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Fabrication Of Solar Operated Refrigeration And Oven By Using Peltier Plates

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***Abstract*:** Thermoelectric Cooling (TEC) solar refrigerator runs on energy provided by sun, which includes photovoltaic or solar thermal energy. The Thermoelectric module refrigerator work on the principle of Peltier effect. Recently, the application of TEC modules in an industry is dramatically increased. They have been adopting the solar refrigeration, widely recognized as alternative to the conventional vapour compression system for their merits of energy saving and being eco-friendly. The paper presents a design of TEC solar refrigeration using thermoelectric cooling and heating. The aim of this paper is to establish an alternative eco-friendly refrigeration cycle for producing a temperature usually encountered in a conventional refrigerator. By designing and manufacturing such type of refrigerator adds new dimension to the world of refrigeration. The proposed solar refrigeration system using TEC module is a feasible alternative for local refrigeration system. Briefly, the paper presents an economical and feasible model of solar refrigeration system.

Key Words: **Thermo-Electric Module, Peltier Effect, Solar Energy, Refrigeration, Oven system.**

I.INTRODUCTION

Recent years have seen a resurgence of interest in thermoelectric heating (or cooling) technology because of its unique advantages over more traditional methods like electric heating (or cooling) systems and vapour-compression. Thermoelectric (TE) modules are solid-state heat pumps (or refrigerators in case of cooling) that utilize the Peltier effect between the junctions of two semiconductors. The TE modules require a DC power supply so that the current flows through the TE module in order to cause heat to be transferred from one side of the TE module to other, thus creating a hot and cold side . 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 basic device is insufficient to moderate its temperature.

In an era where sustainability and renewable energy are at the forefront of technological innovation, the integration of multiple functionalities into single systems has become a hallmark of efficiency and practicality. Among such innovative solutions stands the concept of a "Solar Powered Thermo-Electric Refrigeration cum Oven System." This cutting-edge technology not only harnesses the power of the sun to provide cooling for perishable goods but also utilizes its energy to enable cooking capabilities, all within a single, self-contained unit. By leveraging solar energy, this system offers a sustainable and environmentally friendly approach to both food preservation and meal preparation, with potential applications ranging from off-grid households to remote communities and disaster relief efforts. In this article, we delve into the workings and benefits of this innovative system, exploring its components, functionality, and real-world implications.

Moreover, the portability aspect of these solar-operated appliances enhances their practicality, allowing users to enjoy refrigeration and cooking capabilities even in remote locations such as camping sites, outdoor events, or emergency situations. By harnessing the power of the sun, these compact and efficient systems offer a sustainable solution to the challenges of food preservation and meal preparation, promoting self sufficiency and environmental stewardship in today's energy-conscious world.

II.LITERATURE REVIEW

[1] Arjun Kumar G B, Pruthviraj B G , Chethan Kumar Y K , Rashmi P:(Design and Implementation of Peltier Based Solar Powered Portable Refrigeration Unit) In this paper to introduce the portable refrigerator using peltier module with solar energy as supply which overcomes the disadvantages of existing refrigerator with increase in population and environment degradation there is an alarming rate for thermoelectric couple system have come to rescue as these are environmental friendly, affordable and compact in size.

[2] Julian Albert D. Nohay, John Karl H. De Belen, John Vernon B. Claros(Design and Fabrication of a Portable Solar Powered Thermoelectric Refrigerator for Insulin Storage) In this study , to design, develop and fabricate a solar-powered portable refrigerator that will be able to attain the desired temperature for the storage of insulin. In the design, a thermoelectric refrigerator operating under the principle of Peltier effect was fabricated.

[3] Shuwang Chen, Jun Zuo and Dan Xie(Design of solar power semiconductor refrigerator) Proceedings of the 8th World Congress on Intelligent Control and Automation, IEEE , 2010.In this paper , A solar energy semiconductor cooling box is Presented. compared with the normal mechanical refrigeration, the semiconductor refrigeration system which makes use of Peltier effect does not require pumps, compressors and other moving parts, and so there is no wear and noise.

III.METHODOLOGY

In this we first explain the definition of the problem than plan and conducted the market research and prepared the bill of materials with this make space for Peltier module and calculate the specification of module than made the circuit connection and assemble the parts.

