SMART POWER GENERATION FROM WASTE HEAT BY THERMO ELECTRIC GENERATOR

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Abstract- Generating electricity in present there is a shortage of fossil fuel, oil, gas, etc. burning of these fuels causes environmental problem like radio activity pollution, global warming etc. So that these (coal, oil, gas) are the limiting resources hence resulting new technology is needed for electricity generation, by using thermoelectric generators to generate power as a most promising technology and environmental free and several advantages in production. Thermoelectric generator can convert directly thermal (heat) energy into electrical energy. In this TEG there are no moving parts and it can not be produce any waste during power production hence it is consider as a green technology. Thermoelectric power generator convert direct waste heat in to generate electricity By this it eliminated emission so we can believe this green technology. Thermoelectric power generation offer a potential application in the direct exchange of waste-heat energy into electrical power where it is unnecessary to believe the cost of the thermal energy input .This method will have an maximum outcome. The application of this option green technology in converting waste-heat energy directly into electrical power can too improve the overall efficiencies of energy conversion systems. Heat source which is need for this conversion is less when contrast to conventional methods. By using this energy is used to charge the mobile electronics

Keywords- Thermoelectric generator, seebeck effect, waste-heat recovery, alternative green technology, direct energy conversion, thermocouple , thermal shield, thermoelectric materials, thermo electric module, thermal fin

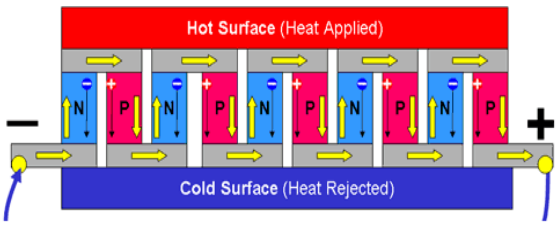
I. INTRODUCTION

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 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.. [3]
The device by converting heat energy to electrical energy. This thermoelectric generator is suitable
power for space research, Satellites and even un-manned facilities. Satellites are settled at the planets that so for from the earth. For example, thermoelectric devices can be used in vehicles to producing electricity using the waste heat of the engine also. [2]

TEG is used to convert thermal energy (heat) into 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



Fig(a): Schematic of a thermoelectric generator

Theory and the technology

when “electrons” are in motion, we have an electricalcurrent (i.e., charge per unit time per unit area).electrical voltage (“pressure”) usually is the driving force but, other forces like temperature difference andhence flow of thermal energy/heat can drive the electrons

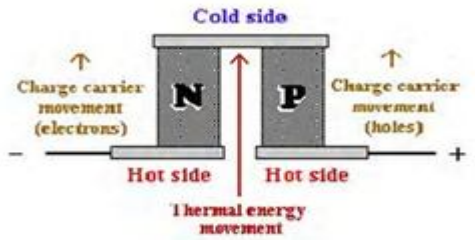


Fig. 1 Schematics of a P&N couple

background of the thermoelectric chip

In 1821, J. T. Seebeck (1770-1831) discovered that dissimilar metals that are connected at two different locations (junctions) will develop a micro-voltage if the two junctions are held at different temperatures. This effect is known as the "Seebeck effect"

The use of both N and P type materials in a single power generation device allows us to truly optimize the Seebeck effect. As shown in Fig. 1, the N and P pellets are configured thermally in parallel, but electrically in a series circuit. Because electrical current (i.e., moving electrons) flows in a direction opposite to that of the hole flow, the current-generating potentials in the pellets do not oppose one another, but are series-aiding. Thus, if each pellet developed a Seebeck voltage of 20mV, this combination of an N pellet and a P pellet would generate approximately 40Mv

II. PROBLEM DEFINITION

Some developing countries and most populated industrialized countries (India china Mongolia Korea) etc. have average of 3 to 10 hours of daily power-cuts because the increase in demand of consumer utilization electricity exceeds so that the production of electrical energy is lesser then the consumer demand. And also shortage of fossil fuel and coal i.e. about 60% of electricity is generated from fossil fuels. (Oil and gas) are imported from Arabian countries. So that pollution also may occur due to the combustion of this fossil fuel. And also the generating the power from these conventional sources may lead to harmful environment and pollute the nature.

In the new generation they are depending upon the rechargeable batteries or diesel /petrol engine etc. when there is no power and at the time of load shedding. The use of generator is common in industrial and commercial sector. This ultimately increases the shortage of power and more cost.

And also the people are not utilizing the power properly they were unnecessarily wasting the power and they are not designing the power consumption properly hence basically a low power production in that also wasting means in the future we live without light Now a days consumer demand is more then the power production that is the major difficulty to overcome.

