Thermoelectric Solar Refrigerator

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Abstract

Solar energy is one of the most well-known green sources of energy. Solar absorption refrigeration systems increasingly attract research interests. The performance of the refrigerator was simulated using Mat lab under varying operating conditions. The system consisted of the refrigeration chamber, thermoelectric modules, heat source and heat sink. When two conductors are placed in electric contact, electrons flow out of the one in which the electrons are less bound, into the one where the electrons are more bound. The performance of thermoelectric solar refrigerator was simulated using Mat lab under varying operating conditions. The system consisted of the thermoelectric solar refrigeration chamber, thermoelectric modules, heat source and heat sink. Results show that the coefficient of performance (C.O.P) which is a criterion of performance of such device is a function of the temperature between the source and sink.

Keywords: Thermoelectric module, Peltier effect, Solar Cells, Coefficient of Performance, Refrigeration Load

I. INTRODUCTION

The function of compressor in the vapour compression system is to continuously withdraw the refrigerant vapour from the evaporator and to raise its pressure and hence temperature, so that the heat absorbed in the evaporator, along with the work of compression, may be rejected in the condenser to the surroundings. In vapour – absorption system, the function of the compressor is accomplished in a three – step process by the use of the absorber, pump and generator or re boiler as follows.

Solar powered refrigerators may be most normally consumed in the evaluative world to help reduce poverty and environment change. By solar energy, these refrigerators are able to keep perishable goods such as meat and dairy cool in hot season and are used to keep much needed vaccines at their appropriate temperature to avoid spoilage. The portable devices can be caused with simple components and are refrigerator beneficial for areas of the developing world electricity is unreliable or non-existent.

Solar refrigerator based on the thermoelectric cooling technology it's differ from the refrigerator mainly used in present time .In this type of refrigerator don't have any requirement of compressor, evaporator ,condenser, and not any pump also .in this refrigerator solar panel in used for power supply.

II. MATERIALS USED

Thermoelectric Refrigeration is the many material used of this research paper. Thermal conductivity, on the other hand, is about double parallel to the crystal – rising axis that direct side. The thermoelectric element must be incorporate into a cooling module so that the crystal growth axis is parallel to the length of this element. And used of p-type and n-type semiconductor materials.

III. THERMOELECTRIC REFRIGERATION CONSTRUCTION

Thermoelectric Refrigeration are constructed using two parts of semi-conductors, one n-type and other p-type , The flow of Direct current across the joint of the two semi-conductors creates a temperature difference. As a result of the many temperature difference, Peltier cooling causes heat to be absorbed from the cooling plate and to move to the end of the device.

The thermo electric heat is carried through the cooler by electron carriage and liberated on the in front of side as the electrons gate from a high to low energy state. When the two materials are connected to each other by an electrical conductor, a new equilibrium of free electrons is established.

A. Working of Thermoelectric Solar Refrigerator:

The thermoelectric module consists of pairs of P-type and N-type semi-conductor thermo element forming thermocouple which are connected electrically in series and thermally in parallel. The modules are considered to be highly reliable components due to their solid state construction. For most application they will provide long, trouble free service**.** Let's examine how the heat transfer occurs as electrons flow through one pair of p-type and n-type elements within the thermoelectric module.

The p-type semiconductor is doped with certain atoms that have fewer electrons than necessary to complete the atomic bonds within the crystal lattice .When a voltage is applied, there is a tendency for conduction electrons to complete the atomic bonds. When conduction electrons do this, they leave 'holes' which essentially are atoms within the crystal lattice that now have local

positive charges .Electrons are then continually dropping in and being bumped out of the holes and moving on to the next available hole. In effect, it is the holes that are acting as the electrical carriers.

Now, electrons move much more easily in the copper conductors but not so easily in the semiconductors. When electrons level the p-type and enter into the copper on the cold-side holes are created in the p-type as the electrons jump out to a higher energy level to match the energy level of the electrons already moving in the copper. The extra energy to create these holes comes by absorbing heat. Meanwhile the newly created holes travel downwards to the copper on the hot side. Electrons from the hot – side copper move into the p-type and drop into the holes, releasing the excess energy in the form of heat.

