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Design and Fabrication of Solar Refrigerator by using Peltier Module

Kiran Kumar Chittiboyina[1], Peesapati Venkata Rangacharyulu[2]

[1]*Assistant Professor, Mechanical Engineering Department & Visakha Institute of Engineering and Technology*
[2]Assistant Professor, Mechanical Engineering Department & Visakha Institute of Engineering and Technology

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Abstract - In present days we are using high electricirty consuming refrigerators.which are also produce CFC polutant (Chloroflouro carbon gas) into the atmosphere by usage of different refrigerants in refrigerators. which type of polutant is most effect the environment and humans health by increasing global warming. So we are find the solutions to the global warming problem, by coming up with a solutions to eliminate the emission of CFC's. Our project is to design and fabrication of portable solar Refrigerator by using pelier module, which eliminates the emission of CFC's by neglecting the refrigerants , is very ecofriendly and also cheaper when compared to the present day Refrigerators. The fabrication of a portable refrigerator works on solar energy and thermoelectric effect. This portable solar powered refrigerator can be used in deserts, rural areas where electricity is not available throughout the day, and also be used in medical applications like prevention of medicines, injections. This is also arranged with a charging device which can be used for lighting and to charge electronic devices like mobile phones.

1.INTRODUCTION

Refrigeration is a process of removing heat from a low temperature reservoir and transferring it to a high-temperature reservoir. The work of heat transfer is traditionally driven by mechanical means, but can also be driven by heat, magnetism, electricity, laser, or conditioning. Refrigeration has had a large impact on industry, lifestyle, agriculture, and settlement patterns. The idea of preserving food dates back to at least the ancient Roman & Chinese empires. This has resulted in new food sources available to entire populations, which has had a large impact on the nutrition of society. Electricity generation is the leading cause of industrial air pollution in the country. Most of our electricity comes from coal, nuclear, and other non renewable power plants. Producing energy from these resources takes as every to all on our environment. Polluting our air, land. Renewable energy sources can be used to produce electricity with fewer environmental impacts. It is possible to make electricity from renewable energy sources without producing CO2. This refrigerator will be suitable for cooling purposes meant for small objects and will have a relatively small chilling time as compared to the normal to the refrigeration systems, also for the backup.This refrigerator will be attached to a dynamo based charging system which will maintain the smooth operation of refrigerator in case of non availability of solar power .In most of the rural areas of our country, the electric supply is either sporadically available or not available at all. The most severe effect of this problem is on the Primary Health Care Centres. Due to no electricity, most of the PHC's do not maintain adequate supply of medicines and equipment which need to be kept in a cold environment. So in case of any emergency, the patient is to be referred either to the town or city hospital which results in loss of precious time and may prove fatal for the patient. Due to the difficulty in disposal of Chloroflouro carbon (CFCs) and Hydro Chloroflouro carbons (HCFCs), conventional sources are being used so as to decrease the environmental degradation.The temperature difference is developed between the two junctions of the thermocouple due to which one side of the pettier becomes cold and other hot. In refrigerator space, cool side of the thermocouple model is used whereas hot side is used for the rejection of heat to atmosphere with the help of heat sink . The size of the peltier varies from very small to very large size according to the requirement and application.

2. Body of Paper

The circuit of the refrigerator is made quite simple and convenient so that in case of any fault, it can be easily dissembled and can be repaired without any major changes to the design. The peltier unit are connected to the 12 volt DC supply. The cooling fans mounted on the heat sink are connected with the power supply of 12 DC volts.

A switch is placed in the incoming positive dc supply and an LED along with a 1 Kilo-ohm resistance is placed after the switch in parallel with the supply. The circuit diagram of the circuitry of the refrigerator is as shown in the following figure.

