International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 10 | Oct 2020 www.irjet.net p-ISSN: 2395-0072

HEAT RECOVERY FROM INTERNAL COMBUSTION ENGINE

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Abstract - *Thermoelectric device are the device in which develop voltage when there is a different temperature on each side. Peltier module is thermo electrical device which is based on Peltier effect. Since the voltage acquired from thermoelectric generator is very small, certain addition in series and parallel produce power generation is more efficient. Our prototype generates 4.40 volts and 3.85 volts from industrial waste heat and automobiles respectively.*

Key Words: **Thermoelectricity, Peltier Effect, Seebeck Effect, Peltier Module.**

1. INTRODUCTION

In 1822, Estonian physician named Thomas Seebeck state that interflow between two dissimilar metals produce a voltage which is depend on temperature. Thermocouples depend on this Seebeck effect.

Later on Peltier state that inverse of Seebeck effect is possible. i.e., cold and hot interflow will be formed, when voltage is applied to two dissimilar metals connected as junction. Peltier module is also worked on same principle. This Paper show that Heat is produce from different heat sources and give to Peltier module and obtain different amount of voltages and overall power. This Paper also is focused on using different ways to extract heat from opposite side of the module to made yield voltage to change as to need.

2. THERMOELECTRIC MODULE BASICS

The thermoelectric semiconductor material frequently utilized in the present TE coolers is a composite of Bismuth Telluride that has been reasonably doped to give singular squares or components having particular "N" and "P" qualities. Thermoelectric materials regularly are manufactured by either directional crystallization from a soften or squeezed powder metallurgy.

2.1 Construction

A functional thermoelectric module for the most part comprises of at least two components of n and p-type doped semiconductor material that are associated electrically in series and thermally in parallel. Thermoelectric components and their electrical interconnects normally are mounted between two ceramic substrates. Consider it like this, take a bit of metal, heat one end and at the same time cool the other.

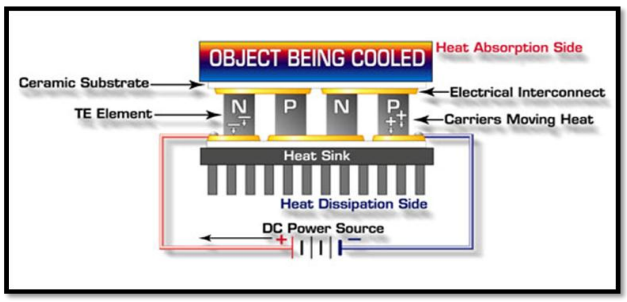

Fig-1: General Structure of A TEG

2.2 Working

A thermoelectric (TE) module, likewise called a thermoelectric cooler or Peltier cooler, is a semiconductor-based electronic segment that functions as a small pump, moving heat from one part of the device to the other. Sometimes thermoelectric module are also be used to create electricity by using temperature differential between the two sides of the module. By Appling DC power to a thermoelectric module, heat flow through one side of module to other. One module face, thusly, will be cooled while opposite face is at the same time heated. Important is that this phenomenon may be reversed whereby a change in the polarity i.e. plus and minus which causes heat flows in the opposite direction. Subsequently, a thermoelectric module might be utilized for both heating and cooling accordingly making it exceptionally appropriate for exact temperature control applications. A thermoelectric module can likewise be utilized for power generation. Right now, temperature differential applied over the module will produce a current.

The electrons encompassing the metal particles at the hot end will have more vitality than the electrons on the cooler end. This implies that the hot electrons will shake around quicker than that on the cool end, and they will in general move quicker towards the cold end. In the end, the cold end will turn out more negatively charged, and the hot end will turn out to positive charged. Hence it knows as thermoelectric effect.

3. COMPONTS

3.1 Peltier Module

The Construction of the module contain more than two ceramic plates inside which a variety of little bismuth telluride cubes are stored. The charge bearers inside the

material and the semiconductors move openly while conveying both charge and the heat. Making temperature differences makes the conveys at hot end diffuse at the cold end. This development of bearer charge at hot end results into a development of net charge at the cold end in this way coming about in the voltage creation.

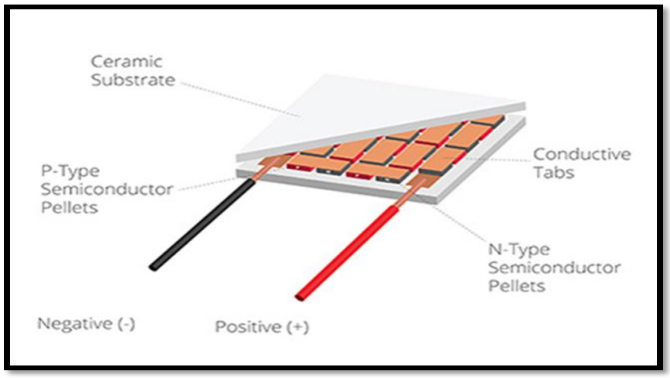

Fig-2: Internal View of Peltier Module

3.2 Heating System

Heat is essential for Peltier module. There are various heating sources such as cooking in domestic areas, exhaust of automobile i.e., Engine, industries. Where heat is not present, Candle fumes or wood can be used. Peltier module is place above the heating source hence one side gets hot and to spread the heat equally. By changing heating source, Temperature difference is also varies .It should be noted that, up to certain limit temperature is rises beyond limit causes the damage.

