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# EXTRACTION OF ENERGY FROM WASTE HEAT DISSIPATED FROM A VEHICLE ENGINE HEAT UP

**Prajwal S. Deshmukh[1], Nikhil A. Bhosale[2], Smiti R. Saha[3], Rohan B. Jadhav[4], Dr. Shenbagalakshmi[5]**

*Student, Electrical engineering, Sinhgad institute of technology and science, Lonavala, Pune, India[1234]*

*Professor, Electrical engineering, Sinhgad institute of technology and science, Lonavala, Pune, India[5]*

*prajwaldeshmukh697@gmail.com[1], nik1997niku@gmail.com [2]*

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**Abstract: Currently, there is a lack of fossil fuels, oil, and natural gas to generate electricity. Burning these fuels can cause environmental problems, such as radioactive pollution, global warming, etc. Therefore, new technologies that use thermoelectric generators to generate electricity are needed. A more promising technology is available that will bring many environmental benefits. Thermoelectric generators can directly convert thermal energy (heat) into electrical energy. TEG has no moving parts and no movement waste from power generation. Therefore, it is considered as an environmentally friendly technology. If people don't have to believe in the cost of heat input, then thermoelectric potential has the potential to generate electricity. The remaining thermal energy is directly exchanged for electrical energy. This method obtains the best results. The protection technology can directly convert the remaining heat energy. Electricity can also improve the overall efficiency of the energy conversion system. Compared with traditional processes, this conversion requires fewer heat sources. This means that the energy can be used to charge mobile electronic devices, home appliances, and DC lighting.**

***Keywords:*** *Thermoelectric Generator, Seebeck Effect, Waste Heat Utilization, Alternative Environmental Protection Technology, Direct Energy Conversion, Thermocouple, Thermoelectric Material, Thermoelectric Module.*

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## I.INTRODUCTION

As the name suggests, this system will prove to be an effective alternative to extract and generate the required energy from the remaining energy. According to the law of energy dialogue, energy cannot be generated or destroyed. It changes from one shape to another, but energy is lost in the conversion process. We will use this energy effectively in our system. Our car is one of the vehicles used every day. Because most vehicles use combustion. The motor generates a lot of heat and releases it into the environment. We have proposed a thermoelectric power generation technology system that uses a direct power converter to maintain power proportional to the temperature difference. These transducers work according to the principle of thermocouple technology, which states that when the connecting material is composed of combined elements, the temperature of the two flows between the contacts is kept constant due to different electrons. Different temperatures In order to improve efficiency and ease of use, a postal module has been implemented, which generates different voltage waveforms to monitor and meet our daily needs, such as for example mobile phones during charging, household alternating current, and direct current.

## II.SYSTEM DESCRIPTION

As shown in the diagram below, a system starts from a thermal electric energy generator which generates the electricity and supplied to the dc-dc boost circuit which then connected to the charger for battery charging with the tickle charging technique to feed up the battery in a very short time. In order to maintain the temperature difference between the hot junction and reference cold junction, an aluminum fin heatsink is mounted on the cold side with a cooling fan assembly for the demonstration at the local level. In the real implementation of the vehicle system, this

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cooling mechanism will be linked to the engine cooling system of the vehicle. Also, the battery health monitoring system is included in the circuit. On the output side, a battery protection circuit is used to prevent the deep discharge by the load to ensure long battery life. As suggested In the system for daily life utilization, we have incorporated the inverter circuit for the generation of 230 Volts ac mains ac supply to drive ac load. At the same time, USB charging ports are provided for smartphone charging directly to avoid ac-dc conversion losses from a normal plug-in mains charger. This charger is considered to be one of the important parts as we all use smartphones nowadays generally consume near about 900 Watts a month. So this system will help us to reduce that unnecessary wastage of energy. With the same consideration of conversion losses in mobile chargers, we have deployed a dedicated dc lightning source that can drive the dc lightning source directly. So all this design increases the overall efficiency of the system.

