PIPE BENDING

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ABSTRACT

The main aim of our project is to produce the air conditioning effect using peltier effect and eliminating the use of compressor condenser and other refrigerants like Freon and Ammonia which is toxic in nature. Thermoelectric couples are solid state devices capable of generating electrical power from temperature gradient known as seebeck effect or converting electrical energy into a temperature gradient known as peltier effect. We implement this peltier effect by using a series connection of peltier module to cool the air and it will be a better alternative to vapor compression system. We monitor the performance of the thermoelectric air conditioner and various temperature readings have been tabulated and COP is estimated.

Keywords: *thermoelectric,compressor,performance.*

INTRODUCTION

In thermoelectric materials, electrical energy can be directly converted into thermal energy and thermal energy into electrical energy. Direct conversion between electrical energy and thermal energy is possible because of two important thermoelectric effects: the seebeck effect and peltier effect. The seebeck effect refers to the existence of the electrical potential across a thermoelectric material subject to the temperature gradient. The peltier effect refers to the absorption of the heat into one end of the thermoelectric material and the release of heat from the opposite end due to the current flow through the material.

1.1 PELTIER EFFECT

It works on the principle that when a current is made to flow through the circuit, heat is evolved at the lower junction and absorbed at the upper junction. Peltier heat is reversible when the direction of current is reversed; the peltier heat is the same but in opposite direction. Peltier coefficient depends on the temperature and material of a junction. This effect will be reversed thereby a change in the direction of electric current flow and reverse the direction of heat flow.

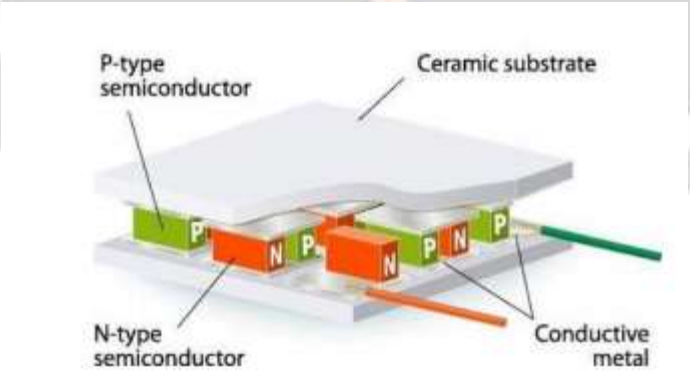

Fig 1.1: Thermoelectric Module

1.2 SEEBECK EFFECT

It is discovered by Thomas Johann seebeck in 1821. He accidentally found that the voltage existed between two ends of a metal bar when there is an electric current. The voltage is proportional to the temperature gradient existed within the bar. The temperature difference causes diffusion of electrons from the hot side to the cold side of a conductor. The motion of electrons creates an electric current the voltage is proportional to the temperature difference as governed by.

$$V = Ch\ (T2 - T1)$$

Where
T2 = temperature of the hot side of the module
T1 = temperature of the cold side of the module
Ch = coefficient of heat transfer

