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Design and Hardware Implementation of Portable Generator using TEG

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Abstract: ***Electrical energy has become a part of all human beings, the claim for electricity has been very high in the current days and hence electricity generated by usual means is not plenty. Nowadays solar, wind and thermal power station are mostly used to generate electricity. But by using this more amount of space can be occupied, fuel cost is increasing day by day, and also power consumption rate is very high in commercial sectors. So avoid these problems by using Thermo Electric power Generator (TEG). It is in the form of peltier coolers and TE generators. TE generator produces electrical energy from waste heat. It works based on principle of SEEBECK effect. It is named after the Baltic German physicist Thomas Johann seebeck. This paper proposed an idea of Design and Hardware implementation of Portable Generator using TEG. Hardware model was implemented and tested.***

Keywords: Power Generator, Thermo Electric power Generator, TEG, Seebeck effect

I. INTRODUCTION

A. Essential requirement of Electricity

Power is one of the major crisis among human beings, because of industrial purpose, domestic requirements etc. Especially in India power demand increases 8% to 9% per year. So in the need of increasing the power generation, the power plant is also increasing day by day. Fuel is also another major crisis in India. Simultaneously rate of power production cost is increased. So, novel source electrical energy is required [1-3].

B. Discovery of the waste thermal energy

Thermal Energy is using for various purpose in various sectors. This thermal energy is not fully utilizing effetely. For example Hotel stove, Heat boiler, automobile engines, solar heat energy (by using Fresnel lens), during Incineration of waste disposals are producing enormous amount thermal energy. This kind of thermal energy is discovering many places in the world [4-7].

II. TEG COMPACT POWER GENERATOR

The proposed system was focused on the Thermoelectric Power Generation by using waste thermal power or solar thermal energy, TEG module, Regulating circuit, Boost convertor, charging circuit, Storage device and cooling device. The formation of Thermoelectric Power Generator is exposed in figure 1. This will provide an up-to-date review of Thermoelectric Power Generator and their benefits to compact power supply [8].

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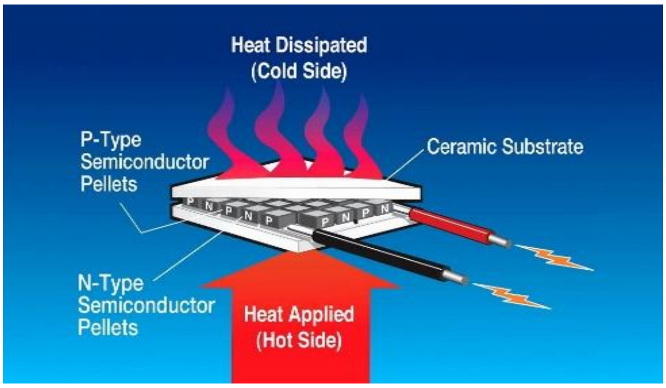


Fig. 1 Structure of Thermoelectric Power Generator

TEG is producing the electrical power from waste thermal energy. That out is given to voltage regulator. This voltage regulator to regulate the input voltage and given the input to dc - dc convertor. That dc - dc convector is boost input voltage and output of the dc convertor is connected in charging circuit for charging the battery [9-10].

A. Seebeck effect

The Seebeck result may be a incident within which a temperature difference between 2 unrelated electrical conductors or semiconductors produces a voltage distinction between the 2 substances. Electricity (Seebeck) Power generation modules (Fig. 2) have an outsized thermal growth (and contraction) through vary of allowable temperatures -60ºC to 300ºC. Electricity (Seebeck devices or TEGs) generators can solely generate electricity if there's a temperature distinction across the module. Meaning that the “cold” facet should be a minimum of colder than the “hot” facet for there to be any power generation. the recent facet is mostly hooked up to a supply of warmth whereas the cold facet is usually connected to a conductor that's air or liquid cooled [11-13].

