IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, May 2022
Impact Factor: 6.252

Thermoelectric Air Condition

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Abstract: *In thermoelectric material, electrical energy can be directly converted into Thermal energy and thermal energy is converted into electrical energy. Direct conversion between electrical and thermal energy is possible due to two important thermoelectric effects one The Seebeck effect and other the Peltier effect. The Seebeck effect refers the existence of an electric potential across a thermoelectric material subject to temperature gradient. The Peltier effect refer to the absorption of heat in one end of a thermoelectric material and the release of heat from the opposite end due to the current flow through the material.*

Keywords: Peltier, Peltier Effect, Thermal Energy, Refrigeration

I. INTRODUCTION

In thermoelectric material, electrical energy can be directly converted into Thermal energy and thermal energy is converted into electrical energy. Direct conversion between electrical and thermal energy is possible due to two important thermoelectric effects one. The Seebeck effect and other the Peltier effect. The Seebeck effect refers the existence of an electric potential across a thermoelectric material subject to temperature gradient. The Peltier effect refer to the absorption of heat in one end of a thermoelectric material and the release of heat from the opposite end due to the current flow through the material.[7]

Thermoelectric cooling is commonly referred to a cooling technology using thermoelectric coolers. TECs has advantages of high reliability, no mechanical moving parts, compact in size, light in weight and no working fluid. In addition it has a advantage that it can be powered by direct current (DC) electric sources, When a voltage / DC current is applied to two dissimilar conductors a circuit can be created that allows for continuous heat transport between the conductors junctions this is the principle of thermoelectric air-condition. Air conditioning is a process of removing heat from a room or any other applications. There are many ways of producing a cooling effect like by vapour compression and vapour absorption air condition. These air conditioner produce cooling effect by using refrigerants like Freon and ammonia etc. It gives maximum output but one of the disadvantage is it produce harmful gases to the atmosphere. The harmful gases are like cluro fluro carbon and some other gases are present.[7]

This types of air conditioners have wide range of applications. An air conditioner is a major home appliance system or mechanism designed to change the air humidity and temperature within an area. The cooling is typically done using simple refrigeration cycle but sometimes evaporation is done commonly for comfort cooling in motor and vehicles buildings. Basically we use the vapour compression air-condition system which has many moving parts and as well as produce harmful gases to the environment. By using thermoelectric peltier modules air-conditioners we can overcome the existing air- conditioning system by modifying it to protect the environment from harmful gases

II. METHODOLOGY

2.1 Construction

Below fig shows a schematic constructional figure of thermoelectric cooling/AC which shows the components peltier, heat sink, fans etc.

Thermoelectric cooling uses the Peltier effect to create a heat flux between the junction of two different types of materials. A Peltier cooler, heater, or thermoelectric heat pump is a solid-state active heat pump which transfers heat from one side of the device to the other, with consumption of electrical energy, depending on the direction of the current. Such an instrument is also called a Peltier device, Peltier heat pump, solid state refrigerator, or thermoelectric cooler (TEC). It can be used either for heating or for cooling, although in practice the main application is cooling. It can also be used as a temperature controller that either heats or cools. The main components used in a Thermoelectric AC are explained below.

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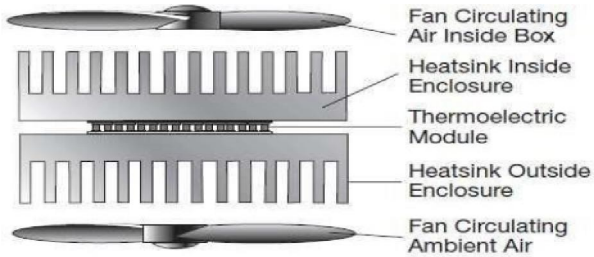
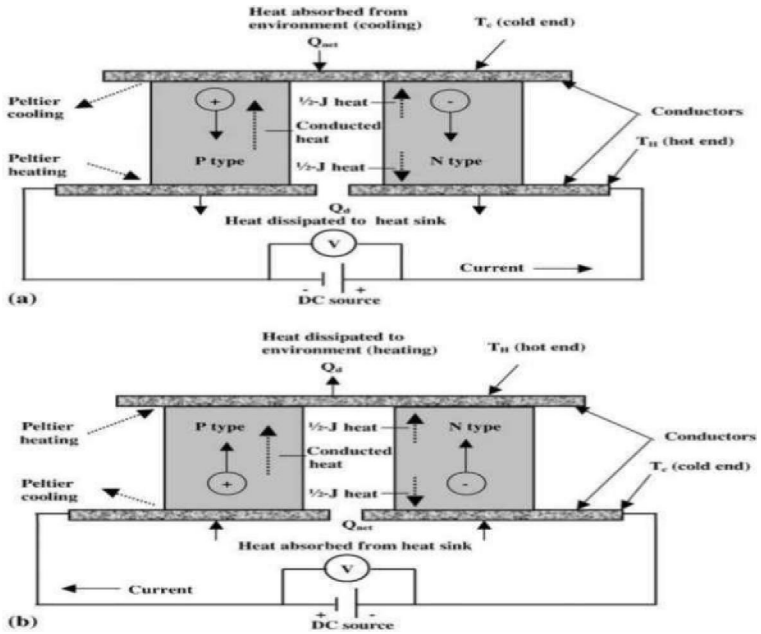
1. Switched Mode Power Supply(SMPS)
2. Peltier
3. Heat sink
4. Blower
5. Exhaust fans
6. Transformer & Digital thermometer



2.2 Working



The working of thermoelectric AC is mainly based on the working of peltier or peltier effect When a voltage is applied to the free ends of the two semiconductors of peltier there is a flow of DC current across the junction of the semiconductors causing a temperature difference. The side with the cooling plate absorbs heat from the heat sink attached which is then moved to the other side of the device where another heat sink is placed and thus cooling effect is generated across the peltier. This cooling effect is passed to the occupant with the help of cooling fans or blower used . The direction of heating and cooling is determined by the polarity of the applied voltage.