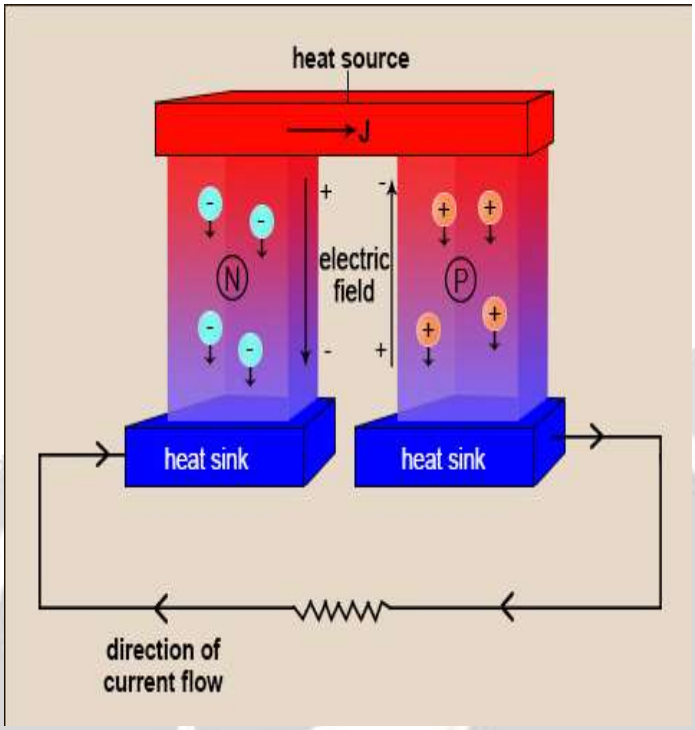

Fig 1.2: Seebeck Effect

1.2 THERMOELECTRIC MATERIALS

The common thermoelectric materials used in different applications are bismuth sulphide, lead telluride, antimony telluride, cesium sulphide, bismuth telluride and germanium telluride, the seebeck coefficient for different materials differs according to their properties which are given in the table below

Material	$\alpha(K^{-1})$
Germanium telluride	1.5×10^{-3}
Cesium sulphide	1×10^{-3}
Bismuth telluride	41×10^{-8}
Lead telluride	1.5×10^{-3}

Table 1.1: Seebeck Coefficient for Different Material

1.3 REQUIREMENTS

- Narrow band gap semi-conductors because of room temperature operations
- Heavy elements because of their high mobility and their low thermal conductivity.
- Large unit cell
- Complex structure
- Highly anisotropic or highly symmetric
- Complex composition

2. HEAT TRANSFER IN MODULES

Heat transfer is a discipline of thermal engineering that concerns the generation, use, conversion and exchange of thermal energy between physical systems.

Heat conduction also called diffusion, the direct microscopic exchange of kinetic energy of particles through the boundary between two systems. When an object is a different temperature from another body or its surroundings, heat flows so that the body and surrounding reaches the same temperature at which point they are in thermal equilibrium. Such spontaneous heat transfer always occurs from a region of high temperature to another region of low temperature.

Heat sink is a component that transfers heat generated within a solid material to a fluid medium, such as air or liquid examples of heat sinks are the heat exchangers used in refrigeration and air conditioning systems.

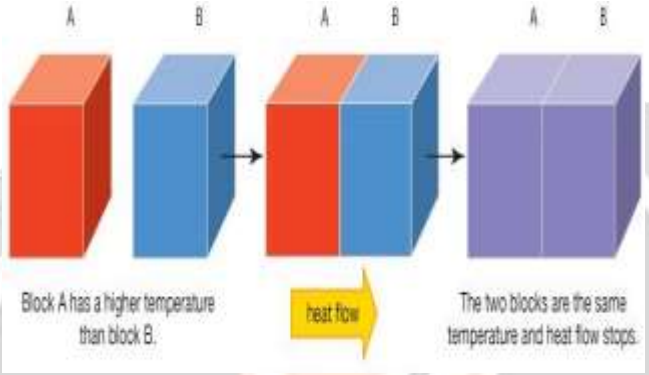

Fig 1.3: Heat Flow

3. LITERATURE REVIEW

Wei He et al., Theoretical and experimental investigation on a termoelectricheating and cooling system driven by solar applied energy 107, 89-97, (2013) Conducted did Numerical study of Theoretical and experimental investigation of a thermoelectric cooling and heating system driven by solar. In summer, the thermoelectric device works as a Peltier cooler when electrical power supplied by PV/T modules is applied on it. The minimum temperature 17 degree C is achieved, with COP of the thermoelectric device higher than 0.45.Then comparing simulation result and experimental study of comparative investigation of thermoelectric air conditioners versus vapor compression and absorption air conditioners. Three types of domestic air conditioners are compared and compact air conditioner was fabricatedcompared performances of thermoelectric and conventional vapor compression air-conditioners. In this paper analyze the cooling performance of compact thermoelectric air-conditioner. TEC1-12708 typethermoelectric modules used for heating and cooling application. The compact TE air conditioners COP was calculated to its optimum parameters. Results show that the actual COPs of vapor compression and thermoelectric air-conditioners are in the range of 2.6-3.0 and0.38-0.45, respectively. However, thermoelectric air conditioners have several advantageous features compared to theirvapor-compression counterparts.

