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Solar Refrigerator

Ajendra Kumar Singh
Assistant Professor, Dept. of Mechanical Engineering
Amity University Uttar Pradesh Lucknow Campus
Lucknow, India

***Abstract*— Refrigeration is very important in many areas these days. Food storage sector, blood banks, hospitals, defense sector etc, have seen a lot of refrigeration use. General refrigeration technique involves a vapor compression cycle, which uses various components like compressor, condenser, refrigerant. Also it involves a good amount of electricity to maintain the refrigeration. The current paper involves modeling and fabrication of a refrigeration system that works on peltier principle. This refrigeration system uses solar energy for battery charging, which is further used for maintaining the refrigeration. This system has two major benefits, the first is, it uses the renewable source of energy and the second is, it has no refrigerant so its fully environment friendly. This paper involves basic setup and principle for the modeling of a solar refrigerator.**

Keywords*— *Solar refrigeration, peltier effect, thermoelectric cooling

I. INTRODUCTION

These days the requirement of refrigeration and air conditioning has increased at a good pace. Conventional air conditioning systems works with moving components and also uses refrigerants. These refrigerants evaporate to the environment and pollute it in various ways. The other issue related with the conventional air conditioning systems, is the huge amount of power consumption. In order to take care of these drawbacks a new concept was introduced in the year 1834 by Jean Charles Athanase peltier. When two dissimilar materials are joined and a current is passed at the interface, the energy levels of materials are changed at atomic level and there comes a phenomenon in which, at one end, heat is released and at the other end heat is absorbed. Peltier found that this is because of the combination of p and n type of semiconductor materials. When the electron jumps from p type of material to n type of material , it jumps to higher energy level and it absorbs energy from surroundings and thus makes one end cooler. The converse is also true that if the electron jumps from n type of material to p type of materials, it goes to lower level of energy and releases energy and thus makes other end hotter.

Thermoelectric cooling and power generation- peltier effect can be used in both ways, for thermoelectric cooling and for thermoelectric power generation. For this method two dissimilar materials (p type and n type) are connected. Now for using it as a cooler, a current is passed at the interface, this makes one to go cooler and other side gets heated, however a fan or cooling fins may be used to dissipate the heat and increase heat flux. Now to use it as thermoelectric generator, the same combination of materials is taken and its one end is heated than the other, the heat flux thus generated gives rise to an EMF in the connected circuit.

A. Solar referigerator

The major components which are used for the construction are-

- 12v and 20w solar panel for battery charging.
- 6v and 4.5A battery.
- MPPT (maximum power point tracking) solar charging module.
- Materials used are alloys of bismuth and tellurium.
- A heat sink with aluminum fins.

The construction (fig.1) involves connecting both materials first and then a electric circuit is formed using the battery terminals and material interface. This is the discharging circuit of the battery. Now another circuit for charging the battery is formed via solar panel through the MPPT module. The charging current from solar module is always intermittent and not constant. Therefore, a MPPT module is introduced, its job is to protect the battery and also to optimize the charging of battery. The solar panel module is not used without battery because the battery acts as a buffer and gives a stabilized voltage to the system.

B. Working

As the circuit is completed, the current is passed at the interface of the connected materials. The system consists of p type and n type of materials. With the flow of current through the materials the p type material becomes hotter and the n type material becomes cooled because the current tries to establish equilibrium of electron in two materials. However, by changing the polarity of circuit the hot and cold junction will get change again. The colder part is attached to the space, needed to be made cold and the hotter portion will be connected to a heat sink with a fan, and this heat sink will remove the heat faster. The heat pumped is actually the function of quantity of electrons that cross the p-n junction

II. COMPARISON BETWEEN VAPOR COMPRESSION AND THERMOELECTRIC COOLING.

The thermoelectric cooling system doesn't use any moving part unlike the vapor compression system which uses compressor. This is why a thermoelectric system is easy and cheaper to maintain. The thermoelectric system uses no refrigerant unlike a vapor compression system, which uses a

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refrigerant, generally these refrigerants are CFC, these CFC, when evaporate, cause serious trouble to atmosphere. The vapor compression system is more compact than thermoelectric cooling. The vapor compression system is preferred for deep freezing application over thermoelectric cooling. Peltier modules can also be used for thermoelectric generation by doing a simple modification unlike vapor compression systems, which are pure power absorbing cycle.

III. SET UP OF SOLAR REFERIGERATOR

FIG.1 Set up of solar referigerator

FIG. 2 Closed view

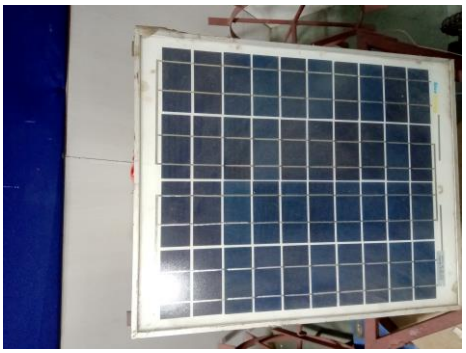

FIG.3 Solar panel

FIG..4 Heat sink with fan.

IV. CONCLUSION

In this paper, a working model of a solar refrigerator is made which works on thermoelectric cooling system. The paper gives a brief about peltier effect and its various applications. The paper has given solar energy as a renewable energy source, to be used in thermoelectric systems efficiently. The various aspects of vapor compression system and thermoelectric cooling system has been compared.

V. ACKNOWLEDGMENT

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