International Journal of Engineering Research and Science & Technology

ISSN : 2319-5991
Vol. 1, No. 2
April 2015

2nd National Conference on "Recent Advances in Science Engineering & Technologies" RASET 2015

Organized by

Department of EEE, Jay Shriram College of Technology, Tirupur, Tamil Nadu, India.

www.ijerst.com

Email: editorijerst@gmail.com or editor@ijerst.com

International Journal of Engineering Research and Science & Technology

ISSN 2319-5991 www.ijerst.com
Special Issue, Vol. 1, No. 2, April 2015
2nd National Conference on "Recent Advances in Science, Engineering&Technologies" RASET-2015

Research Paper

A POLLUTION FREE RENEWABLE ENERGY BASED REFRIGERATION SYSTEM

M Adharsh[1]*, M.Sasikumar[1], M V Vivek[1] and Arun Jose[1]

*Corresponding Author: ***M Adharsh***

The main problem in the present day refrigeration system is that it runs a heavy compressor consuming large power and pollutes our environment with emission of Freon gases. These form cfc's and hcfc's and destroy the ozone and creates space for entry of harmful ultraviolet radiations. In this method an alternate way of refrigeration is tried. The method is known as thermoelectric cooling using the principle of peltier effect. An array of thermoelectric sensors can be arranged in a particular way that it removes all heat from a particular region and transfers it to the other side. The region deprived from the heat gradually builds up refrigeration. The heated region can be cooled using exhaust fans or other cooling mechanisms. This mechanism is an alternate approach towards refrigeration whereby eliminating the heavy power requirement and also eliminates any degree of pollution. This could prove to be a viable renewable energy product if combined with solar or wind systems to power the sensors.

Keywords: Thermoelectric sensors, Peltier effect, Refrigeration, Renewable energy, Cooling mechanism

INTRODUCTION

Refrigeration is the process of pumping heat energy out of an insulated chamber in order to reduce the temperature of the chamber below that of the surrounding air. Thermoelectric refrigeration uses a principle called the "PELTIER" effect to pump heat electronically. The Peltier effect is named after a French scientist who discovered it in 1834. In 1834 Jean Peltier noted that when an electrical current is applied across the junction of two dissimilar metals, heat is removed from one of the metals and transferred to the other. This is the basis of thermoelectric refrigeration.

Peltier Effect

Thermoelectric cooling uses the Peltier effect to create a heat flux between the junction of two different types of materials. A 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. Such an instrument is also called a Peltier device, Peltier heat pump, solid state

[1] Karpagam Institute of Technology, Coimbatore.

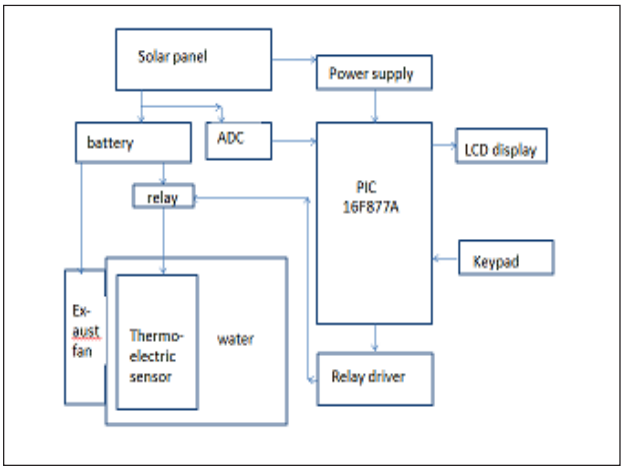
refrigerator, or thermoelectric cooler (TEC). They can be used either for heating or for cooling (refrigeration), although in practice the main application is cooling. It can also be used as a temperature controller that either heats or cools. This technology is far less commonly applied to refrigeration than vapor-compression refrigeration is. The main advantages of a Peltier cooler (compared to a vapor-compression refrigerator) are its lack of moving parts or circulating liquid, and its small size and flexible shape (form factor). Its main disadvantage is that it cannot simultaneously have low cost and high power efficiency. Many researchers and companies are trying to develop Peltier coolers that are both cheap and efficient. (See Thermoelectric materials.)

A Peltier cooler can also be used as a thermoelectric generator. When operated as a cooler, a voltage is applied across the device, and as a result, a difference in temperature will build up between the two sides. When operated as a generator, one side of the device is heated to a temperature greater than the other side, and as a result, a difference in voltage will build up between the two sides (the Seebeck effect). However, a well-designed Peltier cooler will be a mediocre thermoelectric generator and vice-versa, due to different design and packaging requirements.

