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GAS FLOW CONTROL IN ROCKET ENGINES

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In the new conditions of application of launch vehicle boosters, space tugs, etc., modern rocket engines often do not satisfy the current stringent requirements. This calls for fundamental research into processes in rocket engines for improving their efficiency. In this regard, for the past 5 years, the Department of Thermogas Dynamics of Power Plants of the Institute of Technical Mechanics of the National Academy of Sciences of Ukraine and the State Space Agency of Ukraine has conducted research on gas flow control in rocket engines to improve their efficiency and functionality.

Mechanisms of flow perturbation in the nozzle of a rocket engine by liquid injection and a solid obstacle were investigated. A mathematical model of supersonic flow perturbation by local liquid injection was refined, and new solutions for increasing the energy release rate of the liquid were developed. A numerical simulation of a gas flow perturbed by a solid obstacle in the nozzle of a rocket engine made it possible to verify the known (mostly experimental) results and to reveal new perturbation features. In particular, a significant increase in the efficiency of flow perturbation by an obstacle in the transonic region was shown up, and some dependences involving the distribution of the perturbed pressure on the nozzle wall, which had been considered universal, were refined.

The possibility of increasing the efficiency of use of the generator gas picked downstream of the turbine of a liquid-propellant rocket engine was investigated, and the advantages of a new scheme of gas injection into the supersonic part of the nozzle, which provides both nozzle wall cooling by the generator gas and the production of lateral control forces, were substantiated.

A new concept of rocket engine thrust vector control was developed: a combination of a mechanical and a gas-dynamic system. It was shown that such a thrust vector control system allows one to increase the efficiency and reliability of the space rocket stage flight control system. A new liquid-propellant rocket engine scheme was developed to control both the thrust amount and the thrust vector direction in all planes of rocket stage flight stabilization.

New approaches to the process organization in auxiliary elements of rocket engines on the basis of detonation propellant combustion were developed to increase the rocket engine performance.

A model of gas-jet bulk grinding and an automatic mill loading control system were developed.

Keywords: *rocket engine, thrust vector control system, nozzle flow perturbation mechanisms, gas-dynamic system, combined control system*

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