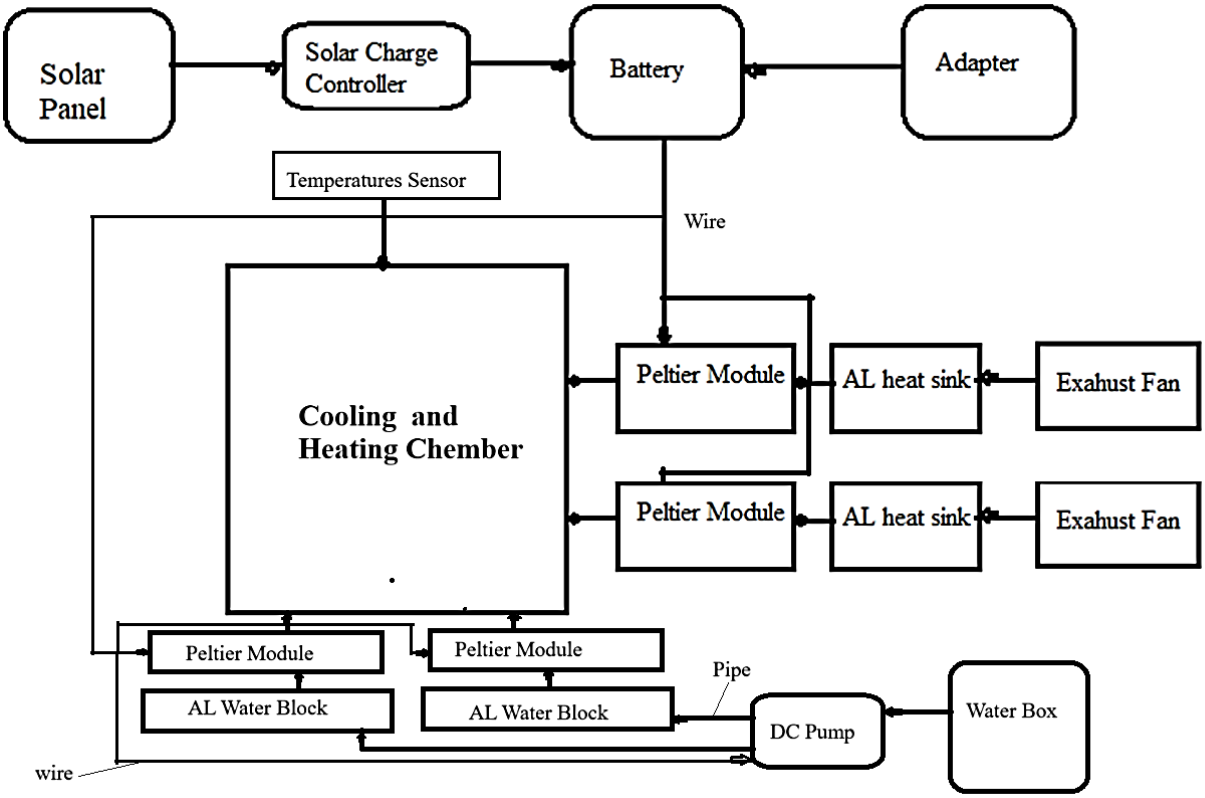
Generally we see that refrigeration process uses electric energy which is not available at most of the remote places in our country .we know that sun energy is available everywhere which also green energy and renewable energy source. We also save electric energy here. From last century till now refrigeration has been one of the most important factors of our daily life.

The current tendency of the world is to look at renewable energy resources as a source of energy. This is done for the following two reasons; firstly, the lower quality of life due to air pollution; and, secondly, due to the pressure of the ever increasing world population puts on our natural energy resources. From these two facts comes the realization that the natural energy resources available will not last indefinitely.

The basic idea is implementation of photovoltaic driven refrigerating system powered from direct current source or solar panel (when needed) with a battery bank. The See beck, Peltier and Thomson effects, together with several other phenomena, form the basis of functional thermoelectric modules.

Thermoelectric module aims at providing cooling effect and heating by using thermoelectric effects rather than the more prevalent conventional methods like those using the vapour compression cycle or the gas compression cycle.