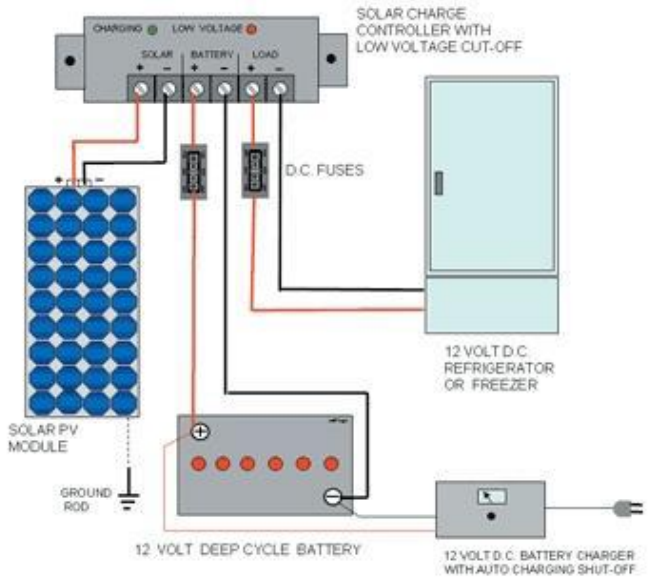
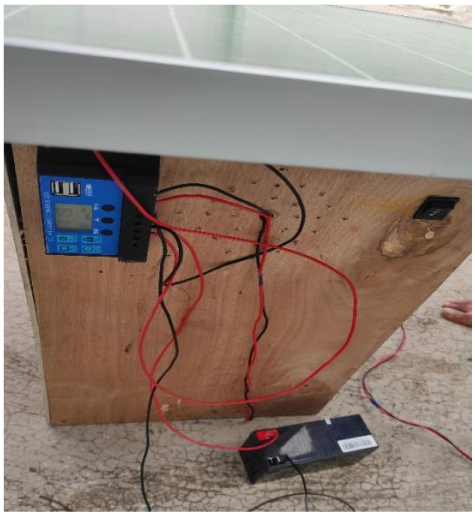


Table -1: Sample Table format

REFRIGERATOR

The refrigerator is provided power supply from a 12 volt DC 7 amperes battery. To start the refrigerator, the switch on the refrigerator is turned on. When the switch is turned on, a led starts glowing indicating that the refrigerator is now online. Now two Peltier thermoelectric device are insulated from the cooling side and arranges in the refrigerator generates cooling effect on inner side and heat is dissipated on outer side. • On the heat side of the peltier unit, a heat sink along with the fan wo-ks to dissipate the heat from the peltier unit in the outer environment The eltier thermoelectric Device will be so arranged in a box with proper insulation system and heat sink so that efficient cooling takes place at all the time. To turn off the refrigerator, switch can be turned off. Then the glowing led will also stop glowing indicating no power for the refrigerator. Solar radiations which are emitted by the solar energy are absorbed by the solar panel. Solar panels collect solar radiation from the sun and actively convert that energy to electricity. Solar panels are comprised of several individual solar cells.These solar cells function similarly to large semiconductors and utilize a large-area p-n junction diode. When the solar cells are exposed to sunlight, the p-junction diodes convert the energy from sunlight into usable electrical energy. The energy generated from photons striking the surface of the solar panel allows electrons to be knocked out of their orbits and released, electric fields in the solar cell solar cells pull these free electrons in a directional current, from which metal contacts in the solar cell can generate electricity. The more solar cells in a solar panel and the higher the quality of the solar cells, the more total electrical output the solar panel can produce. The conversion of sunlight to usable electrical energy has been dubbed Photovoltaic Effect. Solar energy comes from the sunshine. The sun has constant thermonuclear exsions due to the fact that hydrogen atoms are bonded together with helium atoms. Energy brought on by this process that travels to the surface of the earth is known as radiation. Sun power panels convert radiation into electrical energy which can be stored in batteries for later use. Solar panels help to harvest elecrt-ricity from the sun so that it can be converted into usable energy that is utilized in everyday activities.A solar panel that has an efficient photovoltaic cell 1/5m within diameter creates approximately several amps at two volts. Many solar panels will not perform and also other solar panels because of atmospheric interference. Some your own solar panels may get direct sunlight all day long while other may just get partial sunlight. Also, solar panels may lose efficiency over the years due to overheating and physical use.The quality of power a unit yields is directly influenced by the quality of the solarpanel. The types of materials utilized, the types of technology utilized and the quantity of time the solar panel has been functioning all factor into how efficient the solar panel will be. The main concern for purchasing a solar panel is the dollars/watt ratio The photovoltaic effect arises from the properties of the p-n junction diode;



