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Carbon-Carbon Recuperators in Closed-Brayton-Cycle Space Power Systems

Barrett, Michael J.; Johnson, Paul K.; [2006]; 13 pp.; In English; 2nd International Energy Conversion Engineering Conference (IECED), 16-19 Aug. 2004, Providence, RI, USA

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The use of carbon-carbon (C-C) recuperators in closed-Brayton-cycle space power conversion systems was assessed. Recuperator performance was forecast based on notional thermodynamic cycle state values for planetary missions. Resulting thermal performance, mass and volume for plate-fin C-C recuperators were estimated and quantitatively compared with values for conventional offset-strip-fin metallic designs. Mass savings of 40-55% were projected for C-C recuperators with effectiveness greater than 0.9 and thermal loads from 25-1400 kWt. The smaller thermal loads corresponded with lower mass savings; however, at least 50% savings were forecast for all loads above 300 kWt. System-related material challenges and compatibility issues were also discussed.

Author

Brayton Cycle; Regenerators; Closed Cycles; Carbon; Spacecraft Power Supplies; Thermodynamic Cycles; Satellite Solar Energy Conversion

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An Implanted, Stimulated Muscle Powered Piezoelectric Generator

Lewandowski, Beth; Gustafson, Kenneth; Kilgore, Kevin; [2007]; 24 pp.; In English; University of Texas Workshop on Piezoelectric Energy Harvesting, 30-31 Jan. 2007, Arlington, TX, USA; Original contains color illustrations

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A totally implantable piezoelectric generator system able to harness power from electrically activated muscle could be used to augment the power systems of implanted medical devices, such as neural prostheses, by reducing the number of battery replacement surgeries or by allowing periods of untethered functionality. The features of our generator design are no moving parts and the use of a portion of the generated power for system operation and regulation. A software model of the system has been developed and simulations have been performed to predict the output power as the system parameters were varied within their constraints. Mechanical forces that mimic muscle forces have been experimentally applied to a piezoelectric generator to verify the accuracy of the simulations and to explore losses due to mechanical coupling. Depending on the selection of system parameters, software simulations predict that this generator concept can generate up to approximately 700 W of power, which is greater than the power necessary to drive the generator, conservatively estimated to be 50 W. These results suggest that this concept has the potential to be an implantable, self-replenishing power source and further investigation is underway.

Author

Piezoelectricity; Electric Batteries; Implantation; Medical Equipment

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Developmental Considerations on the Free-Piston Stirling Power Convertor for Use in Space

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Free-piston Stirling power conversion has been considered a candidate for radioisotope power systems for space for more than a decade. Prior to the free-piston Stirling architecture, systems were designed with kinematic Stirling engines with rotary alternators to convert heat to electricity. These systems were proposed with lightly loaded linkages to achieve the necessary life. When the free-piston configuration was initially proposed, it was thought to be attractive due to the relatively high conversion efficiency, acceptable mass, and the potential for long life and high reliability. These features have consistently been recognized by teams that have studied technology options for radioisotope power systems. Since free-piston Stirling power conversion was first considered for space power applications, there have been major advances in three general areas of development: demonstration of life and reliability, the success achieved by Stirling cryocoolers in flight, and the overall developmental maturity of the technology for both flight and terrestrial applications. Based on these advances, free-piston Stirling convertors are currently being developed for a number of terrestrial applications. They commonly operate with the power, efficiency, life, and reliability as intended, and much of the development now centers on system integration. This paper