3.1BLOCK DIAGRAM



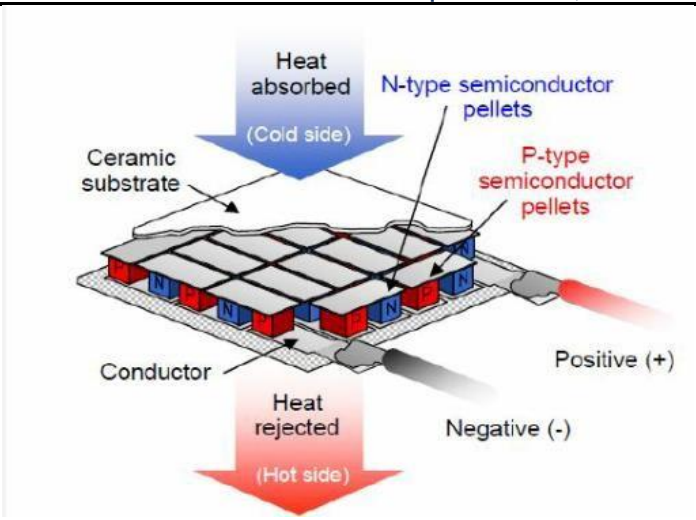
3.2WORKING

A thermoelectric device will create a voltage when there is temperature difference on each side of the device. On the other hand when a voltage is applied to it, a temperature difference is created. The temperature difference is also known as Peltier effect. Thus TEC operates by the Peltier effect, which stimulates a difference in temperature when an electric current flows through a junction of two dissimilar materials. A good thermoelectric cooling design is achieved using a TEC, which is solid state electrically driven heat exchanger. This depends on the polarity of the applied voltage. When TEC is used for cooling, *Nagpur*

it absorbs heat from the surface to be cooled and transfers the energy by conduction to the finned or liquid heat exchanger, which ultimately dissipates the waste heat to the surrounding ambient air by means of convection. In this project we are using solar panels for charging a Lead Acid Battery (12V, 1.2 Amp hrs), a Peltier thermoelectric device when connected to battery generates cool effect and hot effects depending on the mode required by the user. Since we are using this for fridge & oven we need only cool mode & heat mode. A Peltier thermoelectric device is connected to the battery to generate cooling & heating effect. From the solar panel specific amount of energy is controlled through the solar controller and smps model. The temperature sensor is connected to the Peltier plates so the temperature reading of the Peltier plates is shown in the display of temperature sensor. For the charging of the battery through the AC supply SMPS Model is added that converts the AC supply to DC and it charges the battery. To Avoid overheating of the Peltier plates water blocks is added connected to water chamber with DC Water pump.

3.3Operating Principle Of The Thermo-Electric Module

The TEM operating principle is based on the Peltier effect. The Peltier effect is a temperature difference created by applying a voltage between two electrodes connected to a sample of semiconductor material to create a hot side and a cold side. The cold side of the thermoelectric module is utilized for refrigeration purposes; provide cooling to the refrigerator space. On the other hand, the heat from the hot side is utilized for heating purpose. In a thermo-electric heat exchanger the electrons acts as the heat carrier. The heat pumping action is therefore function of the quantity of electrons crossing over the p-n junction.



IV.ADVANTAGES

We believe that thermoelectric cooling offers a number of advantages over traditional refrigeration methods, as:

1. No moving parts, eliminating vibration, noise, and problems of wear.
2. No Freon's or other liquid or gaseous refrigerants required,
3. High reliability and durability.
4. Compact size and light weighted,
5. Relatively low cost and high effectiveness,
6. Eco-friendly C-pentane, CFC free insulation
7. Reversing the direction of current transforms the cooling unit into a heater.

V.DISADVANTAGES

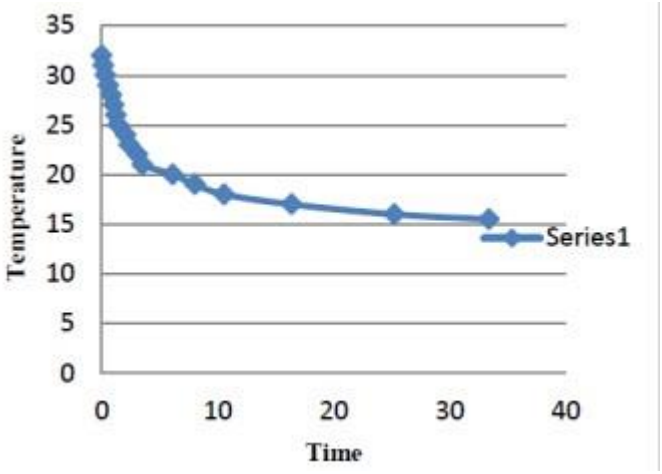
1. C.O.P. is less as compared to conventional refrigeration system.
2. Suitable only for low cooling capacity.

