WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

A REPORT ON PELTIER (THERMOELECTRIC) COOLING MODULE

Madhan Mohan Reddy T[1], Sagar T[1], VenkataMahendra T[1], Punitha(Guide)[2]

Department of Electronics and Communication Engineering, Muthayammal Engineering College, Rasipuram, Namakkal (D.t), Tamilnadu - INDIA

ABSTRACT

The increase in demand for refrigeration (cooler) globally in the field of air-conditioning, food preservation, medical services, vaccine storages, and for electronic components temperature control led to the production of more electricity and consequently an increase in the CO2 concentration in the atmosphere which in turn leads to global warming and many climatic changes. Thermoelectric refrigeration is a new alternative because it can reduce the use of electricity to produce cooling effect and also meet today's energy challenges. Therefore, the need for thermoelectric refrigeration in developing countries is very high where long life and low maintenance are needed. The objectives of this study is to develop a working thermoelectric cooler to cool a volume of 25 L that utilizes the PELTIER effect to cool and maintain a selected temperature range of 5^0C to 25^0C. The design requirements are to cool this volume to temperature within a short time and provide retention of at least next half an hour. The design and fabrication of thermoelectric refrigerator for required applications are presented. This system also can be used as a heater.

Keywords*: PELTIER effect, Cooler and green house management*

1. INTRODUCTION

The global increasing demand for refrigeration in field of refrigeration air-conditioning, food preservation, vaccine storages, medical services, and cooling of electronic devices, led to production of more electricity and consequently more release of CO2 all over the world which it is contributing factor of global warming on climate change. Thermoelectric refrigeration is new alternative because it can convert waste electricity into useful cooling, is expected to play an important role in meeting today for energy challenges. Therefore, thermoelectric refrigeration is greatly needed, particularly for developing countries where long life and low maintenance are needed.

Where electrical power supply is unreliable when a solar panel charger is added for battery charging. A thermoelectric module thus uses a pair of fixed junctions into which electrical energy is applied causing one junction to become cold while the other becomes hot. Because thermoelectric cooling is a form of solid-state refrigeration, it has the advantage of being compact and long lasting. It uses no moving parts except for some fans, employs no fluids, and do not require bulky piping and mechanical compressors used in vapour-cycle cooling systems. Such sturdiness favour thermoelectric cooling over conventional refrigeration in certain situations. The compact size and weight requirements, as well as portability in the design, rule out the use of conventional refrigeration.

A. Existing Method

Conventional cooling systems such as those used in refrigerators utilize a compressor and a working fluid to transfer heat. Thermal energy is absorbed and released as the working Fluid undergoes expansion and compression and changes phase from liquid to vapor and back, respectively.

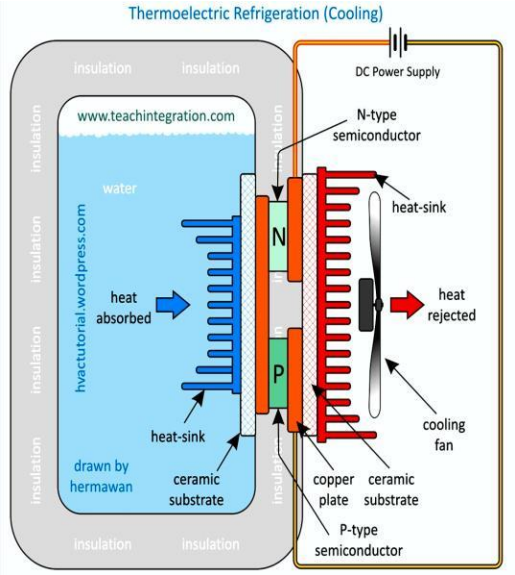
Problem Statement

This system consumes more electricity and consequently more release of harmful gas like CO all over the world which is a contributing Factor of global warming on environment change. The design of the system focused towards only cooling process.

