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Solar Operated Portable Thermo-Electric Refrigeration Cum Oven System

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Abstract:- Solar energy, such as photovoltaic or solar thermal energy, powers thermoelectric cooling (TEC) solar refrigerators. The Peltier effect is the basis for the thermoelectric module refrigerator's operation. The use of TEC modules in an industry has grown significantly in recent years. They have been using solar refrigeration, which is well known for being an environmentally benign and energy-efficient substitute for the traditional vapor compression technique. The design of TEC solar refrigeration with thermoelectric heating and cooling is presented in this study. The purpose of this work is to develop a different, environmentally friendly refrigeration cycle that can achieve the same temperature as a typical conventional refrigerator. The realm of refrigeration is expanded by the design and production of such a refrigerator. The solar refrigeration system that is being suggested

Keyword: **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 that use the Peltier effect between two semiconductor junctions to function as refrigerators in the case of cooling. For heat to be transported from one side of the TE module to the other and create a hot and cold side, the TE modules need a DC power source so that current may flow through them. Heat sinks are employed in conjunction with high-power semiconductors, such power transistors, and optoelectronics, like light-emitting diodes (LEDs), in situations where the fundamental device's capacity for heat dissipation is inadequate to control temperature. A cabinet could be made by Any of a large variety of synthetic or semi-synthetic organic materials that are pliable and can be molded into solid objects in a variety of shapes make up plastic. Although they may incorporate other materials, plastics are primarily made of high molecular mass organic polymers. Many of them are partly natural, but most are synthetic, typically generated from petrochemicals. The capacity to permanently deform without breaking is known as plasticity, and it is a general attribute of all materials. However, this class of moldable polymers exhibits this ability to such an extent that its name emphasizes it.

II. BLOCK DIAGRAM:

When there is a temperature difference on both sides of a thermoelectric device, a voltage is produced. On the other hand, a temperature differential is produced when a voltage is supplied. The Peltier effect is another name for the temperature differential. Hence, the Peltier effect, which occurs when an electric current passes across the junction of two dissimilar materials, causes a temperature differential, is how TEC functions. A solid state electrically powered heat exchanger, or TEC, is used to develop an effective thermoelectric cooling design. The polarity of the applied voltage determines this. When TEC is used for cooling, heat is taken up from the surface that needs to be cooled and conducted to a finned or liquid heat exchanger, which convectively releases the waste heat into the surrounding ambient air. Here, we're using the Micro Controller (AT89S52), which enables quicker and more dynamic control. The system's LCD (liquid crystal display) makes it easy to operate. In this project, a lead acid battery (12 V, 1.2 Amp hours) is being charged by solar panels. A Peltier thermoelectric device is attached to the battery to produce either a hot or cold effect, depending on the user's selected mode. We just need the cool setting because we are using this as a fridge. To create a cooling effect, a peltier thermoelectric device is linked to the battery. We use the ADC0808 that is provided to the controller in order to display the voltage. In order for this ADC to function, we are providing clock pulses via a 555 timer. A regulated 5V, 500mA power supply is used in this project. Voltage regulation is accomplished with a 7805 three terminal voltage regulator. A bridge type full wave rectifier is utilized to rectify the ac output of the step down transformer's secondary (230/12V).