Objective

The main aim of this project is to develop much cleaner noise less cost effective different way of power generation method for charging the battery as well as to utilization proper only the requirement of usage, which helps to reduces the global warming as well as reduce the power shortages, load shedding and also we can transfer the portable generating unit. In this project the conversion of waste heat into generate electricity by using thermoelectric generator. Waste may refrigerator heat, vehicle radiator heat, laptop heat, even body heat can be used as a input source as a waste heat to generate electricity and it can be charged directly mobile battery and also stored in a rechargeable lead acid battery for further usage. And also waste energy human body locomotion also produce electricity body weight locomotion of the energy in to electrical energy by using electromagnetic induction principle. The control mechanism carries regulator circuit etc and the power saving mechanism carries microcontroller relays etc.

1) Charge the mobile battery where ever waste heat is obtained

2) Maintain the heat transfer from hot side to cold side because of uniform charging mobile battery

3) Charge the 12v battery for further usage to converting by using inverter to 220v

III. SCOPE OF THE STUDY

The scopes of project study are;

1) by using thermoelectric generator connecting in series /parallel we can generate the power for maximum level

2) even body heat also generate the heat that can be utilizing by using TEG to generate the power to charge the portable equipment like laptop mobile etc

3) by installed in the vehicle above the radiator means the vehicle battery will charge self

IV. LITERATURE SURVEY

Method for generating power such as burning of wood, petrol, diesel, coal, is continuously depleting with nature, so that exceeded usage of electricity according to the consumer demand.

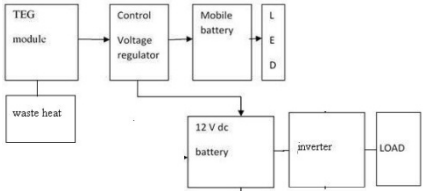
Global warming is the increase in the average measured temperature of the Earth's near surface air and Oceans since the mid-20th century, and its projected continuation. Global surface temperature increased 0.74 ± 0.18 °C (1.33 ± 0.32 °F) during the

Thomas Jon Seebeck (1934) invented that a temperature formed between two dissimilar conductors produces a voltage and current. At the heart of the thermoelectric generator effect is the fact that a temperature difference in a conducting material results in heat flow between one side to another side

V. BLOCK DIAGRAM

This section gives the brief description of each component used in designing the waste heat to generate electricity By using this thermoelectric power generation (TEPG) TEC12706 devices shown When ever heating of one surface (waste heat example refrigerator outer surface heat, laptop heat, ion box heat, solar radiation heat ,even human body heat) is also an input of thermo electric generator.

When heat is applied one side there will be a continuous electron or holes will flow continuously based on the temperature of heat. If the temperature is increases the voltage is also increases vice verse in such a way that the other side of thermoelectric generator is cold because heat transform is uniform then only electron will flow and voltage is developed at the output side of the thermoelectric generator



Fig, block diagram Voltage regulator (control circuit)

In this part voltage from the TEG is regulated by required voltage for mobile charger

Mobile battery

After the regulated voltage is passed to the battery terminal to charge the mobile so that the required specification is 3.8 v li-ion batteries 5.70wh is required. Finally the mobile battery will charge under desired voltage condition

LED (light emitting diode)

Led indicates that mobile battery is charging or not if the led will not glow means there is no power at the output side and also the battery will not get charging.

Inverter Used for to convert variable dc to fixed ac

Thermoelectric generator construction and working principle:

A thermoelectric generator is a solid state flexible device that consists of a P-type and N-type semiconductor particle arranged in series, shown in Figure When heat is applied to one surface of the thermoelectric generator (hot side), N-type (electrons) semiconductor and the holes in the p-type semiconductor will moves out.This movement of electrons and holes that forms charge. A thermoelectric generator can be connected in series, which increases the voltage, the current.

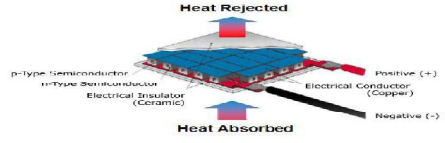


Fig. Schematic diagram of a thermoelectric generator.

Seebeck Effect Jon seebeck invented the new designed circuit consisting of two (cold and hot side) different thermal conducting materials, whose connections based on the different temperatures. In case of a Peltier cooler module the Seebeck voltage can be determined by 1

$$VS = \alpha (Th - Tc) \quad (1)$$

where Th-Tc is the temp difference between heat applied and cold side of TEG.

