

**Steel Primer Chamber Assemblies for Dual Initiated Pyrovalves**

NASA’s Jet Propulsion Laboratory, Pasadena, California

A solution was developed to mitigate the potential risk of ignition failures and burn-through in aluminum primer chamber assemblies on pyrovalves. This was accomplished by changing the assembly material from aluminum to steel, and reconfiguration of flame channels to provide more direct paths from initiators to boosters. With the geometric configuration of the channels changed, energy is more efficiently transferred from the initiators to the boosters. With the alloy change to steel, the initiator flame channels do not erode upon firing, eliminating the possibility of burn-through. Flight qualification tests have been successfully passed.

This work was done by Carl S. Guernsey and Masashi M. Iizukami of Caltech, Zac Zenz of Conax Florida Corp., and Adam A. Pender of Lockheed Martin Corp. for NASA’s Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov. NPO-46302

**Voice Coil Percussive Mechanism Concept for Hammer Drill**

NASA’s Jet Propulsion Laboratory, Pasadena, California

A hammer drill design of a voice coil linear actuator, spring, linear bearings, and a hammer head was proposed. The voice coil actuator moves the hammer head to produce impact to the end of the drill bit. The spring is used to store energy on the retraction and to capture the rebound energy after each impact for use in the next impact. The maximum actuator stroke is 20 mm with the hammer mass being 200 grams. This unit can create impact energy of 0.4 J with 0.8 J being the maximum.

This mechanism is less complex than previous devices meant for the same task, so it has less mass and less volume. Its impact rate and energy are easily tunable without changing major hardware components. The drill can be driven by two half-bridges. Heat is removed from the voice coil via CO₂ conduction.

This work was done by Avi Okon of Caltech for NASA’s Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov. NPO-45712

**Inherently Ducted Propfans and Bi-Props**

Noise would be reduced without the weight and other disadvantages of shrouds.

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The terms “inherently ducted propfan” (IDP) and “inherently ducted bi-prop” (IDBP) denote members of a proposed class of propfan engines that would be quieter and would weigh less than do other propfan engines that generate equal amounts of thrust. The designs of these engines would be based on novel combinations of previously established aerodynamic-design concepts, including those of counter-rotating propfans, swept-back and swept-forward fixed wings, and ducted propfans.

Henceforth, noise-reducing propfan designs have provided for installation of shrouds around the blades. A single propeller surrounded by such a shroud is denoted an advanced ducted propeller (ADP); a pair of counter-rotating propellers surrounded by such a shroud is denoted a counter-rotating integrated shrouded propeller (CRISP). In addition to adding weight, the shrouds endanger additional undesired rotor/stator interactions and cascade effects, and contribute to susceptibility to choking.

An IDP or IDBP would offer some shielding against outward propagation of noise, similar to shielding by a shroud, but without the weight and other undesired effects associated with shrouds. An IDP would include a pair of counter-rotating propellers. The
blades of the upstream propeller would be swept back, while those of the downstream propeller would be swept forward (see figure). The downstream blades would have a geometric twist such that their forward-swept tips could act as winglets extending over the tips of the upstream blades. In principle, the resulting periodic coverage of the upstream-blade tips by the downstream-blade tips would suppress outward propagation of noise, as though a short noise-shielding duct were present. Furthermore, it is anticipated that an IDP would be less susceptible to some of the operational limitations of a CRISP during asymmetric flow conditions or reverse thrust operation.

An IDBP would be based on the same principles as those of an IDP, except for one major difference: In an IDBP, to enhance structural integrity, pairs of the blades of the downstream propeller would be connected by the winglets. This arrangement is particularly suitable for high solidity installations and can reduce overall weight and drag as compared to a rotating shroud concept.

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An IDP Would Be a Counter-Rotating Propfan with scimitar type blade design. The propellers could be located forward or aft, relative to the wing.