VISUALIZATION OF FLOWS ON THE TRAJECTORIES OF CONTROLLED THROWING OF BODIES FROM BALLISTIC SYSTEMS

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Visualization method(s): shadowgraph, holographic interferometry
Other keywords: stabilizer, detachable flow, numerical analysis

ABSTRACT**:** Researching of flow of bodies of revolution with and without aerodynamic attachments by a supersonic current is a topical problem of aerodynamics and impact ballistics ([1], [2]). Throwing of cylindrical bodies of different lengths was carried out from powder and light-gas ballistic systems of different caliber with the speed of flight up to the Mach number $M_\infty \le 10$ with the help of special detachable drivers. For visualization of gas-dynamic flows shadow spark pictures and a five-angle holographic interferometer on the basis of the laser OGM-20 were used (fig. 1).

The numerical analysis of flow peculiarities was made using the method based on the Euler-Lagrange equation ([3]). Flow parameters were found by means of ascertainment, i.e. multiple repetition of the steps by time until flow parameters reached quasi-stationary value. The calculation for cylindrical bodies was carried out with stabilizers in the form of flat and dished discs. Numerical calculations allowed getting a more detailed picture of the flow in the zone of detachment in front of circular stabilizers. Particularly, it was discovered that in front of the dished-disc stabilizer there was deeper underpressure and a larger zone of turbulent flows than in front of the flat disc.

The research of visualization of detachable flows in the zone of disc stabilizers conducted experimentally and by calculation showed that the change of the disc form may result in finding a more aerodynamically beneficial configuration of the detachment zone and guarantee stabilization of lengthy cylindrical bodies along the trajectory and further regular functioning of the construction near the target. Visualization of flows when throwing a set of bodies allowed working out a method of controlled throwing of different bodies and ensuring their distribution in space in a necessary mode. The research is done thanks to the Russian Foundation for Basic Research (Project 11-08-98062).

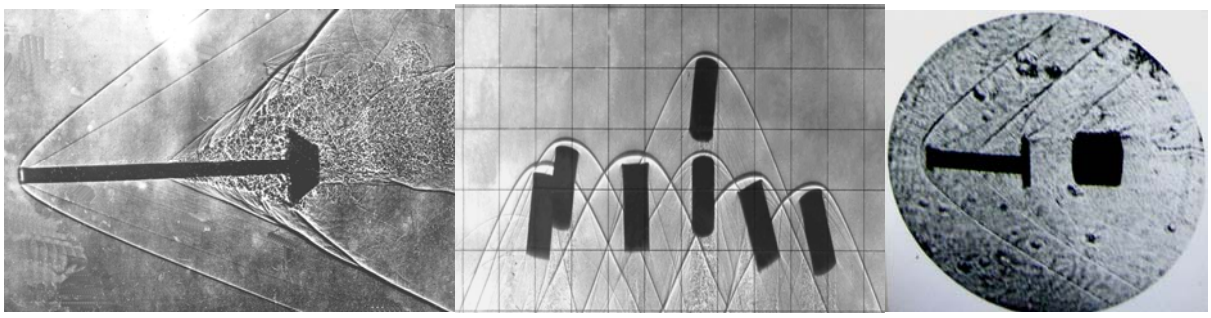

Fig.1 Shadowgraph shots of the flow of the cylinder (length 25 diameters) with a dished stabilizer where $M_\infty = 3{,}0$ (left) and a set of cylindrical bodies where $M_\infty = 3{,}3$ (centre), shadow-angle picture of the flow of the cylinder (length 6 diameters) with a flat stabilizer and a hitting disc where $M_\infty = 2{,}0$ (right)

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