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Thermoelectric Refrigerator

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Abstract: *In any refrigeration system heat energy is lost to the surroundings and it goes as a waste. The work is deals with the utilization of the out coming heat energy to produce hot water in the water refrigeration. There by we are utilizing the heat lost and also reducing the heat in the condenser to get maximized cold water The circuit used in this work is same as that of the available water refrigeration. This concept of utilizing the heat energy evolved to the surrounding can be applied in any refrigeration systems*
Electric electricity is the technology of converting sunlight directly in to electricity. It is based on photo-voltaic or electric modules, which are very reliable and do not require any fuel or servicing. Electric systems are suitable for plenty of sun and are ideal when there is no main electricity Our objective is to design and develop a electric system normally "THERMO ELECTRIC REFRIGERATION". This electric power is used to run the compressor in the refrigeration system.
Keywords: *Peltier Effect, P-N Semiconductors.*

I. Introduction

Refrigeration is the process of heat-removal from a space in order to bring it to a lower temperature than surrounding temperature. In this context,Thermoelectric refrigerator which works on thermoelectric refrigeration, aims to provide cooling by using thermoelectric effects rather than the more prevalent conventional methods like „vapour compression cycle" or the „vapour absorption cycle".

There are three types of thermoelectric effect: The Seebeck effect, the Peltier effect, the Thomson effect. From these three effects, Peltier cooler works on the Peltier effect; which states that when voltage is applied across two junctions of dissimilar electrical conductors, heat is absorbed from one junction and heat is rejected at another junction.

Thermoelectric refrigerators are basically used as a cooling element in laser diodes, CCD cameras (charge coupled device), blood analyzers, portable picnic coolers laser diodes, microprocessors, blood analyzers and portable picnic coolers

II. Literature Review

Refrigerator and air conditioners are the most energy consuming home appliances and for this reason many researchers had performed work to enhance performance of the refrigeration systems. Most of the research work done so far deals with an objective of low energy consumption and refrigeration effect enhancement. Thermoelectric refrigeration is one of the techniques used for producing refrigeration effect. Thermoelectric devices are developed based on Peltier and Seebeck effect which has experienced a major advances and developments in recent years. The coefficient of performance of the thermoelectric refrigeration is less when it is used alone, hence thermoelectric refrigeration is often used with other methods of refrigeration. This paper presents a review of some work been done on the thermoelectric refrigeration over the years. Some of the research and development work carried out by different researchers on TER system has been thoroughly reviewed in this paper. The study envelopes the various applications of TER system and development of devices. This paper summarizes the advancement in thermoelectric refrigeration, thermoelectric materials, design methodologies, application in domestic appliances and performance enhancement techniques based on the literature. This paper reviews the developments in TER system over the years. This study on the thermoelectric refrigeration emphasize that the TER system is a novel refrigeration system which will be a better alternative for conventional refrigeration system. The research and development work carried out by different researchers on TER system has been thoroughly reviewed in this paper.

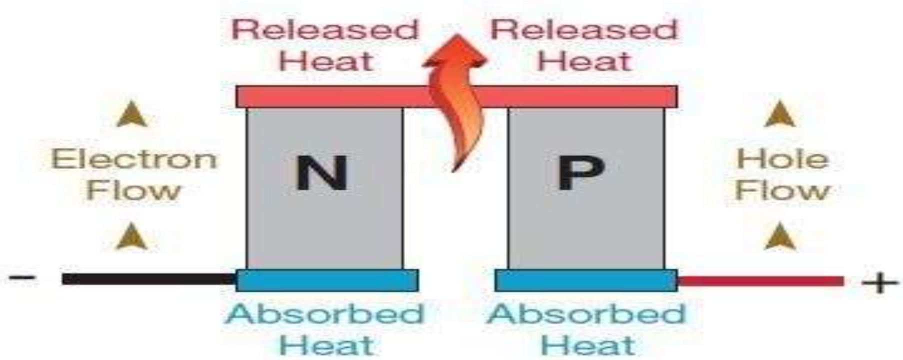
III. Objectives

- The objective of this paper work is to analyze the working of thermoelectric refrigerator.
- Study of the principles and working of thermoelectric refrigerator; working parameters; performance parameters of the same.
- Studying new heat sink designs, which improves the performance of the thermoelectric refrigeration

