SPACE PROPULSION SYMPOSIUM (C4)
Propulsion Systems II (2)

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ROCKET PROPULSION USING UNITARY PASTE-LIKE PROPELLANT. DESIGNS FOR USING IN COMPOSITION OF PLANETARY LANDING UNITS AND UPPER STAGES OF LAUNCH VEHICLES

Abstract

Currently the strong interest of advanced space companies is increased to rocket propulsion plants (RPP) which capable to regulate a value of consumption and thrust characteristics on-the-fly and deeply, and also to be restarting many times. On the contemporary level of development of rocket-space technique there are heightened requirements in particular to simplification of propulsion design, rise of reliability and accuracy for bringing to an adjusted orbit of payloads, improvement of mass-power and ballistic efficiency, improvement of operational kinds. The indicated requirements in full measure are treated to main and manoeuvre propulsion plants for upper stages of LVs like European VEGA or Ukrainian MAYAK, space boost units and landing units for the Moon and Mars. The most part of above requirements the rocket propulsion using unitary paste-like propellant (PlP) allow implement. The Paste-like Propellant Rocket Propulsion (PPRP) works with forced supply of the unitary PlP to combustion chamber. The PPRP absorbed into itself advantages of Solid Rocket Motors (design simplicity, high reliability) and Liquid Rocket Motors (deep throttling, multi restarting). It was considered a number of design schemes for the PPRP for upper stages of LVs, space tugs and boosters and planetary landing units. Also it was considered two principally different schemes for thrust vector control for a RPP: rolling of nozzle unit in bracket like elastic hinge and blowing of gas into extra critical area of stationary nozzle, at that, for the blowing it is being used not high temperature chamber gas, and mid temperature gas from displacing gas-generator. The last scheme of the RPP allows control a spacecraft in all three plates. Upon all design schemes the calculations were conducted. The got characteristics of two built and tested PlP Rocket Motors with different thrusts were compared with prototypes of RPP for VEGA and MAYAK LVs. The comparison demonstrated definite advantages of proposed PPRP. The specialists of Laboratory evaluated the use of planetary landing deeply throttling PlP Rocket Motor Plants. The plants allow provide effective breaking during the landing on the Moon or in atmosphere of Mars, carry out hang and horizontal flight of a spacecraft over planet surface to select an acceptable landing area and essentially soft landing to the surface. Thus the conducted ballistic calculations of using of the PPRP for Mars mission gave better mass efficiency in comparison with parachute breaking system and providing of reliable soft landing.