III. Problem Statement

Early mechanical refrigeration systems employed sulphur dioxide (SO_2), methyl chloride(CH_3CL) and ammonia(NH_3). Being toxic, sulphurdioxide(SO_2) and methyl chloride(CH_3CL) rapidly disappeared from the market with the introduction of CFCs.

The inert nature of many of the halo alkanes, chlorofluorocarbon (CFC) and HCFC particularly CFC-11 & CFC-12, made them the preferred choices in refrigerants for many years because of their non-flammability and non-toxicity

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property. However, their stability in the earth atmosphere and their corresponding global warming potential (GWP) and ozone depletion potential(ODP) raised concerns about their usage. This led to their replacement with hydro fluorocarbon (HFCs) and PFCs, especially HFC-134a, which are not an ozone depleting, and have less global warming potentials(GWP) . However, these refrigerants still have global warming potentials(GWP) thousands of times greater than CO_2. Therefore, they are now being replaced in markets where leaks are likely, by using a third generation of refrigerants, most prominently HFO-1234yf, which have global warming potentials(GWP) much closer to that of CO_2.

New refrigerants are developed in the early of 21st century which are safe for the environment, but their application has been held up due to concerns over properties like toxicity and flammability. Compared to halogenated refrigerants, hydrocarbons like isobutene (R-600a) and propane (R-290) offer several advantages: low cost and widely available, zero ozone depletion potential (ODP) and very low global warming potential (GWP). They are energy efficient, but are flammable and can form an explosive mixture with air if a leak occurs. Despite the flammability, they is increase in use of domestic refrigerators. EU and US regulations have their set of maximum charges of 57 or 150 grams of refrigerant, keeping the concentration in a standard form below 20% of the lower explosive limit(LEL). The lower explosive limit (LEL) can be exceeded inside the appliance, so that no potential ignition sources can be present. Switches must be placed out of the refrigerated compartment or should be replaced by sealed versions, and only the spark-free fans can be used. In 2010, about 1/3 of allhousehold freezers & refrigerators manufactured globally used isobutane or an isobutane/propane blend & this was expected to increase in 75% by 2020.

Thermoelectric cooling process uses the Peltier effect to create a heat flux between the junctions of 2 different types of materials. They can be used either for heating(in winter) or for cooling (refrigeration in summer), although in practice the main application is cooling. This technology is very less commonly applied to refrigeration than vapour compression(VC) refrigeration. The main advantages of a Peltier cooler are it consists of less moving parts or circulating liquid, near-infinite life and potential to avoid leaks(no leaks), and its small size and flexible shape & totally reduces the harmful effect of refrigerants on environment like ozone depletion & global warming.

Thermoelectric coolers/AC operate by the Peltier effect which also known by the more general name thermoelectric effect. The device has two sides a heating one and other cooling one, when a DC electric current flows through the device, it absorbs heat from one side to the other, so that one side gets cool while the other gets hot. The hot side is attached to a heat sink so that it remains at its ambient temperature, while the cool side goes below room temperature. In many applications, multiple coolers can be cascaded together for lower temperature effect.

3.1 Objective

1. To make a environment friendly Air conditioner.
2. Reduce the use of refrigerant which have adverse effect on environment.
3. Reducing the use of component like compressors, condensers etc.
4. Reducing the noise

IV. LITERATURE SUMMARY

Thermoelectric cooling uses the Peltier effect to create a heat flux between the junction of two different types of materials. A Peltier cooler, heater, or thermoelectric heat pump is a solid-state active heat pump which transfers heat from one side of the device to the other, with consumption of electrical energy, depending on the direction of the current. Such an instrument is also called a Peltier device, Peltier heat pump, solid state refrigerator, or thermoelectric cooler (TEC). It can be used either for heating or for cooling, although in practice the main application is cooling. It can also be used as a temperature controller that either heats or cools.

This technology is far less commonly applied to refrigeration than vapor- compression refrigeration is. The primary advantages of a Peltier cooler compared to a vapour-compression refrigerator are its lack of moving parts or circulating liquid, very long life, invulnerability to leaks, small size, and flexible shape. Its main disadvantages are high cost and poor power efficiency. Many researchers and companies are trying to develop Peltier coolers that are cheap and efficient.

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V. Conclusion

A Thermoelectric Air cooling & heating system was designed and built which can be used for personal cooling& heating. Four TECs were used for achieving the cooling with a DC power supply through external power supply. It had been shown from testing results that the cooling system is capable of cooling& heating the air when re circulating the air with the help of blower. TEC cooling designed was able to cool an ambient air temperature from 32.5°C to 22.1°C. Cooling stabilizes within ten minutes once the blower is turned ON (with a velocity of 2 m/s). The system can attain a temperature difference of set target which was 6°C. Accomplishing the set target establish the success of the project. All the components in the project had been tested individually and the results were found to be positive.

VI. Scope for the Future Work.

The AC can be made compact by selecting as single TEC of higher power i.e. of 200W or 300W cooling capacity. A proper air flow pattern can increase the performance of AC. More efficient type of Heat sink if used in cooling and heating side can also increase the performance. If a proper arrangement is made for that the 100% of air comes in contact with the heat sink can also give positive effect on performance of AC. A proper design of the model and its component should be done.

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