Pure Rotation for Better Design: Developing a Rotary Vane Combustion Engine for Portable Energy Generators

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This project investigates the design and analysis of a rotary vane combustion engine (RVE) for portable generators to reduce engine imbalances, design complexity and increase torque production by eliminating the conversion of reciprocation into rotation. The RVE prototype was designed in Autodesk Fusion 360 and was made as a scaled down 3D-printed demonstration model to validate geometry, kinematics, and cycle behavior. Data and parameters from simulations conducted and from the CAD design were measured, plotted, and compared to the same or corresponding ones from conventional single-cylinder 4-stroke engine. Measured parameters included: maximum intake and compression volumes, compression ratio, degrees of rotation per stroke, full cycle degrees of rotation, theoretical torque event frequency and count and combustion events per one rotation (360°), and relevant simulation data. The maximum intake volume determined was ~60.391cc and a maximum compression volume of ~5.772cc, yielding a compression ratio of ~10.463:1. The RVE completes a full 4-stroke cycle in 360° of rotation, compared to 720° in piston engines and 4 combustion events per revolution versus 1 per 2 revolutions in piston engines. Additionally, its housing geometry allows 90° of compression and 124.6° of combustion, making it operate the Atkinson Cycle, a more optimal combustion cycle, without sacrificing intake; housing geometry also allows the possibility of a diesel engine prototype. These results indicate improved kinematics, improved theoretical torque event frequency and cycle efficiency, reduced reciprocating components, better engine balance, and improved design complexity, supporting the feasibility of a rotary vane engine for portable generator applications.

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