Astrain, Vian&Domıngu et.al., **Increase of COP in the thermoelectric refrigeration by the optimization of heat dissipation, applied thermal engineering 23, 2183-2200,(2003)** conducted an experimental investigation the COP in the thermoelectricrefrigeration by the optimization of heat dissipation. In thermoelectric refrigeration based on the principle of a thermosyphon with phase change is presented. In the experimental optimization phase, a prototype of thermo siphon with athermal resistance of 0.110 K/W has been developed, dissipating the heat of a Peltier pellet with the size of 40*40*3.9 cm,Experimentally proved that the use of thermo siphon with phase change increases the coefficient of performance up to32%.

Shen, Xiao et al., Investigation of a novel thermoelectric radiant air-conditioning system. Journal of energy and buildings, 59,123 – 132, (2102) investigated a novel thermoelectric radiant air-conditioning system (TE-RAC). The systememploys thermoelectric modules as radiant panels for indoor cooling, as well as for space heating by easily reversing theInput current. Based on the analysis of a commercial thermoelectric module they have obtained a maximum cooling COP of 1.77 when applying an electric current of 1.2A and maintaining cold side temperature at 20°C.

4. EFFECTS OF WATER INJECTION

In a piston engine, the initial injection of water cools the fuel-air mixture significantly, which increases its density and hence the amount of mixture that enters the cylinder. The water (if in small liquid droplets) may absorb heat (and lower the pressure) as the charge is compressed, thus reducing compression work. An additional effect comes later during combustion when the water absorbs large amounts of heat as it vaporizes, reducing peak temperature and resultant NOx formation, and reducing the amount of heat energy absorbed into the cylinder walls. This also converts part of combustion energy from the form of heat to the form of pressure. As the water droplets vaporize by absorbing heat, they turn to high pressure steam. The alcohol in the mixture burns, but is also much more resistant to detonation than gasoline. The net result is a higher octane charge that supports very high compression ratios or significant forced induction pressures before onset of detonation.

OBJECTIVES

- To make a less power consumption in an air conditioner.
- To make work in more areas with any humidity level.
- To dehumidify air and keep the humidity at control levels.
- To reduce heat stress for equipments such as computer machineries etc...
- To avoid refrigerant such as CFC and HCFC and thus making an eco friendly systems.
- To maintain the mean time between failures above the range of 200000 hours.
- To control temperature using peltier module.

4.1 WORKING PRINCIPLE

AIR CONDITIONER:

In this thermoelectric air conditioners system we eliminate the use of compressor condenser and other gases thus making it eco friendly. To find the alternative for a conventional air condition system we make use of the peltier effect. Our air conditioner mainly runs on two principles, peltier effect and seebeck effect. Our design of air conditioner needs both the current AC supply and battery DC supply for efficient run. Current AC supply is given to the Fan blowers and 12V DC supply is given to the peltier module.

Let us illustrate the working principle with a working process diagram given below

