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GAS FLOW CONTROL IN A ROCKET ENGINE

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This paper presents the main results of the investigations conducted at the Department of Power Plant Thermogas Dynamics of the Institute of Technical Mechanics of the National Academy of Sciences of Ukraine and the State Space Agency of Ukraine over the past five years with the aim to solve some problems involving rocket engine gas flow control. The stability and controllability of a Cyclone-4-type rocket space stage with a large variable mass asymmetry were studied. It was shown that combined thrust vector controls that include a mechanical and a gas-dynamic system make it possible to enlarge the space stage stability region, to improve the controllability characteristics and the reliability of the space stage control system as a whole, to solve the problem of active damping of stage structure lateral vibrations, and to significantly simplify the ground tryout of the engine (with a large nozzle divergence ratio).

A bifunctional system of rocket engine thrust vector control was developed. The system separately counteracts the static and dynamic components of disturbing actions on the control object (rocket stage) and provides its motion stability. The mechanical part of the system may be based on the rotation of the engine or thrust-producing parts thereof, and its gas-dynamic part may be based on disturbing the supersonic flow in the engine nozzle with obstacles of various types mounted on the inside wall of the nozzle. Different designs of the gas-dynamic part were substantiated and patented, thus allowing one to choose the optimum alternative at the design stage of a rocket engine thrust vector control system. The new concept of rocket engine thrust vector control was shown to be applicable to different launch vehicle stages, both liquid-propellant and solid-propellant ones.

Keywords: *rocket engine; thrust vector control system; mechanical system; gas-dynamic system; bifunctional system; new concept of thrust vector control system.*

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