from a stabilized rectifier. The heat flux was determined using an ammeter and a class 0.5 voltmeter.

NOTATION

T_2 – wire temperature; T_1 – boiling point; T_0 – temperature of surrounding liquid; I – acoustic pressure in millivolts; q – specific heat flux.

REFERENCES

1. S. S. Kutateladze, Fundamentals of the Theory of Heat Transfer [in Russian], Mashgiz, 1962.
2. E. I. Nesis, IFZh, no. 9, 1964.

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A TWO-DIMENSIONAL PROBLEM OF STEADY HEAT CONDUCTION

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Approximate solutions have been obtained [1, 2] and [3] for the problem of steady heat conduction in a semi-infinite block with internal cylindrical heat sources (distributed channels of circular cross section). The authors, however, do not comment on the degree of approximation of the solutions.

The solution [1, 3] for the case when the block is cooled by a system of recessed channels ($t_s > t_0$) has the form