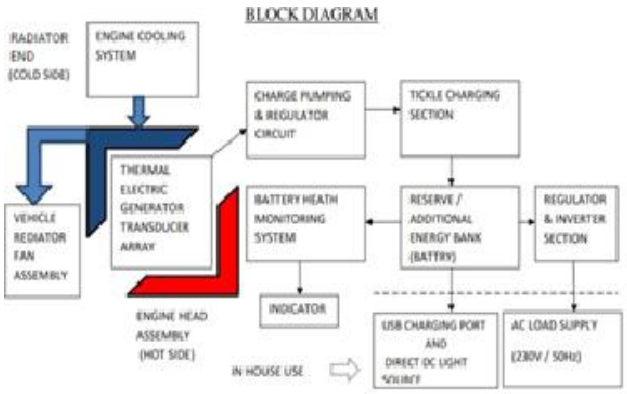


**Fig. 1 Block Diagram**

2.1 Thermocouple:

Here a thermocouple is a sensor that measures temperature. A thermocouple consists of two wires made of different metals. One end of the wire is welded together to form a connection point. Measure the wire at this connection point. When there is a temperature difference, Voltage is generated. A thermocouple is a temperature sensor made by joining two different metals together at one end. The end of the connection is called the hot terminal. The other extreme of these different metals is called the cold terminal. The last point connected to the thermocouple material actually forms a reference junction.

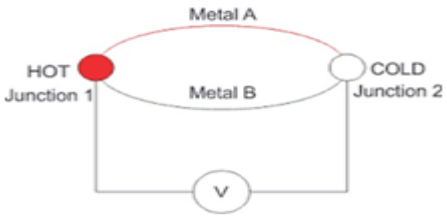


**Fig 2 Temperature between two junctions**

## III.CONSTRUCTION

Two unique semiconductors are used, one is n-type and the other is p-type because they must have different electron densities. The semiconductors are connected thermally in parallel with each other and electrically connected in series, and then connected on each side through a thermally conductive plate. When a voltage is applied to the free ends of the two semiconductors, a direct current flows through the junction, causing a temperature difference. The side with the cooling plate absorbs heat and then transfers the heat to the other side. equipment. Where is the cooler? Usually, TEO is connected next to each other and placed between two ceramic plates. In this case, the cooling capacity of the entire unit is proportional to the number of TECs it contains.

The test kit is designed to apply known heat to the "hot" side of the device. By measuring the output power of the thermoelectric device on the entire load, the efficiency of the thermoelectric device can be calculated: where η = thermal efficiency, Pout = measured output power of the device (watts) Qin = measured number of input thermal energy devices (watts)

3.1 Pelter structure:

A typical thermoelectric module consists of an array of bismuth telluride semiconductor microbeads that have been "doped" so that one type of charge carrier (positive or negative) carries most of the current. The P/N magnetic bead pair is configured in electrical series but thermally parallel. The metalized ceramic substrate provides a platform for the beads and the small conductive sheets connecting the beads.

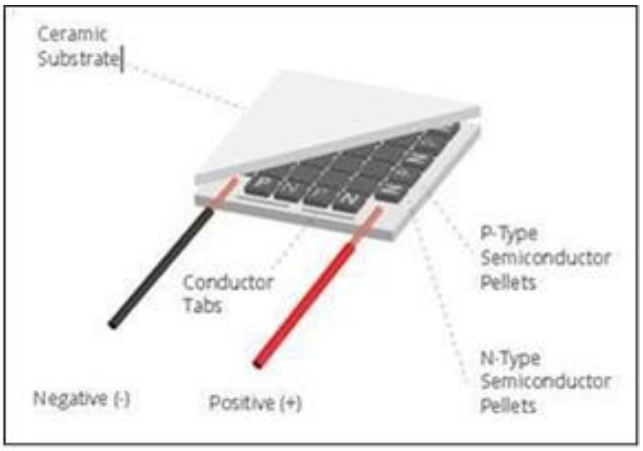


**Fig 3 : Pelters Structure**

### 3.1.1 Pelter Theory:

When a constant voltage is applied to the module, the positive charge and negative charge carriers in the magnetic bead assembly absorb thermal energy from one surface of the substrate and transfer it to the substrate on the other side. The surface absorbing thermal energy is cooled; the opposite surface on which thermal energy is released is heated. If the polarity is reversed, both the hot and cold sides are reversed. When heat is applied to one of the two conductors or semiconductors, the hot electrons flow into the colder electrons. Direct current (DC) flows through the circuit. The voltage generated by the Seebeck effect is very low, usually only a few microvolts (one-millionth of a volt) per Kelvin temperature difference at

the connection point. Some Seebeck devices are large enough to generate voltages of a few millivolts (thousandths of a volt). Many of these devices can be connected in series to increase the output voltage, or in parallel to increase the maximum output current. When a large temperature difference is maintained between the terminals, useful electrical energy is provided on a small scale.

