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METHODS OF INCREASING THE EFFICIENCY OF A DETONATION JET ENGINE RUNNING ON ENVIRONMENTALLY FRIENDLY FUEL.

Abstract

A fundamentally new direction in the development of rocket and space engine building is the development and testing of engines operating on the detonation principle of energy conversion of the working fluid. The use of detonation fuel combustion simplifies the design of the engine by simplifying the fuel supply system, increasing the thermodynamic cycle and obtaining higher fuel efficiency. Aware of the energy crisis and environmental problems, this paper investigates the use of environmentally friendly fuels in the mode of detonation combustion, which will increase productivity and thermodynamic efficiency of fuel combustion.

The aim of the study is to solve the problem of structural synthesis in terms of choosing the composition of the main subsystems and elements, development of the scheme, design of the combustion chamber of a detonation jet engine, development of methods for assessing the main characteristics of a detonation jet engine at the design stage. To solve this problem, we used expert analysis using computer-based testing methods ANSYS and COMSOL Multiphysics.

The results of research show that detonation combustion of environmental fuels requires higher initial mass flows and temperatures, pre-initiation of fuel ignition before the arrival of the detonation wave requires special conditions in relation to the stabilization mechanism of the detonation of the limit cycle. The dependences of the speed of the pressed detonation wave on the distance to the initiation point are obtained. The dependence of the size of the detonation cell in a cylindrical damping wave on the value of its velocity is established. A study evaluating the dynamic response of the injector and turbulent mixing medium to demonstrate the importance of ignition delay with respect to these other mechanisms. The conducted experiments confirm the correctness of the important technical decisions and confirm the increase in the efficiency of the thermodynamic cycle as a whole by 20-30 % in comparison with the existing analogues in deflagmentation combustion.

This area is promising and requires the creation of a specialized laboratory to work with alternative fuels and fire test stands, for the rapid implementation of these achievements in the space industry.