THERMOELECTRIC SENSOR

BLOCK DIAGRAM

Thermoelectric modules are constructed from a series of tiny metal cubes of dissimilar exotic metals which are physically bonded together and connected electrically. When electrical current passes through the cube junctions, heat is transferred from one metal to the other. Solid-state thermoelectric modules are capable of transferring large quantities of heat when connected to a heat absorbing device on one side and a heat dissipating device on the other. The Koolatron's internal aluminium cold plate fins absorb heat from the contents, (food and beverages), and the thermoelectric modules transfer it to heat dissipating fins under the control panel. Here, a small fan helps to disperse the heat into the air. The system is totally environmentally friendly and contains no hazardous gases, nor pipes nor coils and no compressor. The only moving part is the small 12-volt fan. Thermoelectric modules are too expensive for normal domestic and commercial applications which run only on regular household current. They are ideally suited to recreational applications because they are lightweight, compact, insensitive to motion or tilting, have no moving parts, and can operate directly from 12 volt batteries.



TYPES OF REFRIGERATION SYSTEMS

Thermoelectric: Cooling is achieved electronically using the "Peltier" effect - heat is pumped with electrical energy.

Compressor: Cooling is achieved by vaporising a refrigerant (such as freon) inside the refrigerator - heat is absorbed by the refrigerant through the principle of the "latent heat of vaporisation" and released outside the refrigerator where the vapour is condensed and compressed into a liquid again. Uses mechanical energy.

Absorption: Cooling is achieved by vaporising a refrigerant (ammonia gas) inside the refrigerator by "boiling" it out of a water ammonia solution with a heat source (electric or propane). Uses the principle of "latent heat of vaporisation". The vapour is condensed and re-absorbed by the ammonia solution outside the refrigerator. Uses heat energy.

COMPARISON OF THE FEATURES OF ALL THREE SYSTEMS

Compactness: Koolatron thermoelectrics are the most compact because of the small size of the cooling components - cooling module / heat sink / coldsink.

WEIGHT: Koolatron units weigh 1/3 to 1/2 as much as the other units because of the lightweight cooling system - no heavy compressor.

PORTABILITY: Koolatrons are the most portable because they are light enough to carry with one hand and are not affected by motion or tilting. Compressor models are quite heavy and the absorption models must be kept level within 2 - 3 degrees.

Price: Koolatron coolers cost 20% - 40% less than the equivalent sized compressor or absorption units available for recreational use.

Battery Drain: Koolatron coolers have a maximum current drain on 12 volts of 4.5 amps. Compressor portables draw slightly more current when running but may average slightly less depending on thermostatic control settings. Absorption portables draw 6.5 to 7.5 amps when running and may average about 5 amps draw.

Battery Protection: Consider the "Battery Saver" option as discussed in the previous section.

Cooling Performance: Compressor systems are potentially the most efficient in hot weather. Some models will perform as a portable freezer and will refrigerate in ambient temperatures of up to 110 degrees F. Koolatron units will refrigerate in sustained ambient temperatures of up to 95 degrees F. If they are kept full, they will refrigerate satisfactorily even if peak.

Safety: Koolatron systems are completely safe because they use no gases or open flames and run on just 12 volts. Compressor systems can leak freon which can be extremely dangerous especially if heated. Absorption systems may use propane which can be extremely dangerous in the event of a leak.

Reliability: Koolatrons thermoelectric modules do not wear out or deteriorate with use. They have been used for military and aerospace applications for years because of their reliability and other unique features. Compressors and their motors are both subject to wear and freon-filled coils are subject to leakage and costly repairs. Absorption units are somewhat temperamental and may require expert servicing from time to time, especially if jarred when travelling.

Ease of Servicing and Maintenance: Koolatron units have only one moving part, a small fan (and 12 volt motor) which can easily be replaced with only a screw driver. Most parts are easily replaced by the end-user. Compressor and absorption units both require trained (expensive) mechanics and special service equipment to service them.

REFERENCES

1. Taylor R A, Solbrekken G (2013), *Comprehensive system-level optimization of thermoelectric devices for electronic cooling applications*, Components and Packaging Technologies, IEEE Transactions on "Thermoelectric Coolers Basics". *TEC Microsystems*.Retrieved 16 March 2013.
2. "Frequently asked questions about our product". *Tellurex*.Retrieved 16 March 2013.
3. http://www.engr.sjsu.edu/ndejong/ME_146.htm - PowerPoint under the "Thermoelectric Coolers" link
4. "The Heatsink Guide". Retrieved 3 May 2013.

International Journal of Engineering Research and Science & Technology
Hyderabad, INDIA. Ph: +91-09441351700, 09059645577
E-mail: editorijlerst@gmail.com or editor@ijerst.com
Website: www.ijerst.com