VI. Applications

1. Can be uses for remote place where electric supply is not available.
2. Medical and pharmaceutical equipment.
3. Military applications.
4. Laboratory, scientific instruments, computers and video cameras.
5. Outside cooling, conveying the compact fridge along for food safeguarding, drinks protection, meds and so on.
6. In provincial India, in summers when there is no power, sun based controlled thermoelectric cooler comes as a consolation.

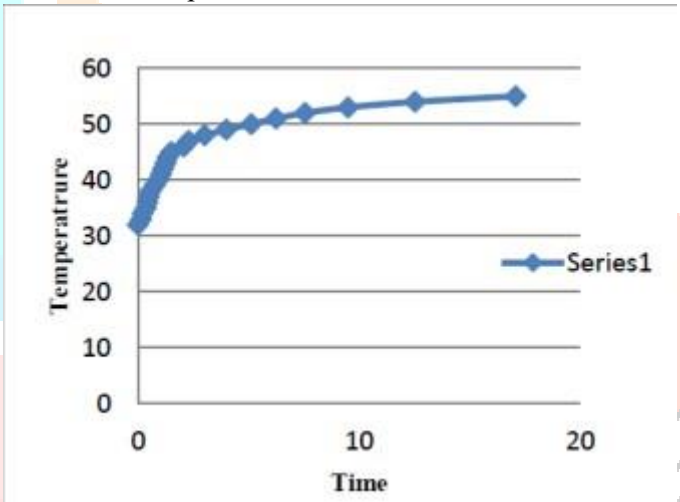
VII.RESULTS AND DISCUSSIONS

We have done experimentation on project without load. Cooling and heating by using Peltier circuit is done. Temperature change with respect to time is measured,



GRAPH 1-COOLING (WITHOUT LOAD)

Cooling by thermo-electric device reduces temperature 32oC to 15.5oC in 35 minutes.



GRAPH 2-HEATING (WITHOUT LOAD)

Heating by thermo-electric device increases temperature 32oC to 60oC in 20 minutes.

Conclusion

A portable Heating & Cooling system was fabricated using thermoelectric module & electric control unit & tested for the cooling and heating purpose. The system is self powers & can be used in isolated & a remote part of the country where load-shading is a major problem. The important aspect to be noted is that it is a onetime investment & is free from maintenance. The heating & cooling rates for different modes of heat transfer (conduction & convection) for water; fruit (orange) & metal (Al) are analysed. Analysis of various materials such as metal, fruit and water is plotted on graph as time on X-axis and temperature on Y-axis. The analysis of various materials indicates that a. Cooling rate for conduction of water is higher compared with convection of water. b. The heating rate of water is higher than cooling rate. Further improvement in the efficiency of the system may be possible through improving module contact-resistance & thermal interfaces. This could be achieved by installing more modules in order to cover a greater surface area of the system.

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REFERENCES

1].Mr. Swapnil B Patondet. al., ―Experimental Analysis of Solar operated thermo electric heating and cooling system‖. IJETT Volume 20 Number 3 Feb-2015. [2]. Chetanjangondaet, al., ―Review of Various Application of Thermoelectric Module‖. IJIRSETISSN(Online) : 2319- 8753 ISSN (Print) : 2347-6710 Vol. 5, Issue 3, March 2016

[3].Prof. Pushkarny B.H et, at., ―Solar Refrigeration Using Peltier Effect‖. IJRAME ISSN (ONLINE): 2321-3051 Vol.4 Issue 2, February 2016 Pgs: 67-74

[4].B. I. Ismail and N. Alabdrabalnabi ―Design and Performance Characteristics of a Portable SolarDriven Thermoelectric Heat Pump under Thunder Bay Extreme Cold Conditions in Northwestern Ontario, Canada‖. Journal of Green Engineering, Vol. 4, 117–134. do: 10.13052/jge1904-4720.422

[5].Vinay gharatet, al., ―Design and Construction of Solar Operated Thermo-Electric Heating and Cooling System‖. IJETAE, ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 6, Issue 3, March 2016 [6]. Solar Refrigeration Using the Peltier Effect", by J.C.Swart, School of Electrical Engineering at the Cape Technicon.