PELTIER COOLER

The electrical energy generated by the solar panel has been sent to the Peltier plate present in the refrigerator. The electrical energy enters to the peltier plate/cooler (or) thermoelectric cooler; the function of peltier plate is to create heat flux between the junctions of two different types of materials. Peltier cooler, heater, or thermoelectric heat pump is a solid-state active heat pump . which transfers heat from one side of the device to the other, with consumption of electrical energy, depending on the direction of the current and can be used either for heating or for cooling (refrigeration), although in practice the main application is cooling. It can also be used as a temperature controller that either heats or cools. In peltier plate, a voltage is applied across the device, and as a result, a difference in temperature will build up between the two sides. Thermoelectric coolers operate by the Peltier effect

(which also goes by the more general name thermoelectric effect). The device has two sides, and when DC current flows through the device, it brings heat from one side to the other, so that one side gets cooler while the other gets hotter.The "hot" side is attached to a heat sink so that it remains at ambient temperature, while the cool side goes below room temperature. In some applications, multiple coolers can be cascaded together for lower temperature. To find out how many amps solar panel will deliver in a full sunshine hour we need to do our calculations. We need to convert solar panel output watts to amp hours, so to find the amps we need to divide watts by volts.

I (amps) = P (watts) ÷ V (volt) 42 Dept of Mech Eng V.I.E.T

CONVERSION OF ELECTRICAL ENERGY OF SOLAR PANEL PER HOUR

Current =watts/volts I = W/V = 50/12= 4.16 amps per hour (on brilliant sunny day And the most likely average in usual weather would be closer to 3.4 amps per hour and we can maintain our battery power requirement between 2 and 3 hours.)

BATTERY CHARGING

The batteries used in the refrigerator are charged from the solar panels using a charge controller rated 12 volts. 10 amps. The battery is connected to the charge controllers which get supply from the solar panels and feeds it to the battery.

LEAD ACID BATTERY

After the conversion of solar energy into electrical energy, the energy has been sent to the Lead-acid Battery. The purpose of Lead-acid Battery is to store the energy for our requirements. Lead Battery is also known as Storage Battery..

Figure

Charts

S.No:-	TIME(min)	ATMOSPHERE	COOLING	DESCRIPTION
	logging in	TEMP.°C	TEMP.°C	
1:-	10:15	35	35	stable
2:-	10:16	34.9	30	stable
3:-	10:17	34.8	29.1	stable
4:-	10:18	34.9	28.2	stable
5:-	10:19	35	27.3	stable
6:-	10:20	35.1	26.4	stable
7:-	10:21	35.3	25.5	stable
8:-	10:22	35.4	23.7	stable
9:-	10:23	35.5	22.8	stable
10:-	10:24	35.7	21.9	stable
11:-	10:25	35.9	20	stable
12:-	10:26	36	19.1	stable
13:-	10:27	36	18.2	stable
14:-	10:28	36.2	17.5	stable
15:-	10:29	36.2	16.1	stable
16:-	10:30	36.3	15.4	logging out

From the data recorded in the observation table, following observations can be made:-