B. Proposed Method

Semiconductor thermoelectric coolers (also known as Peltier coolers) offer several advantages over conventional systems. They are entirely solid-state devices, with no moving parts; this makes them rugged, reliable, and quiet. They use no ozone depleting chlorofluorocarbons, potentially offering a more environmentally responsible alternative to conventional refrigeration. They can be extremely compact, much more so than compressor-based systems. Precise temperature control (< ± 0.1 °C) can be achieved with Peltier coolers. However, their efficiency is low compared to conventional refrigerators. Thus, they are used in niche applications where their unique advantages outweigh their low efficiency. Although some large-scale applications have been considered (on submarines and surface vessels), Peltier coolers are generally used in applications where small size is needed and the cooling demands are not too great, such as for cooling electronic components.

This system also can be used as a heater.



2. LITERATURE REVIEW

This paper presents the performance of solar refrigeration system by using peltiermodule .Thermoelectric modules are the key elements in this refrigerator for providing the thermoelectric cooling. This projects system consist of peltiermodule, heatsink, chargecontroller, solarpanel, battery, micro –controller kit, wooden box etc. Power consumption is one of the major issues in today's general life. But semiconductor is a great solution of this power consumption. If we success to use the semiconductor in well manner then we can reduce power consumptions. Peltier module is one of the best solutions for this. In this project peltier module is used where at one gets cooled and other side become hot and rejects heat to the environment with the help of fans for producing cooling effect this means that cooling is done without use of greenhouse gaseous. This would ultimately reduce the global warming which is usually caused by conventional refrigeration system. The supply are used both ac and dc supply and system will be cooled at 90c and heat will be produced till 850c.due to use of charge controller, system get efficient output. Due to this advantages of our system over conventional system are beneficial. This system having no moving parts, due to which system became rugged and reliable .they can be extremely compact much more than compressor. It is portable and economical system. Dead bodies can preserved at -700C for few days. By using peltier module in our daily life to save electricity or power consumption.

The lifetime of a battery depends mainly on the operating temperature. Thus, this paper proposes a low cost refrigeration system applied to batteries temperature control. In the proposed system, Peltier modules (thermoelectrical devices, which uses the Peltier effect for heat exchange) are used to refrigerate the system. In addition are compared the performance of two control strategies (conventional PI and P+I), applied to the system temperature control. It is shown that the P+I controller has a better performance than the conventional PI controller due to its characteristic of present higher control effort at the initial time. It is proposed, though, a structure with the P+I controller to correct the windup problem. Moreover, the transfer function of the system was obtained applying a system identification method, in order to improve the control precision and to reduce the complexity in obtaining the system model. The prototype is still in development stage, in this way, the results were obtained by simulation.

3. SYSTEM FUNCTION

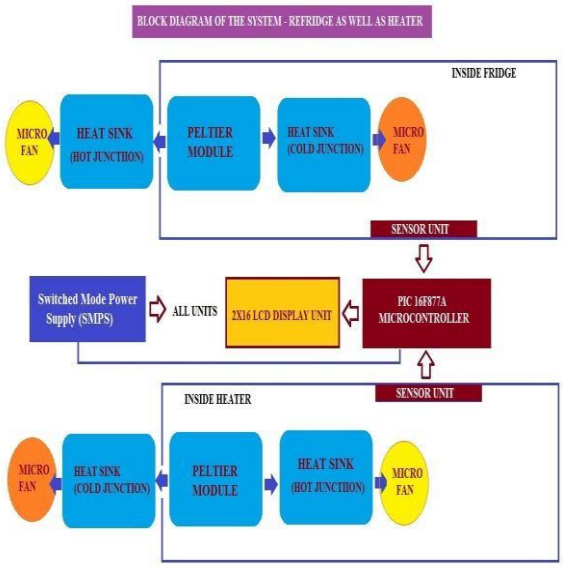


Fig.1 block diagram of the system

In this system consists of 12V/5A power supply, PELTIER modules, Cooling fan, temperature sensor and PIC16F877A, relays and 2X16 LCD unit. The peltier is a semiconductor device which has two junctions. They are i) Hot junction and ii) cold junction. The 12V/5A power supply unit is used to supplies the biasing voltage and current to peltier module through relay driver circuit.