### 3.2 Radiator Fans:

The radiator is a heat exchanger used to cool internal combustion engines, which are used in automobiles, but also in piston-powered airplanes, railway locomotives, motorcycles, fixed drive systems, or similar uses of the engine. An internal combustion engine is generally cooled by circulating a liquid called engine coolant through a cylinder block and heating it therein, then dissipating the heat to the atmosphere through a radiator, and then returning to the engine for cooling. This is usually a water-based liquid, but it can also be oil. The heat from the inside of the liquid to the outside air cools the liquid, which in turn cools the engine. Radiators are also commonly used to cool automatic transmission oil, A/C coolant, air intake, and sometimes engine oil or power steering fluid. The radiator is usually installed where it receives airflow from the advancing vehicle (for example, behind the front grille). When installed, the radiator is usually installed behind the grille to provide sufficient airflow, although this requires a longer coolant duct.

### 3.3 Heat Sink Assembly

A heat sink (also commonly referred to as a cooler) is a heat exchanger that transfers heat generated by electronic

/mechanical equipment to a fluid (usually air or liquid refrigerant) and removes the heat from the equipment and the temperature of the equipment allows The cooler is designed so that its surface is in maximum contact with the surrounding cooling medium (for example, with air). Wind speed, material selection, heat sink design, and surface finish are the factors that affect the performance of the cooler.

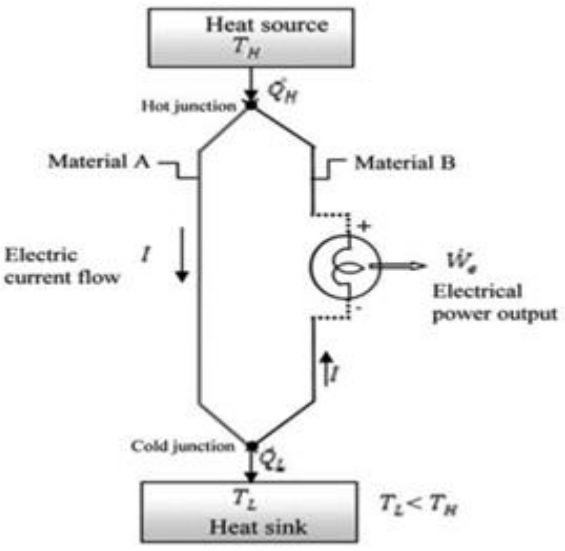


**Fig 4: Process and view of the heat sink**

### 3.4 Battery

The lead-acid battery was invented by the French physicist Gaston Planet in 1859 and is the oldest rechargeable battery. Although they have a very low energy-to-weight ratio and a low volume-to-energy ratio, their ability to deliver high pulse currents means that batteries have a relatively high power-to- weight ratio. These characteristics and its low cost make it attractive in cars because it provides the high current required by car starters.

### 3.5 Charging Unit

Trickle flow charging refers to charging a fully charged battery without charging at a rate corresponding to the self-discharge rate, so the battery remains at its full charge level. A battery charged by trickle charging at a constant voltage is considered to be charged. Floating For lead-free lead-acid floating rechargeable batteries (such as SLI batteries), if lead-acid batteries require a-current charging to maintain a full charge, of course, continuous charging can be achieved at the end of the charging process. The charge flow corresponds to the energy consumed by a lead-acid battery, which separates water and electrolyte into hydrogen and oxygen.

### 3.6 Trickle Charger

Solutions that we use smart chargers to slowly charge 12V lead-acid batteries may affect the health and life of the battery. Both are designed to slowly provide a low-voltage charge to the vehicle's battery and keep the battery fully charged within a few hours, but the main difference is that the charger has the ability to automatically cut off the charging current without overcharging the battery. This can cause overheating and serious damage. Another important difference is that some chargers have the ability to repair and clean the battery plates to restore normal operation and extend battery life. The slim charger is designed to hold the charge corresponding to the battery's self-discharge rate. (2.23 to 2.25 V per battery). Too long a time will cause overheating, which will cause the electrolyte in the battery to boil. The result is that the battery is dead, or in the worst case, it may malfunction and/or explode. However, the maintenance charger (also called floating charger or smart charger) is a turn-key product that can eliminate human error in the battery charging function. The service charger can remain connected to the battery indefinitely without damaging the battery.