3.3 Cooling System

Cooling system is also essential for Peltier module as the heating system and it place other side of Peltier module. There are various cooling sources such as Chilled water, Nitrous oxide etc. Peltier module place above the cooling system so that heat move hot side to the cold side. If cooling source is not available then h eat sink with cooling fan are used.

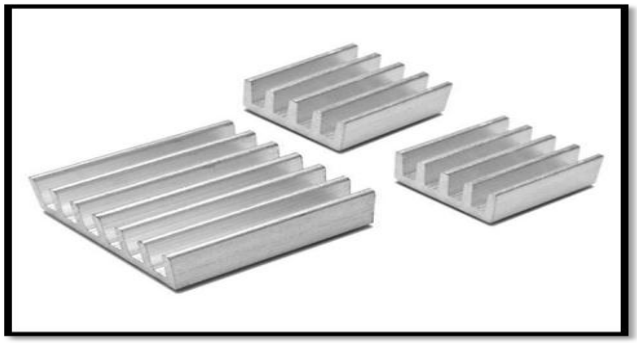

Fig-3: Aluminum Heat Sink

4. HEAT RECOVERY FROM INTERNAL COMBUSTION ENGINE

As the heat source we utilized heat from exhaust pipe of the automobile. Peltier module is kept between the exhaust pipe (Heating system) and pure aluminum heat sink (Cooling system). Heat sink which is cooled with a free turning mechanical fan i.e. no power fan. This arrangement was mounted on the vehicle. As the vehicle moves, exhaust pipe begins to warm up and reach close to 145°C. This gives a decent temperature slope of around 72-80°C, in this manner giving the enough yield capacity to run little gadgets i.e. means electricity is obtained.

Table -1: Output Reading Of Peltier Module

Sr.No	Heat Source	Temperature of Hot side	Temperature of Cold Side	Temperature Diffrences	DC voltage produced by the module at 1 hour of operation
1	Heat from automobiles	135	68	67	3.68v
2	Heat from automobiles	142	67	75	3.93v

As an outcome various vehicle producers are currently trying model TEGs that can search back a portion of this wasted heat from the exhaust and use it to run things like the cooling unit (AC) and the lights or to charge the batteries. In series, five Peltier module is connected. This arrangement is shown in below.

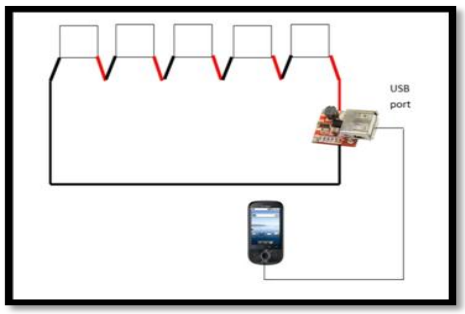

Fig-4: Series Connection of Five Module

Fig-5: Current And Voltage Output

The voltage in the yield acquired is around 4.84 volts and the comparing reading of the current is 0.19 ampere. The charger is associated with the portable.

5. ADVANTAGES AND APPLICATION

5.1 Advantages

- No moving parts.
- Little and lightweight.
- Support free.
- Acoustically quiet and electrically "calm".
- Heating and cooling with a similar module (counting temperature cycling).
- Wide working temperature Range.
- Exact temperature control (to inside 0.1°C).
- Activity in any direction, zero gravity and high G-levels.
- Naturally cordial.
- Sub-surrounding cooling.
- Cooling to exceptionally low temperatures (-80°C).

5.2 Application

- Thermoelectric cooler are widely utilized.
- Portable Product as a Water conditioners, refrigerators, freezers, etc.
- Used in cars for increasing fuel efficiency.
- Deep-Ocean offshore seabed.

6. PRECAUTION

- To keep away from the harm temperature must not surpass the limit of Peltier modules.
- Dropping or applying mechanical shock on the Peltier module can make it break.
- Direct introduce to daylight and humidity may harm the Peltier modules.
- Changing the present polarity quickly as a technique of modulation shortens the life of the unit subsequently it must not be embraced.

7. CONCLUSIONS

The temperature variation between the surfaces of Peltier module produces voltage and a plan can be intended for it. The course of action gives heating and cooling to the opposite sides of Peltier module. Exhaust of a automobile, candle fumes used as a heating source and pure aluminum heat sink without fan used as a cooling source. It deals with the standard of Peltier effect as indicated by temperature variation between dissimilar semiconductors produces. The created voltages are corresponding to the quantity of Peltier modules and the temperature variation between the surfaces. Afterward created voltage are used in domestic area, remote areas etc.

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