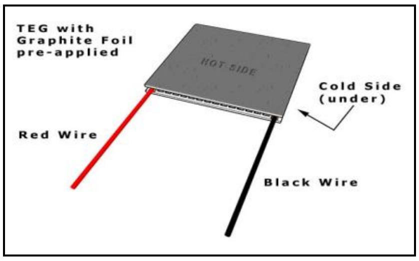


Fig. 2 Thermoelectric Power Generator

The Hot Side of the TEG module can work continuously at a maximum temperature of 300ºC. The TEG's cold side module can work continuously at a maximum temperature of 30-160ºC.The TEG's are most widely used in variety of applications. Especially in automobile engines to produce a waste heat into electricity [14].

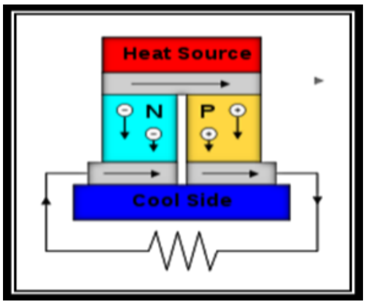


Fig. 3 Circuit of TEG Module

A electricity circuit composed of materials of various Seebeck constant (p-doped and n-doped semiconductors), designed as a electricity generator as shown figure three. If the load resistance at the lowest is replaced with a meter the circuit then functions as a temperature-sensing thermocouple junction. The Seebeck impact is that the conversion of temperature variations directly into electricity. wherever is that the Seebeck constant (also called thermos bottle power), a property of the native material, and is that the gradient in temperature. The Seebeck coefficients usually vary as perform of temperature, and rely powerfully on the composition of the conductor. For normal materials at temperature, the Seebeck constant might home in worth from −100 µV/K to +1,000 µV/K [15-17].

III. PROPOSED DESIGN

Figure 4 give an idea of proposed design. The input heat energy is recovered from heat source of cooking stove or Solar. The heat side of the TEG module is assembled in heat observer aluminium plate. This heat observer plate is transfer the heat to TEG module by conduction method. Opposite side of the TEG module (cold side) is placed on the cooling system.

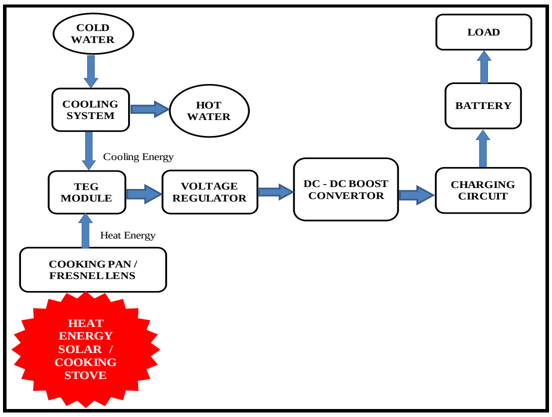


Fig. 4 Block diagram of TEG Portable Generator

In the cooling system has cold water is inlet and hot water outlet. Than the system is use to reducing the heat in the cold side of the TEG by conviction method. Hence the TEG module converts Heat energy to electrical energy. This output supply is connected to voltage regulator. Here Set the voltage deepens on the TEG module. This out is connecting to DC boost convertor it is using to step up voltage and output is connected to charging circuit. The charging circuit is used to charging the battery. Charged electrical energy is used to electrical load.

A. Hardware model

The proposed hardware design model of portable generator using TEG is shown in figure 5. This hardware model contains TEG module, cooling system, booster circuit and storage device.

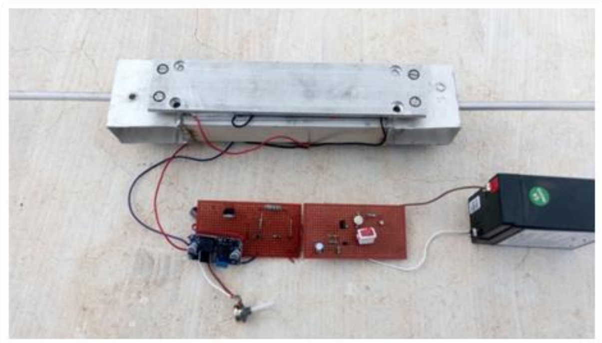


Fig. 5 Hardware design model of TEG Portable Generator

This model is worked based on seebeck effect principle. The power generation in TEG module, it converts into heat source to DC electric power. The DC electric power we are charging to the battery by using charging kit. It can be utilized for domestic applications such as lighting purposes, mobile charging, laptop charging etc.