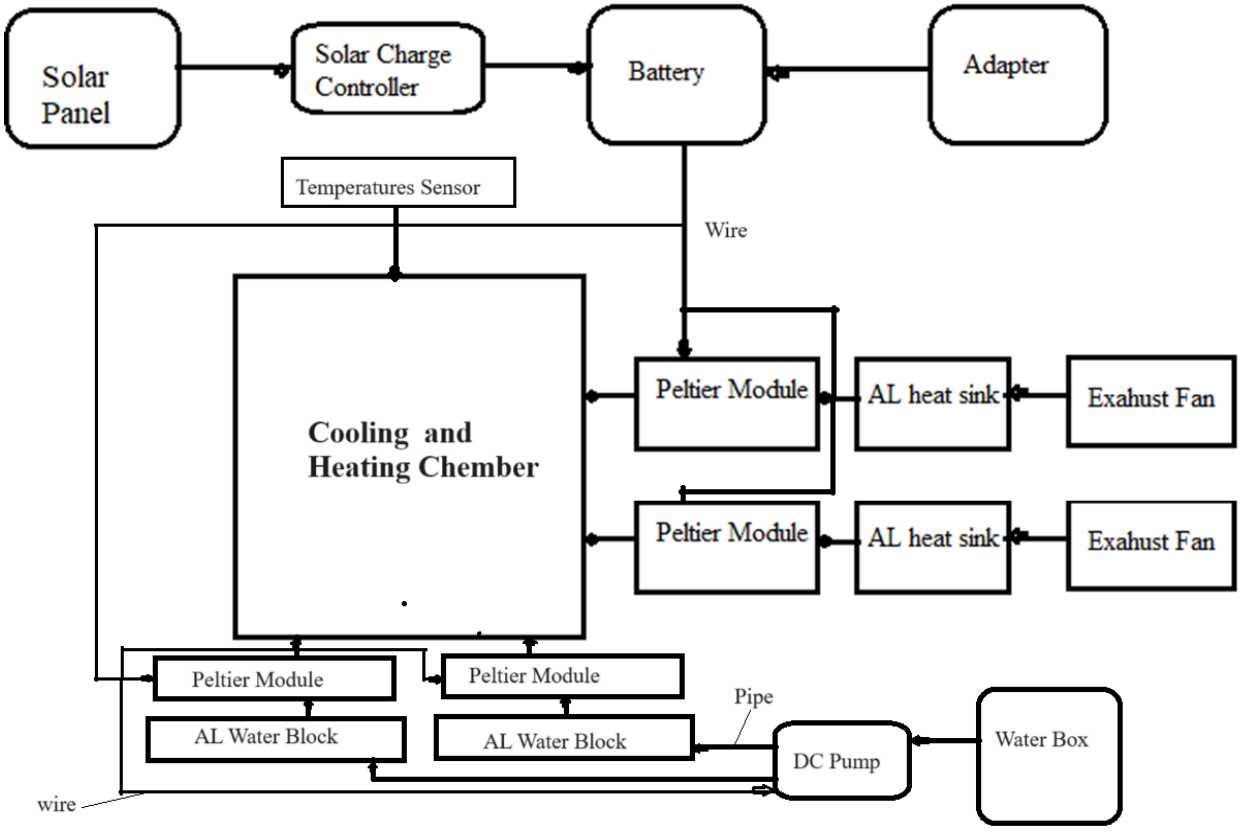

Figure 1: Block Diagram

III. HARDWARE IMPLEMENTATION

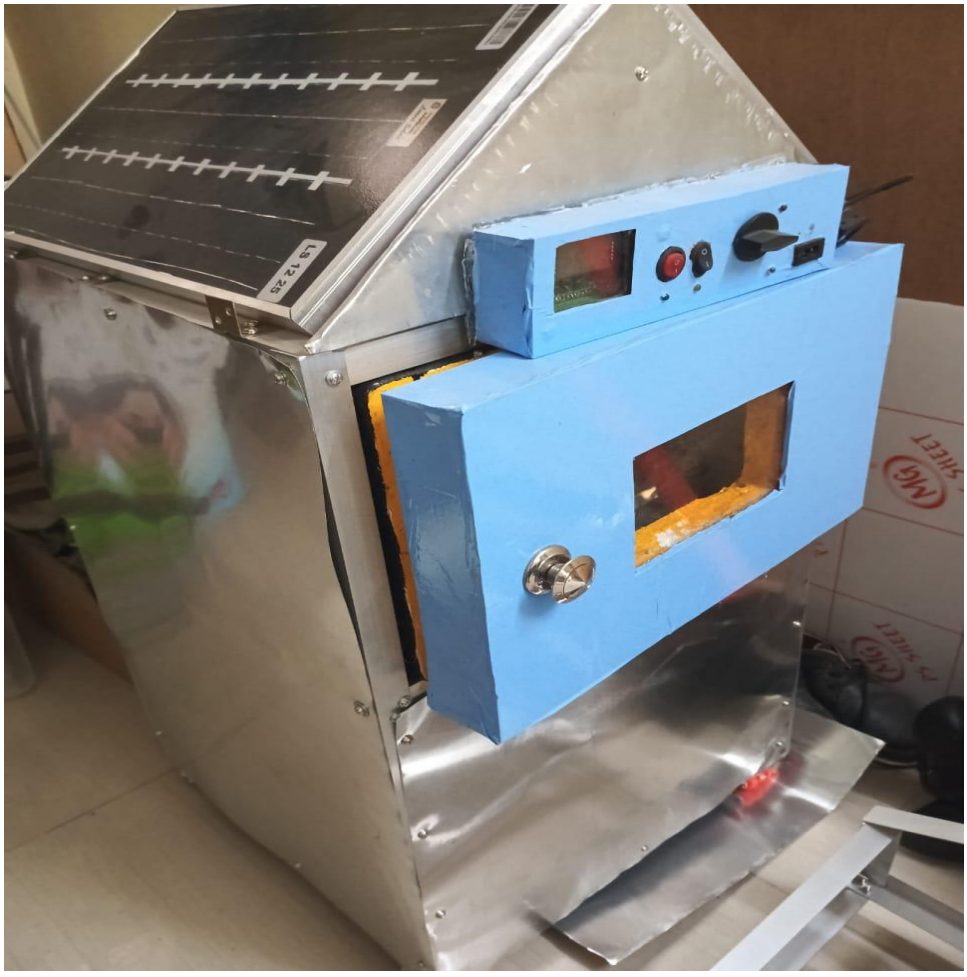

Figure 2: Real Image of the Project

The TEM operating mechanism is based on the Peltier effect. The Peltier effect, a temperature differential, is produced by applying a voltage between two electrodes that are attached to a semiconductor material sample to create a hot side and a cool side. The cold

side of the thermoelectric module is utilized for refrigeration, which cools the refrigerator area. On the other hand, heat from the hot side is used to achieve heating. An electron serves as the heat carrier in a thermoelectric heat exchanger. Therefore, the heat pumping activity is determined by the number of electrons that cross the p-n junction.

Thermoelectric plate heating and cooling efficiency

- Heating up to :- 70 to 80 Degree Celsius.
- Cooling up to:- 5 to 8 Degree Celsius.

Energy produced by 40 W solar plate

The 40 W of 2 solar panel can produce 80 W of output of DC power during peak solar hours.(on 2 to 3 hour in sunlight).

Load Calculation of Battery

- Load calculation = 12 V * 14 A
  = 168 W. (max capacity)

Load consumption

- When plate is heating :- 12V * 6A =72 W/H (Which is 259200 joules).
- When plate is cooling :- 12V * 2A =24 W/H (Which is 86400 joules).
- Overall load consumption of the system : Maximum on heating= 72 W/H.
  Minimum on cooling=24 W/H.

Battery backup

It can operate up to 4-5 hours.

OBSERVATION

- This thermoelectric type combines the functions of an oven and refrigerator onto a single plate, allowing for temperature control. This means that we can heat and cool the material with a single Peltier plate (a thermoelectric module).
- The primary distinction with the current system is that our project operates without the need for freezing systems.

V.Methodology

This involves defining the problem, planning, carrying out market research, creating a bill of materials, making room for the Peltier module, calculating the module's specifications, connecting the circuit, and assembling the components. Generally speaking, the refrigeration process requires electric electricity, which is unavailable in the majority of our nation's distant locations.We are aware that solar energy, along with green and renewable energy sources, is ubiquitous. Here, we also conserve electric