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AN IMPROVED PISTON PRESSURANT SYSTEM FOR SPACECRAFT BIPROPELLANT TANKS

Abstract

In this paper, we present a refined version of a piston pressurant system, which uses a mechanical actuator to positively expel fluids from propellant tanks. This refinement addresses the fabrication method and material having previously demonstrated the concept's technical feasibility.

Conventional pressurant systems inject high-pressure, inert gas into propellant tanks to maintain and expel fluid. With this method, it is difficult to predict exactly how much propellant remains, the amount of inert gas required, and the dynamic behavior of the propellant. Piston pressurant mechanisms were originally developed in the 1960's but never integrated into systems due to a lack of suitable materials and fabrication techniques. These prototypes also only pressurized a single propellant, rather than two as does the current prototype.

The new approach improves upon the previous piston pressurant system by implementing precise manufacturing methods with improved materials for both the device and seals. Additional data were collected demonstrating the predictability and precision of propellant expulsion.

Successful implementation of this technology will benefit in-space propulsion systems where the control of fluid is difficult, and where the precision and predictability of propellant flow are crucial. The technology presented in this paper provides a valuable alternative to conventional pressurant systems which are disadvantaged in microgravity environments. As a result, the new technology offers a solution which is lower risk due to its simplicity.