B. Design of Cooling system (own design)

Figure 6 shown the design of water inlet and outlet point of Coooling system. Here after the nipple is connected to water hose for cold water input and hot water water output purpose.

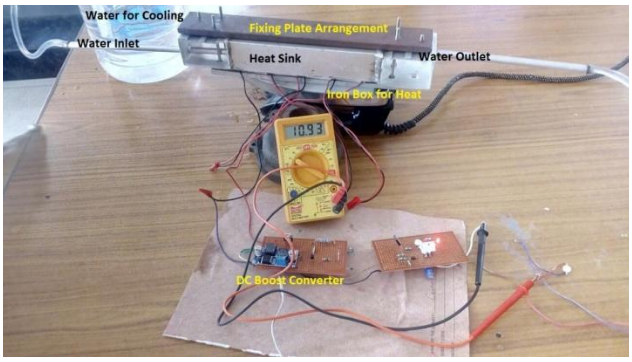
Fig. 6 Water inlet & outlet point

Fig. 7 inside design of tube

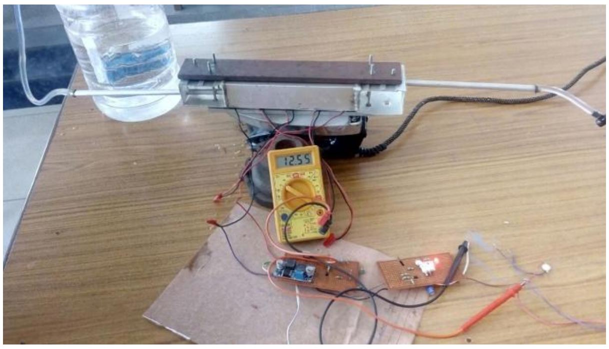
Figure 7 shown the inside of the cooling system. It is intenely bi-sected by two half at bottem side of the cooling system is coold water inlet from the water tank. Upper side of the cooling system is collect the hot water from the bottem side of the cooling system why because it is a hot water gose the upper side of the cooling system.This it is fully made up of aluminium material it can transfer the heat very quickely and effectely in this project we are using rectangular shape aluminium box.

C. Experimental Setup and results

TEG's are used for their incredible power conversion efficiency. Generally, if output getting 2 to 3% between powers in and power out on a TEG, then it is doing pretty well. The experimental setup of compact generator using TEG shown in figure 8 with different temperature.



(a) Output voltage of 10.93v



(b) Output voltage of 12.55v

Fig. 8 Experimental setup of TEG Compact Generator

Thermoelectric modules are fairly heat dependent and efficiencies can differ extensively depending on the operating parameters of the system at hand the higher the ΔT is more efficient. The temperature is varied and the corresponding output voltages are noted. To vary the temperature here we used cloth iron box. We got 2 different voltages 10.93v and 12.55v.

IV. CONCLUSION

World's energy need is increased day by day due to increase in population. The power generation is mostly based on solar panels, hydro power plant, nuclear power plants and wind mills. But some of them are non-renewable energy and also need more space to implement and it takes more risk to manufacture. By taking solar panels and wind mills it occupies more space to implement, and in hydro power plant and nuclear power plant the manual work is more and it makes more side effects for the workers due to radiation and chemicals. In this modern world the engineers put their effort to generate electricity in different ways without any side effects in that way the Thermoelectric Power Generator. This device is made by using PN semiconductors where P type and N type are connected in series.

This device is very small in size and it is very reliable to use. The heat is given to the hot face of the module and the cooling is given in the cold side of the module. This opposite reaction makes to produce electricity. Renewable energy is used in this device and also all kind of heat is utilized to generate electricity in any place even space. It can be used on remote areas & unmanned sites because; they don't have any moving parts and maintenance free. It can be used in satellites and space probes for power generation. It occupies very less amount of space, free of maintenance; hence it is used to make mini size generators. But one of the demerits of this system is capital cost high. The research is going on to improve the use of TEG for world's energy need.

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