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Fabrication of Thermoelectric Power Generation from Waste Heat Energy

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Abstract
The need of energy is increasing rapidly, but only few sources are available to produce energy. To produce the energy efficiently from waste heat the thermocouple is used. Here the power generation is simple, as there is a need of temperature difference to produce power. The waste heat energy is being generated from ocean thermals, steam and various forms of waste heat. The trapping of these waste heat energy is converted into electrical energy with the help of thermocouple, which works on the principle of Seebeck effect. The Seebeck effect is a phenomenon in which temperature difference between two dissimilar metal junctions produces a voltage difference. Also boost converter circuit is used to boost up the magnitude of voltage being generated by the module to charge the battery.

I. Introduction

Recently we are depending upon fossil fuels for maximum electricity generation. However, the reserves of fossil fuels will be goes on depleting, since oil & gas are the least sources. Recent years cost of unit electricity has increasing to unpredictable levels due the less supply of oil, gas and coal. Thus the green energies are more attractive artificial to electricity generation, as it will also provide a pollution free and cost less. In this innovative project, we are using one device which is used to be created and introduced by human as a renewable energy that is thermo electric generator equipment to generate electricity. As we know Renewable energies are, solar energy, wind energy, hydro energy, tidal energy, etc. above energies can produce electricity in different forms and way of generating method. There are some disadvantages. Solar cells are the most commonly used in applications such as household industrial.

and spacecraft electrical systems. However, if there is no sun light there will no production of electricity alternative sources are necessary for generating electricity or a method of storing energy for future use. Wind and hydro electric energy have their own drawback making them less power production and insufficient for wider usage. The device by converting heat energy to electrical energy. This thermoelectric generator is suitable power for space research, Satellites and even unmanned facilities. Satellites are settled at the planets that so far from the earth. For example, thermoelectric devices can be used in vehicles to producing electricity using the waste heat of the engine also.

TEG (Thermoelectric generator) is used to convert thermal energy (heat) in to electricity based on "Seebeck effect" directly. Here there is charge movement in the media. Advantages of Thermoelectric power generators are. - Small size and less weight. . - Green Technology. - increase the overall efficiency (5% to 8%). - Alternative power sources of energy. - It require less space and cost compare to other source waste heat to generate the power is to decrease the cost-per-unit of the devices. TEG can be used in , Jet Engine parts, IC Engines parts, Furnace cover, Hot water tubes, Refrigerator Computer/laptop Body heat etc.

PRINCIPLE USED

The basic theory and operation of thermoelectric based systems have been developed for many years. Thermoelectric power generation is based on a phenomenon called "Seebeck effect".

- **SEEBECK EFFECT:-**

When a temperature difference is established between the hot and cold junctions of two dissimilar materials (metals or semiconductors) a voltage is generated, i.e., Seebeck voltage. In fact, this phenomenon is applied to thermocouples that are extensively used for temperature measurements. Based on this Seebeck effect, thermoelectric devices can act as electrical power generators. A schematic diagram of a simple thermoelectric power generator operating based on Seebeck effect is shown in Fig. (1). As shown in Fig. (1), heat is transferred at a rate of QH from a high- temperature heat source maintained at TH to the hot junction, and it is rejected at a rate of QL to a low-temperature sink maintained at TL from the cold junction. Based on Seebeck effect, the heat supplied at the hot junction causes an electric current to flow in the circuit and electrical power is produced. Using the first-law of thermodynamics (energy conservation principle) the difference between QH and QL is electrical power output We . It should be noted that this power cycle intimately resembles the power cycle of a heat engine (Carnot engine), thus in this respect a thermoelectric power generator can be considered as a unique heat engine.

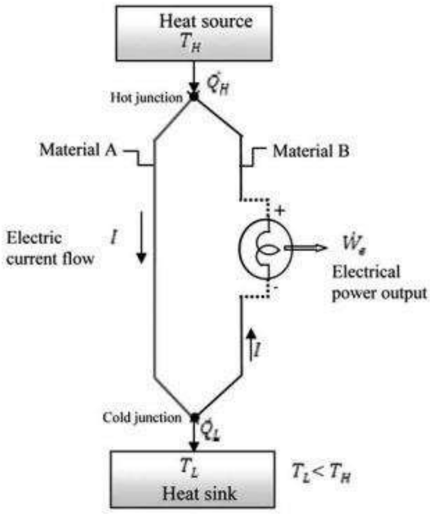

Fig. (1). Schematic diagram showing the basic concept of a simple thermoelectric power generator operating based on Seebeck effect.

