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THE TRANSPORT PROCESS ANALYSIS OF FREE COUNTER CURRENT FLOW BY MEANS OF CTA AND LDA

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The countercurrent jet is the subject of a number of publications which appeared mostly during the recent decade. The reason for interest in counter-current jets is twofold, i.e. the applicability of this type of flow in many practical technologies and the appearance of interesting flow phenomena like absolute instability. The motivation for research in counter-current jets was initiated by the experiment of Strykowski and Niccum [1] and theoretical analysis of Jendoubi and Strykowski [2]. Both these papers revealed the great potential of that way of flow stimulation in terms of an intensification of transport processes. However despite the extensive research performed at ITM by Bogusławski and Asendrych [3] no convincing experimental evidence was found for the existence of this phenomenon in countercurrent jets. That is why, the present study is intended to combine two methods at absolute generation i.e. counter current jet and the density difference, which was found experimentally in heated jets by Monkewitz et al [4] and in helium jets by Kyle and Sreenivasan [5].

The proposed experiment requires the instantaneous measurements of velocity and temperature fields in a non-isothermal flow. These measurement may be performed with the HWA hot wire technique with the use of separate sensors for temperature and velocity and with the LDA laser Doppler anemometry. The main flow parameters of the reported experiment were as follows:

- Reynolds number $Re = U_1D_1/\nu \approx 10000$ and 20000
- aspiration intensity expressed as the ratio of the mean velocities of the reverse flow and main stream $I = U_2/U_1 = 0 \div 0.4$
- overheat expressed as the ratio of the density of the main stream and the reverse flow s = 1, 0.88, 0.7 and 0.5

In Fig. 1 the sketch of the test rig is given. In the experiment with countercurrent jets two regions of special interest were selected, the first one along the symmetry axis of the jet, the line along the edge of the inner jet and the outlet of the inner jet cross section.

The results concerning the influence at suction velocity in outer jet upon the flow characteristic in isothermal jet were presented recently in [6] but the problem of mixing enhancement in non – isothermal jets still needs clarification which is the main motivation for the present study. The article will present accuracy analysis of the experimental results for measurements in non-isothermal counter-current jets.

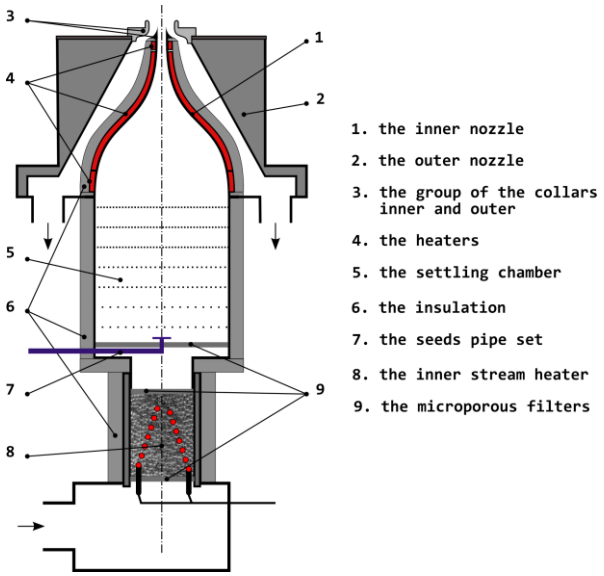

Fig.1. Test rig

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