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CASELESS THROTTLEABLE SOLID MOTOR FOR SMALL SPACECRAFT

Abstract

Equipping small spacecraft with propulsions will expand considerably their applications including orbital maneuvers and interplanetary flights. The problems associating with the propulsions designed for micro and nano class spacecraft are high mass fraction of the propulsion structure and hazardous propellant, liquid or solid.

To resolve the problems, we are developing a concept of the solid propulsion consisting of a propellant rod and a tip unit including a vaporizer, combustion chamber, nozzle and electric heater to restart. The propellant rod is formed with separated fuel and oxidizer (polymeric pipe filled with solid oxidizer) to mitigate the danger of handling. The rod is fed into the tip unit by means of a light mechanism like a gearbox. As the combustion pressure is bigger than feed pressure, a set of valves ensures pulse combustion to feed the rod between the pulses. No case is necessary to contain the propellant rod. By the way the propellant feed system is free of mass penalties caused by pressurized vessels or turbopumps.

Previously we found out experimentally a strong dependence of the solid propellant feed rate on the feed pressure, which can be used as a way to throttle such an engine.

Now to simplify laboratory testing, we apply gasiform oxygen additionally to solid oxidizer or instead of it to support combustion and get pulsations.

The paper presents very recent results of our test firings and parametrical assessment of the caseless solid motor.