TEG components

1. Thermoelectric internal elements
2. Thermoelectric covering
3. Thermal withstanding 4. Copper wire

Fig, thermoelectric generator with fin heat sink

VI. CIRCUIT DIAGRAM AND WORKING BY USING **TEG**

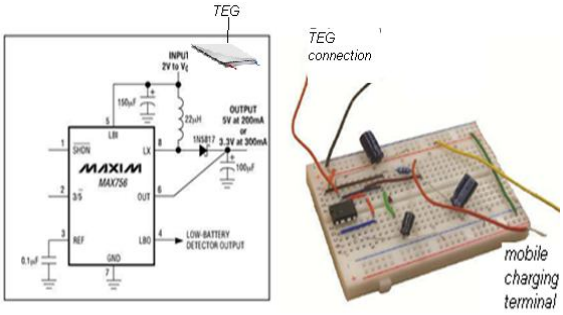


Fig (a); Circuit diagram Figure 1;5 Volt From 1.5 Volt Circuit Schematic

The MAX756/MAX757 are CMOS step-up DC-DC switching regulators for small, low input voltage or battery-powered systems. The MAX756 accepts a positive input voltage down to 0.7V and converts it to a higher pin-selectable output voltage of 3.3V or 5V. The MAX757 is an adjustable version that accepts an input voltage down to 0.7V and generates a higher adjustable output voltage in the range from 2.7V to 5.5V. Typical full-load efficiencies for the MAX756/MAX757 are greater than 87%.

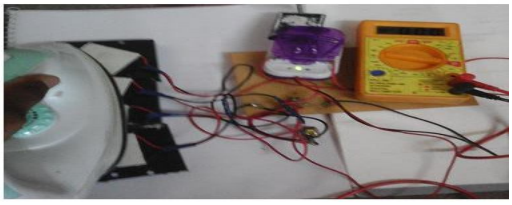
Max756 combine a switch-mode regulator with an N-channel MOSFET, precision voltage reference, and power-fail detector in a single monolithic device. The MOSFET is a “sense-FET” type for best efficiency, and has a very low gate threshold voltage to ensure start-up under low-battery voltage conditions (1.1V typ).

The circuit can be easily wired on a very small rectangular common PCB.All connections should be kept as short as possible. If available,try to add a good quality 8 pin DIP socket for IC1. Note that the power inductor’s (L1) DC resistance significantly affects efficiency. For highest efficiency, limit L1’s DC resistance to 0.03 Ohm or less. A thru-hole type standard power inductor can be used. Similarly, the ESR of all capacitors (bypass and filter) affects

circuit efficiency. Best performance is obtained by using specialized low-ESR capacitors.

VII.TEST ANALYSIS

Testing by using waste heat as a iron box
A)Complete setup to charge the mobile battery by using thermoelectric generator



Fig(a) charging the sample mobile battery using TEG by waste heat

complete setup to charge the mobile battery is shown in fig 4.5, When heat is applied to the hot side the TEG get absorb the heat from any body (ex-refrigerator heat, laptop heat, heat from the vehicle, solar heat, and even human body is also a waste heat source for TEG).
Under this when heat absorbs one side it rejected at the other side (cold side) heat transfer take place from hot surface to cold surface. So that the electron will flow to through copper conductor to the complete circuit so voltage will be regulated at the circuit. The required power for the mobile battery is 3.8 volt it is at the output terminal at the circuit is as shown in the fig a

As it is heat transfer take place from heat applied side to cold side. These thermoelectric generators of two terminals are to connected i.e. positive terminal is connected to diode side and the other terminal is connected to ground Circuit elements consist of Diode (BY127),Potentiometer (10kpot),Capacitor (50micro farad),Zener diode(6v),LED (3.5v),Mobile battery (3.8v)

When heat is applied to the hot side under certain temperature (30 to 300 degree C) electrical power from heat flow across a hot to cold side temperature gradient.. more thermoelectric generator need to be connected in cascade to make the maximum voltage. Thermoelectric device diode eliminates the reverse flow of electron to the thermo electric generator so that continuously electron will flow through diode when applied heat to the TEG.

Potentiometer is used to control the voltage.Zener diode helps to eliminate the excess voltage flow to the battery because battery required to charge.

LED (light emitting diode) is shows the battery is charging or not and it ill glow when the output voltage is above 3.5 volt and

b) Test analysis by waste heat from boiler tube

The exhaust of flue gasses sounds very interesting. We believe the efficiency of such a system would be in the range of 10.6% for QW of Si/SiGe. This takes into account 10 C temperature loss on both the hot and cold end of the thermoelectric for heat transfer

We tested five different modules with different semi-conduct materials in order to find the TEG with the maximum output at a specific temperature difference. Fig. 1 shows the schematic of the module tests. The TEG module was clamped tightly in between two containers, one was the hot side with a high temperature and another was the cold side with a low temperature