IV. Working

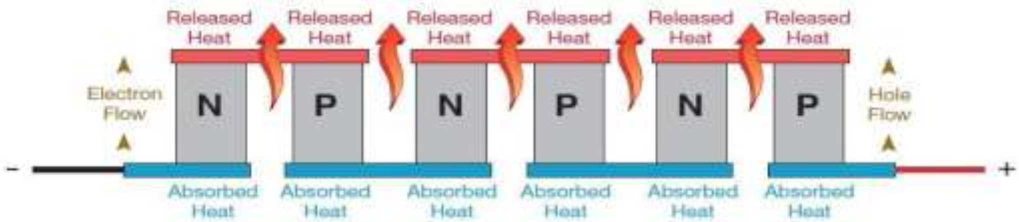
THERMOELECTRIC REFRIGERATION WITH P& N-TYPE SEMICONDUCTOR

By arranging N and P-type pellets in a "couple" and forming a junction between them with a plated copper tab, it is possible to configure a series circuit which can keep all of the heat moving in the same direction. As shown in the illustration, with the free(bottom) end of the Ptype pellet connected to the positive voltage potential and the free(bottom) end of the N-type pellet similarly connected to the negative side of the voltage.As we have seen in previous section, for N-type of semiconductor, heat is absorbed from the junction near to the negative terminal and heat is releases at the junction near to the positive terminal. For P-type of semiconductor, heat is absorbed from the junction near to positive terminal and released at the junction near to negative terminal.



Thermoelectric Refrigeration by couple of N&P

By arranging the circuit as like in above figure, it is possible to release heat to the one side and absorb from another side. Using these special properties of the TE "couple", it is possible to team many pellets together in rectangular arrays to create practical thermoelectric modules as in figure.



Thermoelectric Refrigeration by multiple pallets

V. Result

COOLING LOAD CALCULATIONS

Q cooling= mCpΔT
m = pv = 0.5 kg
Cp of water= 4180 Jkg
ΔT=30-10=20°C
Q cooling =0.5x4180x20=41800 J
Cooling Load= Q cooling/Δt= 41800/ (60 x 30) =23.22 Watts
Maximum cooling load capacity of each module (TEC1-03104T125) =9.8 w
No. of module required=30/9.8= 3(+1) = 4# of module required for cooling.

POWER REQUIRED TO DRIVE REFRIGERATOR

TEC Module Rating:

- current (I)= 4 A (max)
- Voltage (V)=3.7 V (max)

Power required to drive each module: I x V=4x3.7=14.8 Watts
Total power required to drive 4 modules: 4x14.8=59.2 Watts
Cooling fan power= 15 Watts Therefore,
Total Power required to drive refrigerator is 59.2+15=74.2 Watts

VI. Conclusion

In this regard, the Thermoelectric refrigerator does not produce chlorofluorocarbon (CFC), which is believed to cause depletion of the atmospheric ozone layer. In addition, there will be no vibration or noise because of the difference in the mechanics of the system.

Thermoelectric refrigerators are greatly needed, particularly for developing countries, where long life, low maintenance and clean environment are needed. In this aspect thermoelectric cannot be challenged in spite of the fact that it has some disadvantages like low coefficient of performance and high cost.

There is a lot of scope for developing materials specifically suited for TE cooling purpose and these can greatly improve the C.O.P. of these devices. Development of new methods to improve efficiency catering to changes in the basic design of the thermoelectric set up like better heat transfer, miniaturization etc. can give very effective enhancement in the overall performance of thermoelectric refrigerators. Finally, there is a general need for more studies that combine several techniques, exploiting the best of each and using these practically.

PERFORMANCE SPECIFICATION SHEET

Th(°C)	27	50	Hot side temperature at environment: dry air, N2
DT max(°C)	68	76	Temperature Difference between cold and hot side of the module when cooling capacity is zero at cold side
U max(voltage)	15.5	17.4	Voltage applied to the module at DTmax
I max(amp)	12.3	12.3	DC current through the modules at DTmax
Q max(Watts)	117.6	129.3	Cooling capacity at cold side of the module under DT °C
AC Resistance(ohms)	1.0~1.2	1.10 ~1.33	The module resistance is tested under AC

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