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A PORTABLE LAUNCH VEHICLE OF A PICO SATELLITE

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ABSTRACT

The launch cost of a launch vehicle (LV) associates with its initial mass: the lesser cost corresponds to the lesser mass. For present-day LVs an initial mass of 10^2t (10^3kg-payload) corresponds to \$$10^2$M of total launch cost while according to the best modern projects an initial mass of 10^3kg (10^1kg-payload) could correspond to \$$10^3$K of total launch cost. The use of small LVs and spacecraft instead of big ones can therefore be considered as a promising way to reduce launch expenses taking into account high performances of modern and prospective small spacecraft.

However, this way has a limited application and does not cover the task of orbiting a several-kilogram-payload which becomes unresolved by means of a modern technology rocket with an initial mass of 10^2kg and a launch cost of \$$10^2$K. Generally, using state-of-the-art technologies, it seems scarcely possible to design a LV with an initial mass lesser than 1t and correspondingly with a launch cost lesser than \$1M because a scale effect leads to an unacceptably high structure mass fraction.

To resolve the problem, a portable inertial-pulse autophage (PIPA) LV concept is proposed. Here the autophage principle means using the LV structure as propellant; the inertial feed needs no pumps or pressure feed devices; the pulse mode of the LV engine ensures high combustion pressure and therefore high specific impulse. A combination of these design principles together with relatively high initial g-load, 10...20, makes theoretically possible an unusually light, small and cheap portable LV with an initial mass of 20…30kg, a length of 1…1.5m and a launch cost of \$$10^1$K capable of orbiting 50…100g-payload into LEO.

Such a PIPA LV can be launched from a portable tube for educational and scientific purposes. Another prospective task for the PIPA LV is space debris mitigation by means of attaching electric cables to the debris to reentry them by means of electrodynamic force. One more application of the PIPA LV is an emergency communication in a case when conventional lines are destroyed. For example, an international monitoring mission team operating in an area of a natural disaster can launch satellites or reentry containers to contact a central office. Such a method does not need a use of preliminarily launched satellites and therefore seems more fast and safe.

A conceptual design of the PIPA LV and some experimental investigations of a lab-scale model of its engine are considered in the paper.