The n-type semiconductor is doped with atoms that provide more electrons than necessary to complete the atomic bonds within the crystal lattice. When a voltage is applied, these extra electrons are easily moved in to the conduction band. However, additional energy is required to get the n-typ electrons to match the energy level of the incoming electrons from the cold-side copper. The extra energy comes by absorbing heat. Finally when the electrons leave the hot-side of the n-typ, they once again can move freely in the copper. They drop down to a lower energy level, and release heat in the process.

B. Construction of Thermoelectric Solar Refrigerator:

Solar Refrigeration contraction is very compact. It is work on the solar power approximate 5V DC supply. Heat sinker used as condenser and cold plate used as an evaporator. Solar Refrigerator is used different type of element which are giver below.

- Cold Plate
- Peltier Heat Pump
- Heat Radiator or Heat Sinker
- Fan
- Solar Panel

1) *Cold Plate:*

Cold plate in made of aluminium metal. The cold plate resides in the bottom interior of the chamber. Lytron designs and manufactures cold plates including custom cold plates and standard cold plates. Over cold plates to performance fin cold plates are liquid-cooled chassis. In a world of compact designs with increasing power densities, cold plates are satisfying demanding contact cooling requirements in applications as diverse as high-powered electronics, lasers, power drives, medical equipment and military and aerospace. For high watt densities, when air-cooled heat sinks are inadequate, liquid- cooled cold plates are the ideal high-performance heat transfer solution.

2) *Heat Sinker:*

Heat sinker is normally maintaining temperature below the maximum temperature of the normal operates environmentally. In selecting a heat sinker a economisers from power plants, convectors for steam and hot-water heating systems. Cooling coils and condenser coils in refrigerators and air conditioners. The amount of heat and generated by the semiconductor device in watts, the maximum temperature of the ambient temperature.

A heat sink is sometimes used in conjunction with a fan to increase the rate of airflow over the heat sink. This maintains a larger temperature gradient by replacing warmed air faster than convection would.

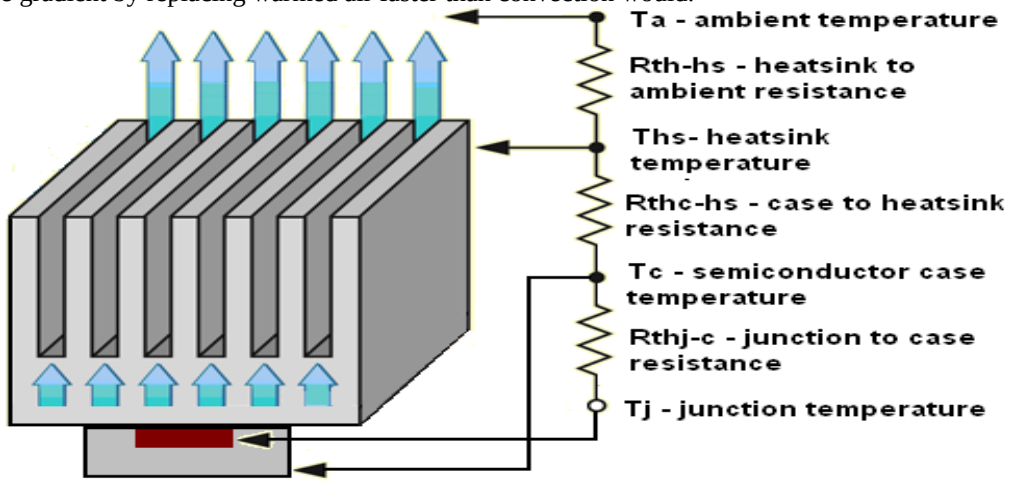

Fig. 1: Heat Sinker

3) *Performance:*

Heat sink Performance is function of material, geometry, and overall surface heat transfer coefficient. Generally, forced convection het sink thermal performance is improved by increasing the thermal conductivity of the heat sink materials, increasing the surface area and by increasing the overall area heat transfer coefficient.