power. Refrigeration has been one of the most significant aspects of our everyday lives since the turn of the century. The global trend at the moment is to consider renewable energy sources as a source of power. This is done for two reasons: first, the declining quality of life brought on by air pollution; and second, the strain that an ever-growing global population places on our natural energy supplies. The understanding that there are finite natural energy resources stems from these two realities. The fundamental concept entails utilizing a photovoltaic driven refrigeration system that is fueled by a battery bank and direct current sources, or solar panels when necessary. Functional thermoelectric modules are based on a number of phenomena, including the Seebeck, Peltier, and Thomson effects. The purpose of the thermoelectric module is to provide heating and cooling by the use of thermoelectric effects, as opposed to the more widely used conventional methods such as the gas compression cycle or the vapour compression cycle.

VI.Conclusion

Using an electric control unit and thermoelectric module, a portable heating and cooling system was constructed and tested for both heating and cooling purposes. The system is self-sufficient and suitable for usage in isolated and remote areas of the nation where load-shading is a significant issue. The fact that it requires no maintenance and is an upfront expenditure is a crucial point to remember. Improving the module's contact-resistance and thermal interfaces may allow for even more system efficiency gains. This could be accomplished by expanding the system's surface area by inserting extra modules.

VII.Future scope

1. In addition to the detrimental effects of pollution, civilization is currently facing an energy crisis. A "Green Technology" that produces power without causing any harm is thermoelectricity.

2. Sites like as universities, industrial areas, furnace districts, metropolises, and educational institutions can be chosen for the construction of these energy centers since they provide readily available waste heat that can be recycled using the same technique.

3. The car's air ventilation system would make use of this system. 4. This system serves as a catalyst for the implementation of government plans such as solar cities.

VIII.Reference

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