### 3.7 Boost Converter:

A boost converter is a DC to DC converter that increases voltage (when current decreases) from input power supply to output load. It is a switch-mode power level (SMPS) that contains at least two semiconductors (diodes and transistors) and at least one energy storage element, capacitor, inductor, or both. In order to reduce voltage ripple, filters made of capacitors (sometimes combined with inductors) are usually added to the output (load-side filter) and input (power-side filter) of this type of converter.

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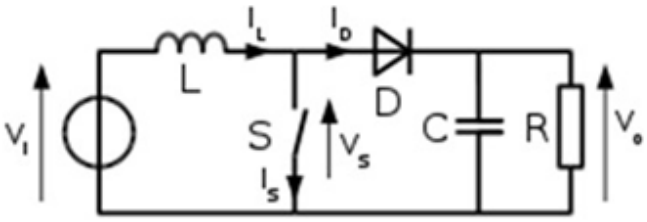


**Fig 5.Boost converter schematic**

**3.8 Inverter:**

The DC/AC converter is designed to efficiently convert DC power into high-voltage AC power, similar to the power provided on a power outlet. For example, batteries, solar panels, or fuel cells must be converted so that the device can operate on AC power. The low-voltage DC inverter process is performed in two steps. The first step is low-voltage DC conversion. To apply power to the high-voltage DC power supply, the second step is to use pulse width modulation to convert the high-voltage DC power supply into an AC waveform. On the other hand, a pure sine wave inverter provides the same sine wave output as the power output. These devices can be used with more sensitive devices, which may damage the changed sine wave, such as: B. Laser printers, laptops, power tools, etc. Digital clock and medical equipment.

...Due to low harmonic distortion, it will generate audible noise in fluorescent lamps and other equipment, and drive inductive loads (such as electric motors) faster and quieter.

**Advantages:**

● Environmentally friendly and recycles wasted heat energy.

● TEGs are solid-state devices, which means that they have no moving parts during their operations.

● No moving parts so maintenance required is less frequently, no chlorofluorocarbons.

● Better utilization of power and reliable source of energy.

● Save money and reduce the overall cost to run nominal home appliances.

● Easy to integrate with existing hardware.

● Simple maintenance.

**Future Scope**

● As currently, we have proposed a system for utilization of our own level so it can be incorporated in the smart grid concept to provide unused energy by us to the grid so others can use this energy and we can reduce the bills.

● As in future natural resources(fuel) will get exhausted as it has limitations and this innovation can be a good remedy for future generations.

● It will be a good alternative

● By using proper heat sink material to avoid the heat in between the gap of fins and to increase the output voltage.

● By the addition of more TEG in SERIES is to increase the voltage

## IV .CONCLUSION

The current method of generating electricity is to use turbines to convert thermal energy into mechanical energy, and then use generators to convert it into electrical energy. Burning these fuels can cause environmental problems such as radioactive pollution and global warming. As a result, there has been a demand for new technologies. The project document has been tested and implemented. The system provides people with the most ideal and environmentally friendly energy solutions. Two generators were built and tested using TEG modules. When the temperature difference between the hot and cold sides is about 200°C, it can reach about 500 W (predicted based on experimental data). This work can be used for many applications in urban and rural areas where there is little or no energy. The system generates and charges 12 V, which can charge mobile phones, thereby avoiding reliance on power sources. This is a promising technology to solve the energy crisis in an affordable way. Experiments have found that when two thermoelectric generators are connected in series, the energy generated is either directly used to power certain auxiliary equipment of the vehicle, or it can be stored in a battery and then used. This reduces the load on the generator.

## REFERENCES

[1] Dipak Patil, Dr. R. R. Arakerimath, (2013), "A Review of Thermoelectric Generator for Waste Heat Recovery from Engine Exhaust." (IJRAME) |Vol. 1|Issue 8|Dec 2013|page 1- 9.

[2] Adhithya k, Rajeshwar Anand, Balaji G., Harinarayana J. (2015), "Battery Charging Using Thermoelectric Generation Module In Automobiles."(IJRET) E-ISSN 2319-1163.

[3] Anchal Dewangan, Dr. N. K. Saikhedkar, (2015) "Experimental analysis of Waste heat recovery using TEG for an internal combustion Engine."(IJISET) |Vol.2|Issue 6|June 2015.

[4] Driss Kenfaui, Guillaume Bonnefont , Daniel Chateigner , Gilbert Fantozzi ,Moussa Gomina, Jacques Guillaume Noudem, Materials Research Bulletin 45 (2010) 1240–1249

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**Address for Correspondence SKN Sinhgad Institute of Technology and Science Lonavala, Pune. 410 401, MS, India.**

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