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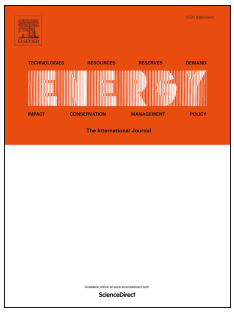

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New polytropic model to predict the performance of Beta and Gamma type Stirling engine

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Abstract

A new Polytropic Stirling Model with Losses (PSML) is proposed to predict performance of Beta or Gamma type Stirling engine. A bypass was added between the compression and expansion volumes and polytropic processes have been considered in these volumes. Shuttle heat exchange and mass leakage in the gap between the displacer and the cylinder have been considered at the same time step. Various losses have been coupled in the model, including regenerator imperfection, heat conduction, fluid viscosity et.al. which interact each other as they are calculated in the same time step.

During the compression and expansion processes, the polytropic number is obtained near the adiabatic number. It was shown that there exists an optimum rotation speed for maximum output power. The output power evolution among different average pressures becomes more important with the rotation speed increasing for both helium and hydrogen as working gas. Increasing engine's average pressure can increase the thermal efficiency, but the increased amplitude decreases with pressure's increasing. Hydrogen is more suitable for high rotation speed engine comparing with helium. An optimum displacer clearance size was determined for a maximum output power. This optimum value increases with the engine pressure increasing.

Key words

Displacer clearance; polytropic; Stirling engine; leakage

Nomenclature