SOLAR POWERED AIR CONDITIONING SYSTEM USING PELTIER EFFECT

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Abstract: This paper is to demonstrate about research on a solar powered air conditioner system using a peltier which undergoes peltier effect to produce the temperature difference. In recent years, with the increase awareness towards environmental degradation due to the production, use and disposal of ChloroFluoro Carbons (CFCs) and Hydro Chlorofluorocarbons (HCFCs) as heat carrier fluids in conventional refrigeration and air conditioning systems has become a subject of great concern and resulted in extensive research into development of novel refrigeration and space conditioning technologies. Thermoelectric cooling provides a promising alternative R&AC technology due to their distinct advantages. Thermoelectric solid-state air conditioners can be a cost-effective solution for cooling electronic and electrical equipment and devices housed in enclosures and cabinets. With relatively low energy requirements and the ability to provide both cooling and heating from the same device when needed. It plays a vital role in the current market and environmental situation to conserve, recycle and reduce the consumption of combustible fuels which emit carbon particles and damage the balance of ecosystem. Therefore, the objective is to design a solar electric system with the help of a thermoelectric cooler (peltier), heat sink to regulate the heat flow, Solar panel to harness the solar radiant energy which produces a necessary voltage. The research aims to design and build a miniature prototype of thermoelectric cooling system for a conventional air conditioned to provide air conditioning to reduce the consumption of electricity and to reduce the pollution.

Index Terms – **Peltier effect, Solar panel, Heat sink, Thermoelectric cooler, Air conditioning system.**

I INTRODUCTION

In thermoelectric materials, electrical energy can be directly converted into thermal energy and thermal energy into electrical energy. Peltier effect which states that "When an electric current is passed through a circuit of a thermocouple, heat is evolved at one junction and absorbed at the other junction". Direct conversion between electrical and thermal energy is possible because of two important thermoelectric effects: the Seebeck effect and the Peltier effect. The Seebeck effect refers to the existence of an electric potential across a thermoelectric material subject to a temperature gradient. The Peltier effect refers to the absorption of heat into one end of a thermoelectric material and the release of heat from the opposite end due to a current flow through the material.

This paper presentation is approach towards the implementation of least cost technology into our daily life to make living comfortable and convenient. Thermoelectric cooling, commonly referred to as cooling technology using thermoelectric coolers (TECs), has advantages of high reliability, no mechanical moving parts, compact in size and light in weight, and no working fluid. In addition, it possesses advantage that it can be powered by direct current (DC) electric sources, When a voltage or DC current is applied to two dissimilar conductors, a circuit can be created that allows for continuous heat transport between the conductors's junctions this is the principle of thermoelectric air-condition. Air conditioning is a process of removing heat from a room or other applications. Many ways of producing a cooling effect by like vapour compression and vapour absorption air condition. These air conditioners are producing cooling effect by using refrigerants like Freon and ammonia etc. It gives maximum output but, one of the disadvantages is producing harmful gases to the atmosphere. The harmful gases are cluro fluro carbon and some other gases are present.

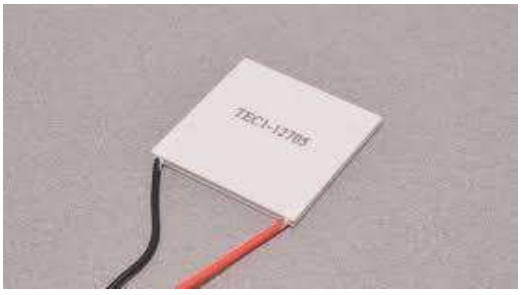
II HARDWARE REQUIREMENTS

2.1 Hardware Requirements

a) Peltier

A Peltier is used to control the air temperature. It helps in getting the difference temperature of atmospheric temperature to the required temperature with the help of heat sink by knowing the cold side and the hot side of the peltier. the cooling of one junction and the heating of the other when electric current is maintained in a circuit of material consisting of two dissimilar conductors; the effect is even stronger in circuits containing dissimilar semiconductors.

Fig 1: Peltier (TECI-12705)



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-Athanase Peltier.

b) Solar panel

Solar panels are used to harness the photovoltaic energy from the sunlight. These are electrically connected in series or parallel to produce electricity which runs the entire system. Solar panels of 20 watts of Vmax are used to harness the electricity required.

Fig 2: Solar panel

A PV module is an assembly of photo-voltaic cells mounted in a framework for installation. Photo-voltaic cells use sunlight as a source of energy and generate direct current electricity. A collection of PV modules is called a PV Panel or a solar panel, and a system of Panels is an Array. Arrays of a photovoltaic system supply solar electricity to electrical equipment. It also helps in improving the efficiency of the system and is also environmental friendly as it consumes renewable source of energy.

c) Heat Sink

A heat sink is a passive heat exchanger that transfers the heat generated by an electronic or a mechanical device to a fluid medium, often air or a liquid coolant, where it is dissipated away from the device, thereby allowing regulation of the device's temperature at optimal levels.

