Reverse Application of a Coaxial Free Piston Stirling Engine for Space Applications

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Owing to their advantages of high overall thermal efficiency, fuel flexibility, low noise, vibration and low emissions, Stirling engines, especially dynamic Stirling engines (i.e., free-piston Stirling engines, FPSEs) are promising candidates for space power applications. It has a high efficiency and can achieve that efficiency at low engine temperature ratios. Low temperature ratios and high efficiencies allow power system operation at high cold-end temperatures. Free-piston Stirling engines can be designed to very low power levels. The space power Stirling converter can be designed to operate at a fixed power output. As other options are considered, the Stirling engine can be designed to load follow. The approach would be to add a small displacer drive linear motor, which would control the displacer stroke, thereby modulating the power output. The selection of free-piston Stirling power conversion systems offers the system designer great flexibility in the overall system integration. Proper system trade-offs must be made to optimize overall system mass using a free-piston Stirling engine. The free-piston Stirling machine has been used as either thermal engine, cryocooler, or heat pump, due to its compact structure, high efficiency, and reliability. A compact engine-refrigerator dual-functional coaxial free-piston Stirling engine can be designed. As a refrigerator or cryocooler, it is normally driven by a linear motor and operating with dynamic noncontact gap seal technology. The compressor piston and the displacer (moving parts) are fully non contacting with the cylinder. Free-piston Stirling cryocoolers (FPSC) have been widely used in aerospace applications. Design of the stirling unit is done with a target cooling power of 100 W. Design and analysis are done with sage6.0. Fluid flow medium is studied with Ansys.