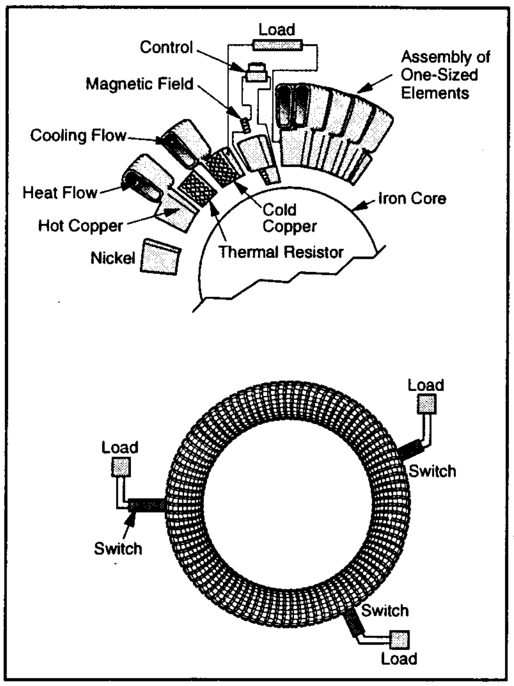
A New Thermoelectric Generator for Rural Electrification

Jon M. Schroeder
The Trymer Company

A new solid-state electric generator can convert almost any available fuel into low-cost electricity. It has promising application in undeveloped countries as well as in North America.



Thermoelectric Generator Mechanism

Introduction

Rural electrification currently requires installing expensive, overhead electric transmission lines. These transmission lines need right-of-way clearing that devastates more vegetation than the area serviced. An alternative--onsite power generation using a motor-driven electric generator--is costly and often beyond the reach of most buyers. These generators also have short lives.

An inexpensive, alternative-energy electrification system is needed in the United States and Canada. A stand-alone, electric power supply would increase productivity and save money in a number of industries, including farming, ranching, and light manufacturing, as well as provide electricity to more isolated areas such as recreational areas. An even larger market for rural electrification exists in less developed parts of the world, where engine-driven generators are the only alternative.

Concept Description

The Trymer Company has developed a portable, solid-state, electric generator based on the thermocouple principle. A specially configured ring of metal plates produces a very high electric-current circulation when it is heated (see the figure). The current store of energy can be tapped to provide a source of ac and dc electric power, and electrical energy can be stored overnight. This generator operates with fuels, such as heat from various wastes, solar, wood, propane, or petroleum. It can produce 5 kW of power, at 120 V, 60 Hz; and its weight of 75 lbs allows portability. There are no moving parts to cause vibration or to make noise.

The thermocouple principle requires the ends of two different metal wires to be twisted together, one terminal heated and the other cooled. This causes current flow in the wires. The magnitude of the current depends on the temperature difference between terminals, the characteristics of the metals, and the electrical resistance of the two wires. Typical power from a thermocouple is one-thousandth the energy needed to power a light bulb.

To improve thermocouple performance, the number of junctions is increased and placed closer together to reduce resistance. Connecting junctions in a loop increases current circulation to a maximum, thereby realizing the highest magnetic field and the highest magnetic energy store. A thermoelectric energy store requires a means of drawing energy from the circulating current store as electricity. This is done using a special Hall switch that converts magnetic energy into conditioned electrical energy as needed.

Economics and Market Potential

Applications of this technology include the transportation field's need for high-energy, low-polluting electric power supplies for automobiles, busses, trains, trucks, tanks, and ships. This technology can be used as a suspension system for high-speed trains and for magnetic suspension of machine elements such as rotating shafts and sliding bearings.

Utility companies can benefit from this technology by generating additional electricity from waste heat sources, with the capability for banking some electrical energy for later use. Related applications will be in the field of magnetic plasma confinement for producing electrical energy from fusion. The technology can also be used for biomolecular refining of pharmaceuticals and for more sensitive, low-cost magnetic resonance imaging (MRI). Wireless, high-energy power transmission for terrestrial and space-based power is possible with this technology. Magnetic sensing, beyond the sensitivity of radar and infrared, is also possible for defense applications and for prospecting and mapping of natural resources.

A key advantage of this concept is that it uses a wide form of common, energy-producing products. These products include hay, grass, coal, animal dung, renewable fuels, and wood byproducts.

Key Experimental Results

Laboratory tests on the generator have achieved densities up to 120,000 amps/in.^{2}, which have been verified independently. Other testing shows that more than 1,000 V can be tapped by the Hall effect using a 1-Tesla, 60-Hz field applied to a junction; output frequencies from 1 Hz to 1 Ghz were achieved. Engineering studies performed at the Pulse Power Directorate at Picatinny Arsenal, New Jersey tested energy densities for specific applications ranging from high-speed train suspension, biomolecular separation, automotive electric power supplies, and ship propulsion. Selected performance data developed with various-sized laboratory models are summarized in the table below.

Future Development Needs

Trymer seeks development partner(s) to prototype and commercialize two types of products: electrical power supplies for the transportation industry and a 60-Hz/600-MWh, diurnal, magnetic energy store for utility grid leveling. The partner should have product development experience and manufacturing and distribution capabilities. The markets for each of these products are projected to be greater than $100 million over the next 5 years.

The 5-kW rural generator is expected to be completed in 1995, and a distributor will be selected to market a family of thermoelectric generators for sale to Third World countries. This type of product is expected to have appeal to a government market, including the Federal Emergency Management Agency and the U.S. Department of Defense. The portable generator can serve as an engine starter or an auxiliary power unit. The primary goal is to supply a unit that sells in the international market for about $500.

For further information, contact

Jon M. Schroeder
The Trymer Company
14301 Bagdad Road
Leander, Tx 78641
Phone: (512) 259-1141
Fax: (512) 259-3833

Compiled by
Pacific Northwest Laboratory for the U.S. Department of Energy, Innovative Concepts Program 590240. This flier was printed on recycled paper.

Performance Data from Testing

Operating Temp.	System Rating		Power		Fuel Consumption	
	Voltage	Amps	kW	HP	MBtu/hr	Gal/h
240°C	6.6	12,000	79	134	0.4	3.1
340°C	8.9	17,000	151	256	0.7	5.3
540°C	14.9	26,000	387	656	1.5	11.7