Figure 2 shows a schematic diagram illustrating components and arrangement of a conventional single-stage thermoelectric power generator. As shown in Fig. (2), it is composed of two ceramic plates (substrates) that serve as a foundation, providing mechanical integrity, and electrical insulation for n-type (heavily doped to create excess electrons) and p-type (heavily doped to create excess holes) semiconductor thermo-elements.

The ceramic plates are commonly made from alumina (Al2O3), but when large lateral heat transfer is required, materials with higher thermal conductivity (e.g. beryllia and aluminum nitride) are desired. The semiconductor thermo-elements (e.g. silicon-germanium SiGe, lead-telluride PbTe based alloys) that are sandwiched between the ceramic plates are connected thermally in parallel and electrically in series to form a thermoelectric device (module). More than one pair of semiconductors are normally assembled together to form a thermoelectric module and within the module a pair of thermo-elements is called a thermocouple . The junctions connecting the thermo- elements between the hot and cold plates are interconnected using highly conducting metal (e.g. copper) strips as shown in Fig. (2). The sizes of conventional thermoelectric devices vary from 3 mm2 by 4 mm thick to 75 mm2 by 5 mm thick. Most of thermoelectric modules are not larger than 50 mm in length due to mechanical consideration. The height of single stage thermoelectric modules ranges from 1 to 5 mm. The modules contain from 3 to 127 thermocouples . There are multistage thermoelectric devices designed to meet requirements for large temperature differentials

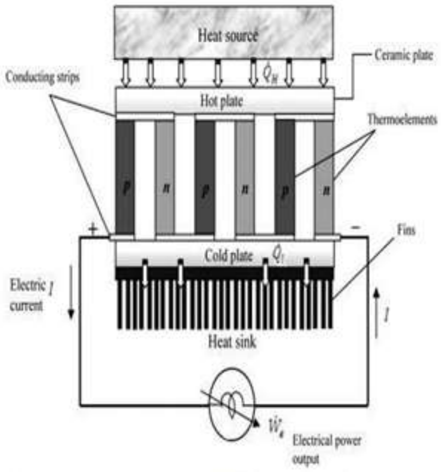

Fig. (2). Schematic diagram showing components and arrangement of a typical single-stage thermoelectric power generator.

WORKING

The heat from the heat source is monitored and measured by a device called thermocouple. This heat from the source is converted to electrical energy of a smaller magnitude ranging from 2V to 3V. This voltage is amplified by using a voltage amplifier, to around 5V. This input voltage from the amplifier is boosted by using a boost converter. The boost converter consists of switched inductor, with MOSFET as a switching device. The MOSFET driver circuit provides high speed switching for the MOSFET in the boost converter. Based upon the switching, the energy is stored in the inductor and is delivered to the battery. A battery of the order of 12V is connected across the boost converter. The variable DC input voltage from the boost converter is used to charge the battery. After the battery is charged, is used to operate the load. The load circuit in this experiment involves the CFL lamps and a fan, which is operated form this single 12 V battery. The performance of the circuit depends on the magnitude of heat at the source.

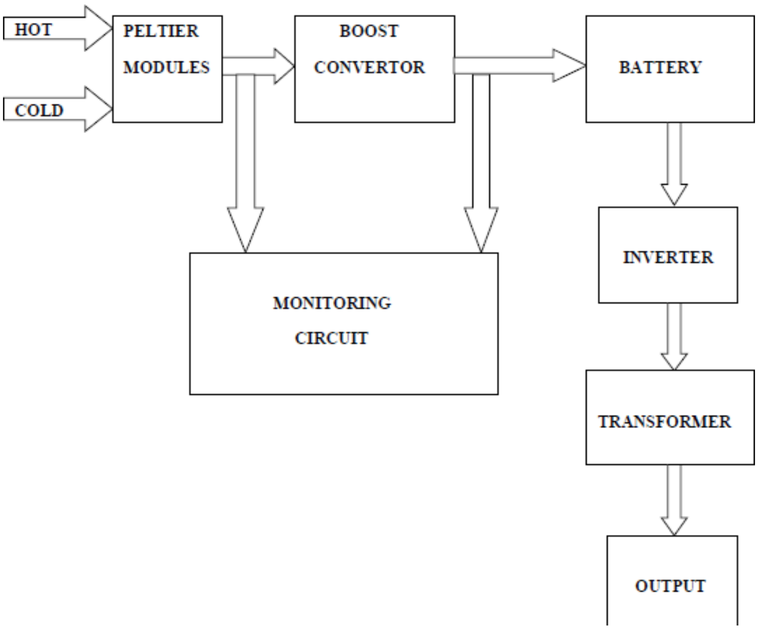

Fig.(3) Block Diagram of the system

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