

DESIGN OF A FREE-PISTON STIRLING ENGINE -PUMP

Sutapat Kwankaomeng, Frank J. Fronczak , Norman H.Beachley and Andrew Pritzl

*Fluid Power Lab, Department of Mechanical Engineering – University of Wisconsin-Madison, Madison, Wisconsin, USA
kwankaomeng@wisc.edu, fronczak@engr.wisc.edu, beachley@wisc.edu and abpritzl@students.wisc.edu*

Abstract

A Stirling-cycle, free-piston engine-pump (FPSEP) is being investigated for use in human-scale, fractional horsepower applications. Stirling cycle engines offer potential advantages over internal combustion engines in fuel choice, quietness, and emissions. A free-piston Stirling engine-pump (FPSEP). A design has been developed that combines a free-piston Stirling engine with a check-valve, single-piston hydraulic pump. The engine piston and the pump piston are connected by a rigid rod. The Beta- type Stirling engine utilizes a pneumatic cylinder as an air spring between the displacer and cylinder head. In the proof-of-concept device currently being developed, heat is supplied by an electric heater and cooling by ambient air. The hydraulic pump consists of one single-acting piston and uses a hydropneumatic accumulator to temporarily store the energy generated. The performance and dynamic characteristics of the free- piston Stirling engine-pump have been simulated to determine its operating characteristics over a wide range of conditions. The simulation results indicate that a FPSEP operating at 550 psi (3.8 MPa) working pressure and with an engine displacement of 1.5 in³ (24.8 cm³) can produce 1.8 HP(1.3 kw) when operating at 4400 cycles per minute. A prototype is being built and tested to verify the simulation results.

Keywords: Stirling cycle engine, free-piston engine, free- piston engine-pump, accumulator, air spring
