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MOBILE PELTIER COOLER

Dr.P.Anusha[1], Dr. M. Naga Swapna Sri[2] , N.Naveen[3], T. Sai Kireet[4], R. Setu Madhav[5], N. Sai Santhosh[6]

[1,2]Assistant Professor, Mechanical Engineering, Prasad. V. Potluri Siddartha Institute of Technology, Vijayawada, Andhra Pradesh.

[3,4,5,6]UG Mechanical Engineering, Prasad. V. Potluri Siddartha Institute of Technology, Vijayawada, Andhra Pradesh

Abstract: Now a days, Advanced cooling solutions are needed to address the growing challenges posed by future generations of microprocessors. Many types of refrigerators are made using refrigerant which to extent affect our environment. Then it strikes to make a refrigerating system in which there is no use of refrigerant so there is an option of vapour absorption system. Now the problem occurs about its shape refrigeration system with absorption system is heavy & bulky. This leads our project to thermo-electric cooling using concept of peltier effect.Cooling and heating applications are outstanding issues, which are widely investigated in the field of thermodynamics to improve energy efficiency. Peltier devices as an element used for heating, cooling and power generation have been title of many research due to their advantages in the term of their simple structures, low weight, working with low noise and capability to manufacture in small sizes. This work was carried out with the aim of reviewing presented studies to summarize Peltier applications and their performance as an important element for refrigerators and air conditioning.

A 40 x 40 x 3.6 mm mini thermoelectric Peltier cooler was designed and built in this study. The Peltier thermoelectric cell was sandwiched between an external and internal heat sinks that acted to remove heat from the cooler box. When the Peltier thermoelectric cell connected to an external power source, the Peltier effect caused the heat from the refrigerator internal space to be conducted and removed to the ambient. This system can achieves minimum temperature of 20℃ and maximum temperature of 35 ℃ where maximum voltage occurs in about 30 minutes. For future development, this system can be used as a replacement of for conventional air-conditioner systems that use coolant that can be harmless for humans in long term.

Keywords: MPC, Thermo electric Principle, Peltier Effect, Coolong, Non Conventional Refrigeration Techniques.

1. INTRODUCTION

The term "thermoelectric effect" encompasses three separately identified effects: the Seebeck effect, Peltier effect, and Thomson effect. The Seebeck and Peltier effects are different manifestations of the same physical process; textbooks may refer to this process as the Peltier–Seebeck effect (the separation derives from the independent discoveries by French physicist Jean Charles AthanasePeltier and Baltic German physicist Thomas Johann Seebeck). The Thomson effect is an extension of the Peltier–Seebeck model and is credited to Lord Kelvin.

Joule heating, the heat that is generated whenever a current is passed through a conductive material, is not generally termed a thermoelectric effect. The Peltier–Seebeck and Thomson effects are thermodynamically reversible, whereas Joule heating is not.

2. PELTIER EFFECT

Thermoelectrics are based on the Peltier Effect, discovered in 1834, bywhich DC current applied across two dissimilar materials causes a temperaturedifferential. The Peltier Effect is one of the three thermoelectric effects,the other two are known as the Seebeck Effect and Thomson Effect. Whereas thelast two effects act on a single conductor, the Peltier Effect is a typicaljunction phenomenon. The three effects are connected to each other by a simplerelationship.

The typical thermoelectric module is manufactured using two thin ceramicwafers with a series of P and N doped bismuth-telluride semiconductor materialsandwiched between them. The ceramic material on both sides of thethermoelectric adds rigidity and the necessary electrical insulation. The Ntype material has an excess of electrons, while the P type material has adeficit of electrons. One P and one N make up a couple, as shown in Figure 1. The thermoelectric couples are electrically in series and thermally in parallel. A thermoelectric module can contain one to several hundred couples.

As the electrons move from the P type material to the N type materialthrough an electrical connector, the electrons jump to a higher energy stateabsorbing thermal energy (cold side). Continuing through the lattice ofmaterial, the electrons flow from the N type material to the P type materialthrough an electrical connector, dropping to a lower energy state and releasingenergy as heat to the heat sink (hot side).

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❖ In a circuit consisting of a battery joined by two pieces of copper wire to a length of bismuth wire, a temperature rise occurs at the junction where the current passes from copper to bismuth, and a temperature drop occurs at the junction where the current passes from bismuth to copper. This effect was discovered in 1834 by the French physicist Jean-Charles-AthanasePeltier.

❖ we use Peltier module for generating this effect.

