



Thermomechanical Cycle for Thermal and/or Mechanical Energy Conversion Using Ferroelectric Materials

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BACKGROUND

Rising awareness in sustainable and efficient energy technologies has stimulated efforts in harvesting energy that would otherwise be wasted. The Olsen cycle, performed on pyroelectric materials, utilizes time-dependent temperature oscillations to convert thermal energy directly into electricity. And although it produces large energy densities, the Olsen cycle requires that source material be hotter than its Curie temperature to generate energy. Moreover, its power density is limited by slow thermal relaxation processes.

INNOVATION

UCLA researchers in the Department of Mechanical Engineering have developed a new technology that takes thermal and/or mechanical energy, and converts it directly into electrical energy. This new thermomechanical cycle can harvest what is typically waste heat from internal combustion engines, heat pumps and refrigeration systems. Potential mechanical energy sources include vibrations from roads and various transportation systems. This system improves upon the Olsen cycle in several ways. It can generate energy at lower temperatures, the maximum power output is greater, and the new cycle can yield efficiencies higher than the Olsen cycle.

APPLICATIONS

- ▶ Harvest waste heat energy and convert it to usable electricity.
- ▶ Heat from solar radiation
- ▶ Heat from power cycles (e.g., gas turbines, combustion engines)
- ▶ Heat from refrigeration cycles (e.g., refrigerators, AC units)
- ▶ Heat from heat pumps
- ▶ Harvest mechanical energy and convert it to usable electricity
- ▶ Vibrations from transportation systems and various mechanical systems
- ▶ Waste mechanical energy from moving objects (e.g., cars, trains, elevators, cranes)

ADVANTAGES

By combining heating and mechanical work, this new cycle can

- Directly generate electricity, even at low temperatures
- Achieve greater maximum power output than the Olsen cycle while maintaining high energy density
- Achieve high energy conversion efficiencies

STATE OF DEVELOPMENT

These new cycles have been reduced to practice on pyroelectric single crystals in Professor Pilon’s laboratory.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,170,678	01/01/2019	2013-637

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

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OTHER INFORMATION

KEYWORDS

Thermomechanical, energy

harvesting, Olsen cycle, CleanTech,

waste heat, waste energy

CATEGORIZED AS

- ▶ **Energy**
 - ▶ Other
 - ▶ Solar
- ▶ **Engineering**
 - ▶ Engineering

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