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ОПРЕДЕЛЕНИЕ ПАРАМЕТРОВ ГАЗОЖИДКОСТНЫХ СТРУКТУР, ФОРМИРУЮЩИХСЯ В КОМПОНЕНТАХ ТОПЛИВА ПРИ ЗАПУСКЕ МАРШЕВОГО ДВИГАТЕЛЯ КОСМИЧЕСКОЙ СТУПЕНИ С МАЛЫМИ УРОВНЯМИ ЗАПОЛНЕНИЯ ЕЕ БАКОВ

DETERMINATION OF PARAMETERS OF GAS AND FLUID STRUCTURES FORMING IN PROPELLANT COMPONENTS IN STARTING THE CRUISE ENGINE OF SPACE STAGE WITH LOW FILLING ITS TANKS

The scientific and methodical support for the determination of the motion parameters of the liquid-propellant components in the tanks of the launch vehicle space stage when starting its cruise liquid rocket engine (LRE) under microgravity conditions and low filling its tanks has been developed. The urgency of the problem is due to the possibility of forming significant hydrodynamic "failures" at the interface of phases of "propellant component and the pressurization gas" in starting the LRE and the penetration of the fuel-tank pressurization gas into the LRE entrance in volumes, which may well be intolerable from the point of view of the starting stability. The proposed software is based on the finite element method and the method of the liquid volume as well as the Computer-Aided Engineering technology (CAE systems). Taking into account the structural features of the intratank space, the software allows the determination of the forms, geometric characteristics and the motion parameters of the free liquid surface under dynamic loading the space stage by the operating actuating devices of the attitude control/stabilization system in the passive flight; the identification of the starting regimes accompanied by the penetration of the pressurization gas in the LRE fuel lines; the evaluation of parameters of emerging free gas inclusions and their influences on the stability of the engine start; the determination of the minimum volume of the fuel components in the tanks of the stage, which provides their maximum use in "normal" operation of propulsion of the space stage during its flight with multiple starts of the cruise LRE. The proposed software creates the prerequisites for reducing experimental testing of upgraded and newly created space launch vehicle stages and cutting the costs of these works.

Keywords: space stage, propellant tank, propellant component, level of filling, cruise, microgravitation, free gas inclusions.

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