Using the integral (5.4), we conclude that a flow without a point of inflection of the form (5.1) will be stable in the linear approximation in the norm (4.9) if there exists an inertial coordinate system in which the sign of the velocity is equal to the sign of the second derivative of the velocity along the vertical, and the flow itself is everywhere subsonic (in the sense of fulfillment of the second condition of (4.9) in this coordinate system).

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LITERATURE CITED


EXPERIMENTAL INVESTIGATION OF A TURBULENT JET CARRYING HEAVY PARTICLES OF A DISPERSE PHASE

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The results are given of an experimental investigation of an immersed jet carrying heavy spherical particles in the case of uniform velocity fields of the particles and the gas and uniform concentration of the particles at the nozzle exit. The laser-optical method was used to measure the velocity fields of the gas and the particles and the concentration of the latter in the flow-rate concentration range of the additive from 0 to 1.5 and particle diameters from 35 to 67 μm. It was found that the flow in the jet is essentially nonequilibrium, the disequilibrium and intensity of the mixing in the jet depending on the concentration of the additive and the diameter of the particles. The investigation of the initial section revealed a somewhat anomalous behavior of the jet at a comparatively small (κ₀=0.5) flow-rate concentration of the additive, and this indicates a need to take into account the prehistory of the flow in the construction of a method for calculating the initial section of a two-phase jet.

The creation of a method for calculating jets carrying a heavy disperse phase must be based on the results of "model" experiments that realize the assumptions generally employed in the idealization of jet flow. For a jet carrying heavy particles, such assumptions are uniformity of the velocity fields of the particles and the gas and the concentration of the particles at the nozzle exit, monodispersion and sphericity of the particles, and a given difference between the velocities of the phases at the nozzle exit.

Several experimental studies have been made of turbulent jets with solid or liquid disperse phases. In some of the studies, for example, in [1, 2], the concentration of the disperse phase was so low as to make the phase passive, i.e., to have no influence on either the averaged or the fluctuation characteristics of the jet. These studies yielded some information about the diffusion of such phases in a turbulent jet for different diameters of the particles or drops. The experiments of [3, 4] made it possible to investigate the influence of the concentration and particle diameter on the averaged and fluctuation characteristics of the jet. It should be noted however that the velocity
profiles of the particles and the gas and the concentration of the disperse phase at the nozzle exit in these experiments were essentially nonuniform, and the particles were not spherical.

Below, we give the results of an experimental investigation of the averaged characteristics of a turbulent jet carrying heavy spherical particles (of a material of density 850 kg·m⁻³). An attempt was made to ensure conditions close to "model" experiments. The experiment was made using equipment similar to that described in [3-5] and differing from it by the presence of a special forming device to ensure uniform velocity profiles of the particles and the gas and a uniform concentration of the disperse phase, and also a given difference between the velocities of the phases at the nozzle exit [6]. The experiments were made with effectively monodisperse powders with mean particle diameters of 35, 45, 60, and 67 μm.

In the experiment, the laser-optical method [5, 7] was used to measure the velocity profiles of the particles of the solid phase and the gas and the profiles of the relative concentration of the disperse phase (by the concentration, we understand the ratio of one kilogram of the disperse phase to one kilogram of air) in the transverse sections of the jet at the distances 3, 45, 60, 90, 120, 150, 210, 300, 450, and 600 mm from a nozzle exit of radius r₀ = 15 mm and initial concentrations x₀ of the disperse phase equal to 0, 0.5, 1.0, and 1.5. The velocity of the particles and gas at the nozzle exit was 35 m/sec. As particles used to visualize the motion of the gas phase, we used small amounts of corundum particles with diameter less than 5 μm.

The influence of the concentration of the disperse phase on the jet characteristics was investigated for particles with mean diameter 45 μm. The influence of the particle diameter was investigated at an initial impurity concentration near unity.

Figure 1 shows the profiles of the particle and gas velocities and the concentration of particles of diameter 45 μm at relative distance x/r₀ from the nozzle exit equal to 14, initial concentration x₀=1, and equal velocities of the particles and the gas at the nozzle exit. The continuous curve shows the profile of the relative impurity concentration x/rₘ, where xₘ is the concentration on the jet axis. The points 1, 2, 3 are the velocity profiles of the gas in a pure gas jet, of the gas in the two-phase jet, and of the particles, divided by the corresponding parameters on the jet axis. The distance from the jet axis (y₀) is divided by the nozzle radius r₀. It can be seen from Fig. 1 that the velocity profiles of the particles of the solid phase and the gas differ.

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