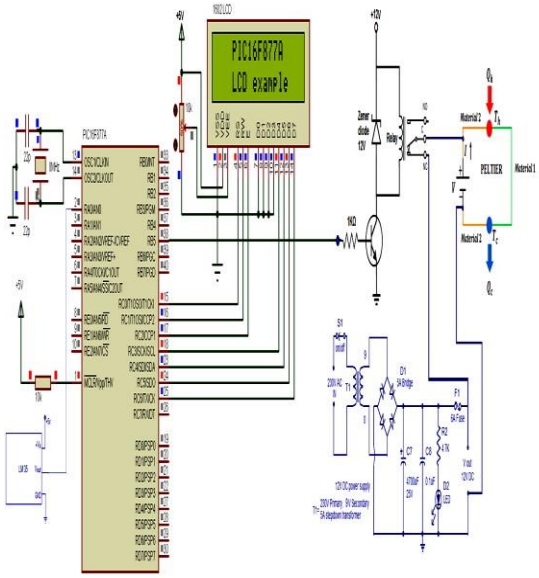


Fig.2 Circuit diagram of the power System

The peltier produces the cool air when it is connected reverse bias condition. The LM35 is a temperature sensor which is used to sensing the environment heat or cold parameters and attached with peltier module. The LM 35 transistor produces the electrical voltage according to corresponding heat or cold of the peltier module. The output of the LM 35 is applied to the input of ADC (Analog to Digital Converter) pin of PIC16F877A microcontroller. The predesigned

program stored in microcontroller for controlling the power supply connection between power supply unit and peltier module through relay driver. The controller enables the relay when it temperature or cold level exit the preset value or point. The relay unit is used to turn ON and OFF the power supply unit when it energized and deenergized by the microcontroller. The 2X16 LCD display unit connected with microcontroller which is used to displays the information about the status of the cooling or heat level of the system.

4. POWER SUPPLY UNIT

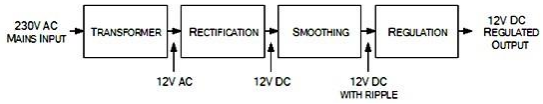


Fig. 3.4: block diagram of the power supply unit system

The transformer used here is a stepdown transformer which converts 230v AC into 12v AC.A full wave bridge rectifier made around the diodes converts the ac supply into a pulsating dc supply. Here the bridge consists of four IN4001 silicon diodes which are capable .

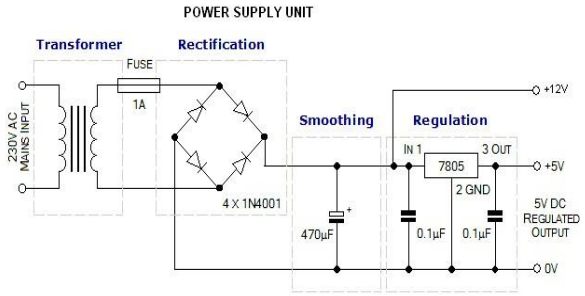


Fig. 3.5 Functional circuit diagram of power

Supply unit

The ripple content in the rectifier output is smoothened by adding a capacitor filter in parallel to the output. The value of capacitor may be from 100 to 4700 microfarads. Higher the chosen value more is the filtering. The 12v dc is regulated to 12v dc using a 3-terminal series pass regulator with the input pin (pin1) to output of rectifier, output pin(pin3) to the supply output. The common pin (pin2) is connected to the supply ground. The output of the regulator will be 12volts.