3. COMPONENTS OF MOBILE PELTIER COOLER

3.1 PELTIER MODULE(12V 0.15A)
3.2 CPU FAN WITH HEAT SINK
3.3 CPU FAN WITHOUT HEAT SINK
3.4 ALUMINIUM HEAT SINK
3.5 PVC PIPE
3.6 ADAPTER(12V 5AMP POWER SUPPLY)

3.1 PELTIER MODULE:

Peltier module (thermoelectric module) is a thermal control module that has both "warming" and "cooling" effects. By passing an electric current through the module, it is possible to change the surface temperature and keep it at the target temperature.

❖ It has a capacity of 12V 0.15AMP.
❖ It gets cooled upto 20°C
❖ It gets heated upto 35°C

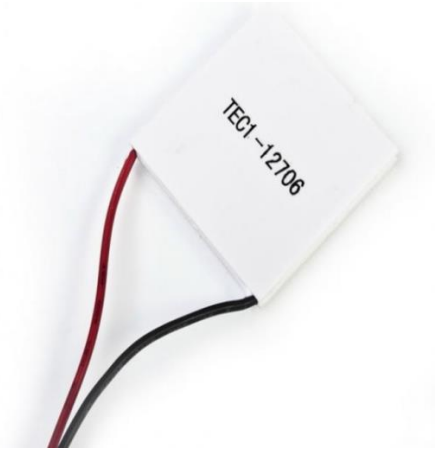

Fig. 1.Peltier Module

3.2 CPU FAN WITH HEAT SINK:

❖ A heat sink and fan (HSF) is an active cooling solution used to cool down integrated circuits in computer systems, commonly the central processing unit (CPU). As the name suggests, it is composed of a passive cooling unit (the heat sink) and a fan.

❖ The heat sink is usually made from a high-temperature conductive material such as aluminum and copper, and the fan is a DC brushless fan, which is the standard used for computer systems.

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Fig. 2.CPU Fan With Heat Sink

3.3 CPU FAN WITHOUT HEAT SINK:

- It's like a normal fan which provides normal cooling air that is like ceiling fan.
- We placed this fan for the purpose of providing cooling air that is coming from bottom side of the component i.e. from heat sink which is attached to Peltier module.
- It has 12V and 0.15amp capacity.

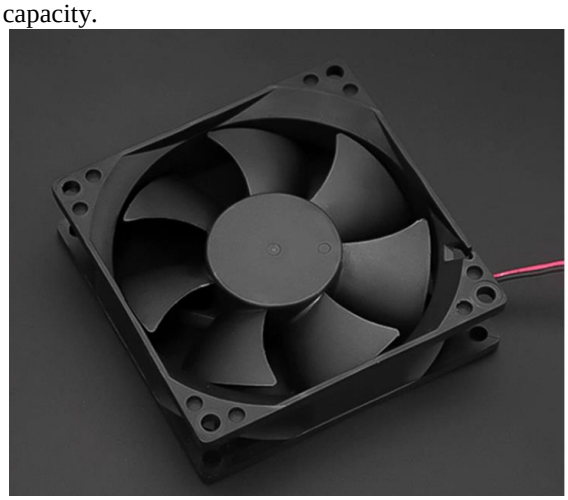

Fig.3. CPU Fan Without Heat Sink

3.4 ALUMINIUM HEAT SINK:

- Aluminum heat sinks are usually made from aluminum 1050 (very thermally conductive but low strength) or aluminum 6060, 6061, or 6063 (less conductive but with better mechanical properties). The most affordable heat sinks are generally made of aluminum alloy.
- We selected 6000 series as they are strong, malleable, and are ideal for extrusion for this project.
- We selected a size of 40mmX40mmX20mm aluminum heat sink.
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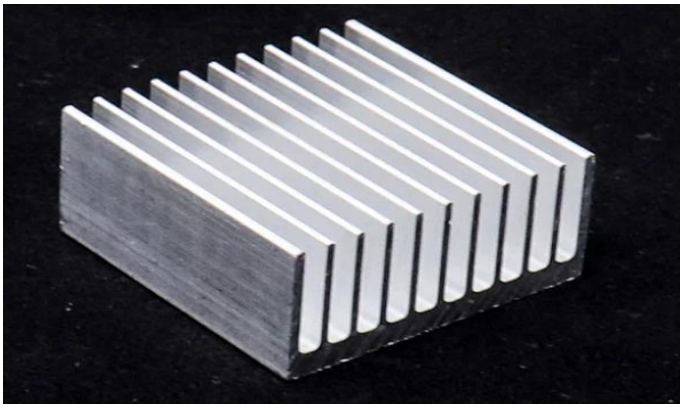

Fig 4. Heat Sink

3.5 PVC PIPE:

- We used 1 inch pipe for more cooling to be released.
- We make so many number of holes on it enter atmospheric air into it.
- We placed two CPU fans on the both sides of the pipes.

