REFRIGERATION REVIEW

A Novel Piston Expander/Linear Alternator

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Immediate innovation and a comprehensive strategy are needed to meet the energy demands of the United States in the near future. Renewable and clean technologies should figure prominently as a solution to not only rising demand but also concerns about climate change. Our proposed approach is that of a novel piston expander/linear alternator (PELA) for use in low power (<10 kW) applications, such as a waste heat recovery system or a solar organic rankine cycle that converts thermal energy to electrical energy (see Figure 1 below). Our current simulation model shows potential isentropic efficiencies of 80%. One of the major strengths of the expander is the simplicity of design with the reciprocating piston being the sole moving part. High power applications use turbines as the expander and have isentropic efficiencies around 90%, for today's well designed multistage turbines, to 70% for smaller single stage turbines. However, turbines begin to lose their appeal at about 50 kW and are objectionable at 10 kW or less due to a sharp decline in efficiency and high relative cost compared to other expander types. Volumetric type expanders, such as reciprocating piston, scroll machine, vane expander, and screw machine, have been shown to have isentropic efficiencies of ~55-65%. A simulation model has since been developed and shown a potential isentropic efficiency of 80% (see Figure 2 below). Future work will involve constructing a PELA unit based on the findings from the simulation model. An emphasis on the materials used for the device and the electrical output from the linear alternator will be explored.

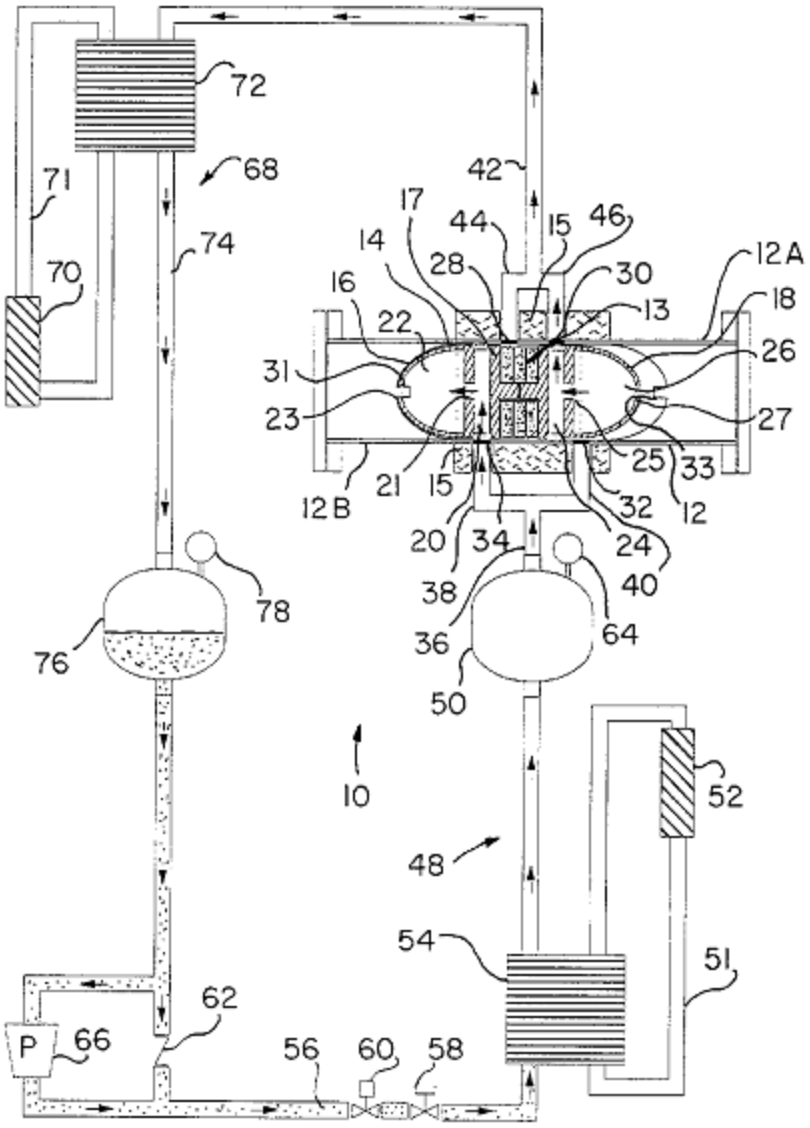

Figure 1 PELA System Diagram
(Patent No. US 6,484,498 B1)

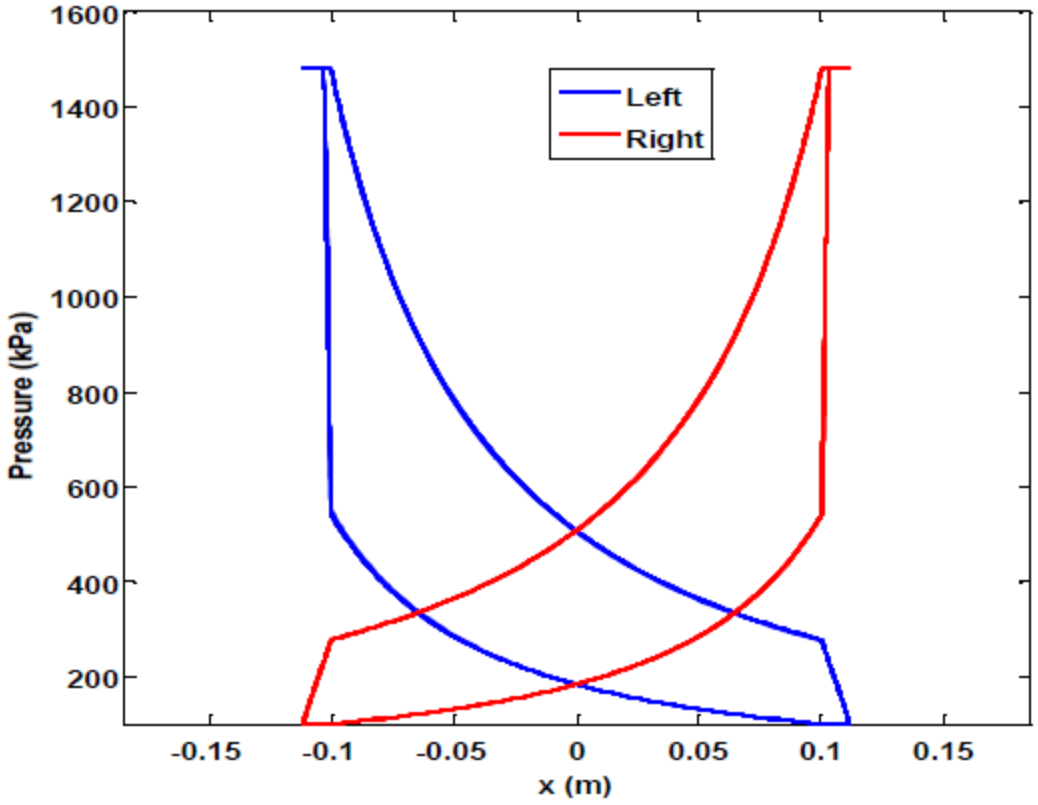

Figure 2 Results from the Simulation Model of the PELA