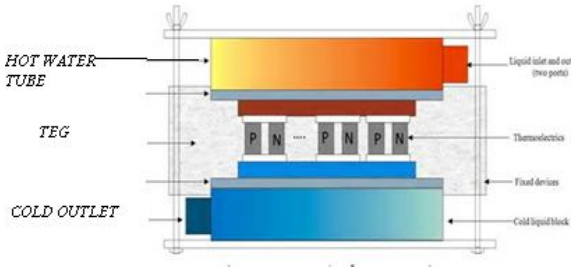
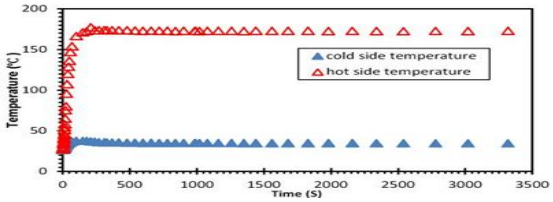


Fig. a) shows the schematic of the module tests.

We kept the temperature on the hot side at about 200°C by using a digital thermostat oil bath and used the tap water as the cooling liquid on the cold side with a temperature of about 20°C. The temperatures of both hot and cold sides were measured and the results are shown in graph. The temperature was measured using two micro-thermocouples with very thin tips. The temperature on the hot side of the modules was stabilized at about 180°C and that on the cold side at about 40°C. The increase in the temperature on the cold side from 20 to 40°C was because of the heat conduction from the hot side through the TEG modules. The temperature difference was stabilized at around 140°C. The results illustrate that the test system for thermoelectric power generation was stable



c)Test analysis from burner

Fundamentally, there are four basic components in a te-powered generator: a heat source, a te, a ‘cold-side’ heat sink, and an electrical load.

the system may also include a voltage regulation circuit or a fan for the heat sink. fig.(a)shows one example of such a system.

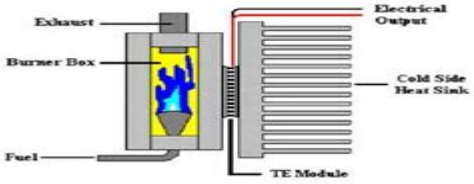


fig.(a)shows one example of such a system.

VIII. RESULT ANALYSIS

Primarily waste heat is used to charge the battery. the system is tested to meet the desired objectives and the

results obtained. For the analysis a T.E.G was putted on a hot chamber plate (body heat or iron box I am using here to get fast output and the aluminum heat sink square shaped is placed on the top side (40x40x40) dimension. Heat sink of the other side of the thermoelectric generator (cold side)

The hot plate (iron box) is sated at different temperature ranging from 30℃to220℃. So that to know the voltage and current by using multi meter that was produced by this TEG. by using thermometer to determine the applied temperature exactly on the hot side of the TEG and cold side. The equation is gives to calculate the temperature of the T.E.G.

Equation is given by

Temperature (▲T) = Temperature Hot (Th) – Temperature Cold (tC)

CONCLUSION

Present method for electricity generation is converting thermal energy into mechanical energy by turbine then into electricity by using generator. Burning of these fuels causes environmental problem like radio activity pollution, global warming. hence (coal, oil, gas) are the limiting resources resulting new technology is needed. The project paper is tested and implemented. The system gives the best economical pollution free, required energy solution to the people.

Two power generators have been built using TEG modules and tested. The power of the first one could reach about 500 W (predicted using experimental data) with a temperature difference of about 200°C between hot and cold sides.

This work can be used for many applications in urban and rural areas where power availability is less or totally absence. By making this system generates and charge 12v which is capable to recharge a mobile. it avoiding dependency of grid supply. This is a Promising technology for solving power crisis to an affordable extent

ADVANTAGES

- Clean, Noise less #, Cost is less #This is a Non-conventional system # #No fuel is require #Easy maintenance # portable# Charging time is less (maximum temp)
- Promising technology for solving power crisis to an affordable extent.# Simple in construction.
- Pollution free.# Reduces transmission losses.
- Wide areas of application# Required less space
- It ca
- n be use at any time when it necessary.
- Less number of parts required. # we can charge any electronic devices

Electricity can used for many purposes # efficient and eliminate the grid searching

DISADVANTAGES

Improper variation of temperature gradient difference may damage the TEG, Complex design

APPLICATIONS

Thermoelectric Generators are basically used in where the power production is less.

In automobile vehicle produce heat that can be used for generating electricity by using TEG.

Recharge the battery where ever waste heat is obtained .Self charging battery by fixing the TEG at radiator or two wheeler silencers pipe

SCOPE OF THE FUTURE WORK

- By using proper heat sink material help to increase the output voltage.
- Using long proper heat sink material is to avoid the heat in between the gap of fins.
- By addition of the more TEG in SERIES is to increase the voltage

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