Fig 5. PVC Pipe

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3.6 ADAPTER:

- ❖ We used 12V 5AMPS capacity of adapter.
- ❖ For the entire component the requirement of power supply is only 12V 5AMPS. So we decided to use this adapter as power source.
- ❖ This adapter is more suitable for any electronics like laptops, pads, mobile equipment.

Fig 6.Adapter

Facricated MPC

Fig 7.Mobile Peltier Cooler

4. APPLICATIONS

- ❖ Since It Is A Mobile Cooler It Can Help More People Who Are Seeling Vegetables At Road Side In Hot Conditions.
- ❖ Countless applications in industrial processes are facilitated using thermoelectric modules. Examples are metallurgy, semiconductor lithography and hardening / curing needs.
- ❖ Thermoelectric cooling with Peltier elements is also used to cool Li-Ion-Batteries of electric cars, when charging the batteries.
- ❖ Thermoelectric cooling is used in medical and pharmaceutical equipment, spectroscopy systems, various types of detectors, electronic equipment, portable refrigerators, chilled food and beverage dispensers, and drinking water coolers.
- ❖ Recreational Vehicle Refrigerators, Mobile Home Refrigerators, Portable Picnic Coolers, Wine and Beer Keg Coolers, Residential Water Coolers/Purifiers. Laboratory and Scientific Equipment
- ❖ Inertial Guidance Systems, Night Vision Equipment, Electronic Equipment Cooling, Cooled Personal Garments, Portable Refrigerators. Consumer Products
- ❖ Some of the other potential and current uses of thermoelectric cooling are: Military/Aerospace
- ❖ Infrared Detectors, Integrated Circuit Coolers, Laboratory Cold Plates, Cold Chambers, Ice Point Reference Baths, Dewpoint Hygrometers, Constant Temperature Baths, Thermostat Calibrating Baths, Laser Collimators. Industrial Equipments

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❖ C Computer Microprocessors, Microprocessors and PC's in Numerical Control and Robotics, Medical Instruments, Hypothermia Blankets, Pharmaceutical Refrigerators - Portable and Stationary, Blood Analyzers, Tissue Preparation and Storage, Restaurant Equipment, Cream and Butter Dispensers. 32 Miscellaneous

❖ Hotel Room Refrigerators, Automobile Mini – Refrigerators, Automobile Seat Cooler, Aircraft Drinking Water Coolers.

5. EXPERIMENTAL RESULTS:

Table.1. Heat Produced On Cold Side Of Module

NO.OF PELTIER MODULES	PELTIER COOLING SIDE TEMPERATURE(℃)	ATMOSPHERIC TEMPERATURE (℃)	TEMPERATURE DIFFERENCE (ΔT)℃
1	22	28	6

❖ By considering cold side of the module, we concluded that if number of modules increases, the cooling produced by the module is may also increases.

Table.2. Heat Produced On Hot Side Of Module

NO.OF PELTIER MODULES	PELTIER HOT SIDE TEMPERATURE(℃)	ATMOSPHERIC TEMPERATURE (℃)	TEMPERATURE DIFFERENCE (ΔT)℃
1	35	28	7

❖ By considering hot side of the module, we concluded that if number of modules increases the heat produced by the module may also increases.

CONCLUSIONS:

This Mobile Peltier Cooler [MPC] can be used in dual mode operation, both heating and cooling. If we change the face of the Peltier module it operates as a heating device and also cooling device.This system can achieves minimum temperature of 20℃ and maximum temperature of 35 ℃ where maximum voltage occurs in about 30 minutes. For future development, this system can be used as a replacement of for conventional air-conditioner systems that use coolant that can be harmless for humans in long term. There is a huge scope of research in this field of improvement about thermoelectric materials, its fabrication, heat sink design etc. In future, a thermoelectric module based on cooling can cool 10X10 rooms with only few minutes in a avery less time. Peltier effect has a efficiency of around 10-15% compared to the refrigerants 40-60% efficiency. As with any component, reliability is an important part of the selection process with a multitude of factors potentially impacting performance. For Peltier modules, these factors can include the operating conditions, installation, and contaminants from outside sources.

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