5. PIC MICROCONTROLLER

The PIC controller used in our project is PIC16F877A, the pin diagram of which is shown in figure. It is used to energize and de-energize the contactors during the weld and non-weld periods. The internal timer of the PIC microcontroller is used to set time delay between non-weld period and power cut off to the primary of the welding transformer.

The advantages of PIC microcontroller are as follows

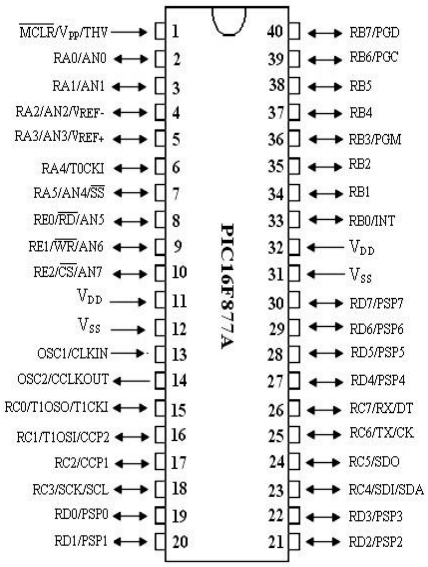
i. Increased reliability through a small part count.

ii. Reduced stock levels, as one microcontroller replaces several parts.

iii. Simplified product assembly

iv. Greater product flexibility and adaptability

v. Rapid product changes or development by changing the program and not hardware.



6. PIN DIAGRAM OF PIC16F877A

This powerful (200 nanosecond instruction execution) yet easy-to-program (only 35 single word instructions) CMOS FLASH-based 8-bit microcontroller packs Microchip's powerful PIC® architecture into an 40- or 44-pin package and is upwards compatible with the PIC16C5X, PIC12CXXX and PIC16C7X devices. The

PIC16F877A features 256 bytes of EEPROM data memory, self programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-toDigital (A/D) converter, 2 capture/compare/PWM functions, the synchronous serial port can be configured as either 3-wire Serial Peripheral Interface (SPI™) or the 2-wire Inter-Integrated

Circuit (I²C™).

7. CONCLUSION

The objective project is to achieve the long term cooling in case of power failure for refrigerator. A TER Cooling system is has been designed and developed to provide active cooling with help of single stage 12 V TE module is used to provide adequate cooling. First the cooling load calculations for this TER compartment considered under study were presented. Simulation tests in laboratory have validated the theoretical design parameters and established the feasibility of providing cooling with single stage thermoelectric cooler was tested in the environmental chamber. As TER not available in open market which we can retain cooling at case of power outage due to high current carrying capacity. The retention time achieved was 52 min with the designed module in this project. In order to achieve the higher retention time, another alternative was incorporate. This consists the additional heater on heat sink. The highest retention time achieved was 57 mins.

REFERENCE

[1] Oshin Dhage, Rupali Gaikwad, Pooja Nagrale, Pooja Bomratwar, Anuradha Mogare Datta meghe institute of engg. technology & reserch, Wardha (Electrical engg.)

[2] K. R. Sombra, F. C. Sampaio, R. P. T. Bascopé, B. C. Torrico Electrical Engineering Department Federal

[3] University of Ceará Fortaleza, Ceará

[4] Julius T. Sese, Joseph Bryan G. Ibarra, Mary Ann E. Latina, Rene Thomas Buenafe, Gieliano Cruz, Mark Angelo Mirano, Jemuel Jethro Yu Mapua Institute of Technology Manila, Philippines

[5] Yahya Sheikhnejad Ricardo Bastos Zoran Vujicic Ali Shahpari Antonio Teixeira

[6] Adrian Ioan Lita1), Daniel Alexandru Visan2) and Alin Gheorghita

[7] Mazare2), Ioan Lita2) 1) Faculty of Electronics, Telecommunication and Information Technology, Politehnica University Bucharest, Bucharest, Romania

[8] H. Dinis*, J. Fernandes*, V. Silva, I. Colmiais, P. M. Mendes