Fig 3: Heat sink

In this device, heat sinks are used to regulate the heat flow between the cold side and hot side of the thermoelectric cooler (peltier) so that cooling can be achieved on one side while the hot side absorbs the heat in that volume of space . Heat sinks are used with high-power semiconductor devices such as power transistors and optoelectronics such as lasers and light emitting diodes (LEDs), where the heat dissipation ability of the component itself is insufficient to moderate its temperature. It plays a vital role in providing the process of the system.

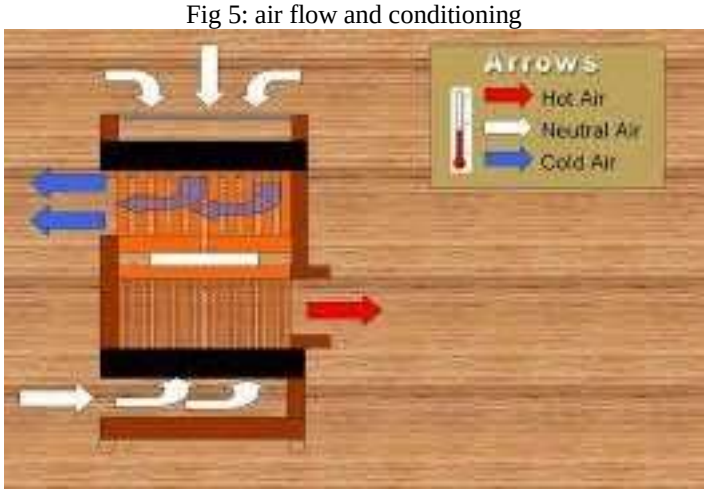
d) LM7809 Voltage regulator

The 7809 is a fixed voltage linear regulator that can output 9V at up to 1A current with an input voltage range of 11 – 35V. The 78xx series of fixed-voltage linear regulators are some of the most popular linear regulators available and have been around for a very long time. They have built-in current limiting and over temperature protection and tend to be fairly robust devices. The prefix may vary depending on the mfr so you may see them listed as LM78xx, MC78xx, L78xx or just 78xx.

Fig 4: LM7809 Voltage regulator

III WORKING PRINCIPLE

Fig 5: air flow and conditioning



The cooling effect produced by the system is basically from the peltier effect**.** Peltier effect is temperature difference obtained by applying a voltage between two electrodes connected to a sample of semiconductor material to create a hot side and a cold side. The temperature of the inlet from the vents and the heat sink creates a difference in the temperature with the help of peltier and producing a cooling effect.

The Peltier coefficients represent how much heat is carried per unit charge. Since charge current must be continuous across a junction, the associated heat flow will develop a discontinuity if Π_A and Π_B are different. The Peltier effect can be considered as the back-action counterpart to the Seebeck effect: if a simple thermoelectric circuit is closed, then the Seebeck effect will drive a current, which in turn (by the Peltier effect) will always transfer heat from the hot to the cold junction. The close relationship between Peltier and Seebeck effects can be seen in the direct connection between their coefficients: $\Pi = TS$

Where Π_A and Π_B are the Peltier coefficients of conductors A and B, and I is the electric current (from A to B). The total heat generated is not determined by the Peltier effect alone, as it may also be influenced by Joule heating and thermal-gradient effects

IV HARDWARE SET UP FOR IMPLEMENTATION

Fig 6: experimental setup of solar powered air conditioner

The above figure 6 shows as experimental setup of solar air cooler. Procedure for installation of as follows below-

1) All the components are tested individually for their working condition.
2) Make the necessary connections to establish a working circuit.
3) Make the solar panel is tilted towards the maximum sunlight radiation.
4) After making the right connections switch on the power supply.

5) Gradually check for temperature difference between the ambient and in-box temperature.
6) Regulate the temp using voltage regulator to maintain a constant air conditioning.

Results and discussions- A temperature difference of 10 degrees is achieved after the system is run for 15mins, a COP of 0.64 is achieved. We can have the control on SAC using the control switch (ON/OFF).

V CONCLUSION

By completing this project, we have achieved clear knowledge of comfort cooling system for humans by using non-conventional energy. This project would be fruitful in both domestic and industrial backgrounds. 5 peltiers are not enough to cause proper cooling in a box of 25X35X24, depending on the cooling fan used with heat sink to obtain cooling. Takes very long time to cause minor drop in temperature resulting in longer time duration to achieve the desired cooling temperature.

Solar was used to run the peltier system but due longer waiting time for the solar panel to generate electricity, 5 9V batteries were temporarily used to run the peltier and later solar panels were used to charge the battery.

Future work

There are variety of enhancements that could be made to this system to achieve greater temperature difference. It is possible using different methods with peltier and can also be achieved when the required volume of cooling is comparatively smaller and more efficient.

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