Starting Time = 10:15am

Final Cooling Temperature achieved = 15deg

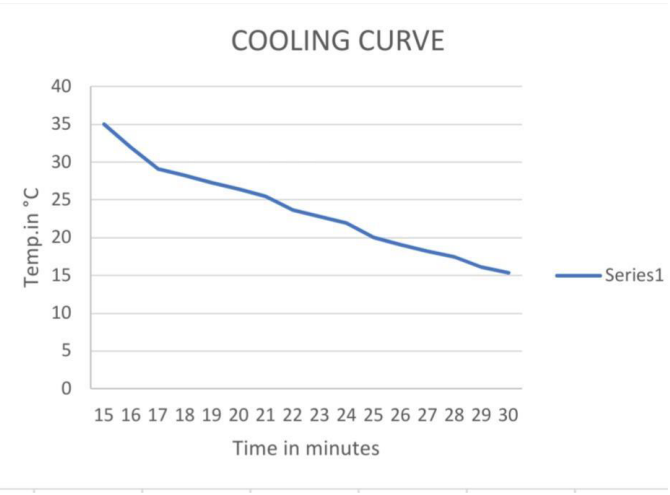
Final Time = 10:30am

Average Cooling Rate =23.5°C

In the above, the temperature corresponds to the value taken inside the refrigerator using the temperature sensor of the Multimeter. Also from the table it is clear about the start logging instance and stop logging instance of the Multimeter.

GRAPHICAL REPRESENTATION

In the above, the temperature corresponds to the value taken inside the refrigerator using the temperature sensor of the Multimeter. Also from the table it is clear about the start logging instance and stop logging instance of the Multimeter.



COEFFICIENT OF PERFORMANCE

-COP is as measure of the performance of a heat pumping device. It is defined as the heat required removing the heat divided by the actual heat removed.

The device was measure to draw 5.2 Amps of current at 11.2v This results in a power consumption of 58.5 Watts. For the calculation of COP, it was assumed that only the air inside the box was cooled together with the aluminium heat sinks.Heat loss from the inside of the

cooler to the outside was asumed to be zero during the cooling of the box as it is a transient process. it took 30 min for the temperature of the air to reach 15.4 degrees Celsius from a starting temperature of 35 degrees Celsius. In these calculations, it was assumed That the properties of canned drinks are the same as those of water (density =1 kg/L and C = 4.18 kJ/kg).V = 0.5 L canned drink, Cools from 35°C to 15.4°C in 30 min.
Calculate COPR:

3. CONCLUSIONS

Solar power now a days is playing a major role in meeting the energy requirements of our country. It is being developed at a very fast rate and its applications in many areas are being explored. The refrigerator is intended at exploring the same and provides an efficient and economical solution to the areas where there is no electricity and cooling efficiency is required.This project main objective was to develop a portable solar refrgerator and this has been successfully done.
The applications of this refr-igerator are very wide and it can be bused in various places for variety of operations. Also the main purpose for which this refrigerator is made is being fulfilled as the space inside the refrigerator's in sufficient enough to cool appropriate amount of medicines and injections needed at the primary health care centres in the villages where there is the sporadic or no power supply. Though this refrigerator is working satisfactorily to its full capacity, still many changes and improvements can be done in this refrigerator to make it more users friendly and sophisticated in nature. This meas-ures and changes, if implemented can play an important role in the future models to be developed. Some of these measures and changes are: •Number of PeliterUnits can be increased to further decrease the temperature inside the refrigerator. Same refrigerator can used for heating purpose if we also insulate the other side i.e. heating side of the refrigerator with in the box.
• To increase the volume of the refrigerator maintaining the same temperature inside the refrigerator, number of PeliterUnit sand heatsink has to be increased.PID controllers can be used for making it a temperature controlled refrigerator.

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Authors:

Ch.Kiran Kumar. Mtech (P.HD)
Asst Professor
Viet Visakhapatnam.

P.V.Rangacharyulu. Mtech
Asst Professor
Viet Visakhapatnam