4) *Solar Panel:*

Solar panel is combination of a photovoltaic module, and solar hot water panel, or to a set of solar photovoltaic (PV) module electricity connected and mount on a supporting structure. A photovoltaic module is a packaged, connected assembly of solar

cells. Solar panels can be used as a component of a larger photovoltaic system to generate and supply electricity in regular and hotels applications. The efficiency of a module determines the area of a module given the same rated output – an 8% efficient 230 watt module will have twice the area of a 16% efficient 230 watt module. There are a few solar panels available that are exceeding 19% efficiency. A solar panel is produce in a limited amount of electricity. Than big power generation than stabilized the broad solar panel than make the more power. An inverter, and sometimes a battery and/or solar tracker and interconnection wiring

The p-n junctions of mono-crystalline silicon cell may have adequate reverse current characteristics that these are not necessary.

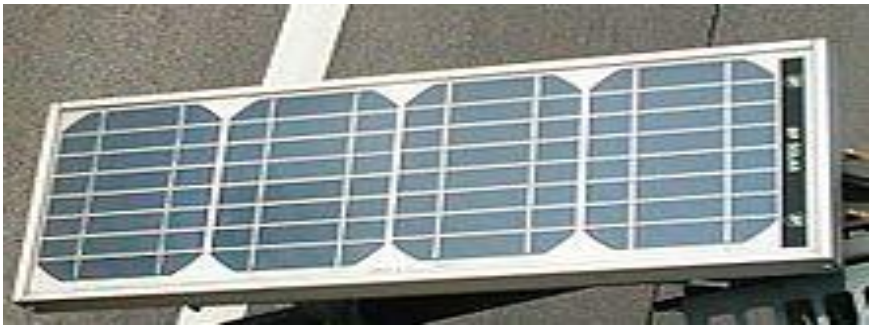

Fig. 2: Solar Panel

5) *Solar Cells:*

The Solar cell is made of different material and silicon is one used for nearly 90% applications. The choice of material depends on the band energy gap, efficiency and cost. The maximum efficiency of solar cell is achieved with the band gap energy of 1.12 eV-2.3 eV. A device which gets heated by the sun's energy is called solar heating device. All the solar heating devices are designed in such a way that they help in collecting as much sunlight as possible. The solar heating devices such as solar cooker, solar water h eater and solar cells have greatly helped in solving the energy problem, it's consumption and future energy demands of our country. Solar energy also reduces our dependence on fossil fuel.

It is device which converts solar energy directly in to electricity. Since solar energy is a light energy so we can say. "Solar cell is a device which converts light energy in to electrical energy"

Solar cells are made by semiconductors such as silicon and gallium. Those solar radiations into electricity are called Solar Cells.

6) *Semi-Conductors:*

- Semi-conductors are those substances which have very low electrical conductivity
- They are neither bad conductors nor good conductors of electricity.
- They are not good conductors, but unlike an insulator, they allow some current to pass through them.
- Two common semi-conductors are (1) Silicon (2) Galium.

7) *Process of Transformation of Solar Energy in to Electrical Energy:*

Solar energy is transformed in the form of electromagnetic radiations of different wavelength .These radiations comprise visible light and invisible light .Solar cells can transform light energy into electrical energy which can be converted in to mechanical energy. The conductivity of solar cells, that is ability to conduct electricity of semi conduct electricity of semi-conductors increases if certain impurities like Boron and Arsenic are added to them.

IV. CONCLUSION

A new dimension has been added to the cooling challenge by reduction of temperatures using thermoelectric solar refrigeration, with the regular demand for improved cooling technology to enhance performance, reliability and reduction in operating cost, a thermoelectric cooling may be considered a potential candidate.

Thermoelectric solar refrigeration technology has been used practically in wide areas recently. The thermoelectric solar refrigeration devices can act as coolers, power generators, or thermal energy sensors and are used in almost all the fields such as military, aerospace, instrument, biology, medicine and industrial or commercial products and use of rulers acres in easily.

A temperature reduction of 12oC without any heat load and 10oC with 100 ml of water in refrigeration space at 24oC ambient temperature in first 30 minutes has been experimentally found at optimized operating conditions.

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