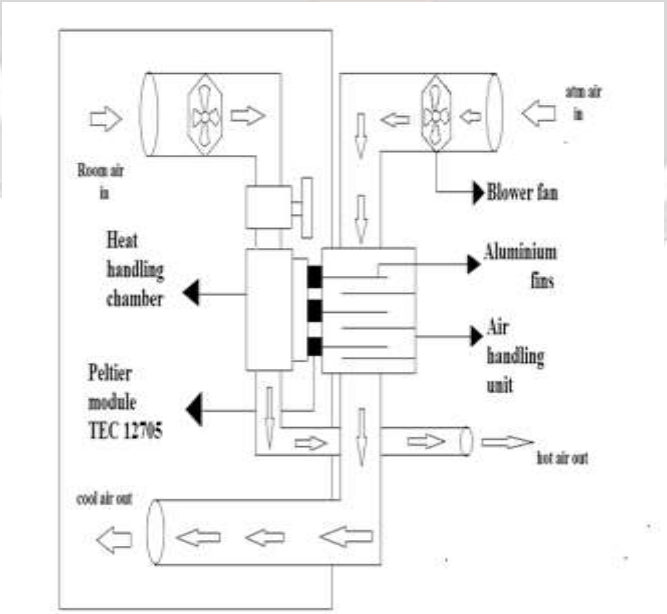

Fig 4.3: working of a thermoelectric air conditioner

Our Ac setup consists of one big chamber which is made of mild steel and two, small hot and cold chambers. This Ac is insulated in-between the walls. The setup is arranged in such a way that the hot and cold chamber sits inside the big mild steel chamber. Both the hot and cold chamber consists of an inlet and outlet hole where we pass the air through the duct. The Ac

setup is clamped and hole is made for duct passage through the chambers. We have chosen peltier module TEC12710 and those peltier modules are made to be placed in-between the hot and cold chambers with the help of thermal paste or otherwise known as hat sink paste. The module wire connections are merged together and it is directed to 12V Dc battery and the blower fan wire connections are directly given to the Ac supply. As we said earlier we use two types of ducts round ducts and tapered ducts. Round duct is fixed to the cold chamber and tapered duct is fixed to the hot chamber.

Cold chamber is made of aluminum sheet metal. It is been cut to four parts and bended and spot welded on its end and thus aluminum box is designed and we also designed fins inside the aluminum chamber. Fins are present in the chamber for a smooth and steady air flow inside the chambers and one input and hole is made with a help of drilling operation and pipes are connected to it which is connected to a duct. A fan is fixed to the end of the duct

Hot chamber is made of stainless steel sheet metal. It is been cut to four parts and bended and spot welded on its end and thus steel box which is also known as het box is designed and we also designed fins inside the hot chamber. Fins are present in the chamber for a smooth and steady air flow inside the chambers and one input and hole is made with a help of drilling operation and pipes are connected to it which is connected to a duct. A fan is fixed to the end of the duct

Firstly the atmosphere air which is in the other side of the room is sucked through the blower fan and pushes it to the cold chamber which is inside the air unit box and fins are present inside the box so the air moves smoothly throughout the fins and reaches the outlet. While passing through the chamber peltier module reacts with the cold chamber at one end which is cold so when air hits the chamber cool air produced and it's sent out to the room and the amount of air is calculated with the help of the temperature sensor.

Secondly the hot air which is inside the room is sucked through the blower fan and pushes it to the hot chamber which is inside the air unit box and fins is present inside the box so the air moves smoothly throughout the fins and reaches the outlet. While passing through the chamber peltier module reacts with the hot chamber which is made up of mild steel at one end which is hot so when air hits the chamber hot air produced and it's sent out of the room with the help of the exhaust and stops after sometime so that when the room is occupied with cold air the suction of hot air from the room will be stopped and cold air will only be circulated again and again.

5 ADVANTAGES OF THERMOELECTRIC AIR CONDITIONER:

Some of the important advantages of thermoelectric air conditioner are as follows:

- A TE module works electrically without any moving parts so they are virtually maintenance free.
- The overall thermoelectric cooling system is much smaller and lighter than a comparable mechanical system. In addition, a variety of standard and special sizes and configurations are available to meet strict application requirements.
- Unlike a conventional heat sink whose temperature necessarily must rise above ambient, a TE cooler attached to that same heat sink has the ability to reduce the temperature below the ambient value.
- **Ability to Heat and Cool With the Same module.** Thermoelectric coolers will either heat or cool depending upon the polarity of the applied DC power.
- **High Reliability.** Thermoelectric modules exhibit very high reliability due to their solid state construction. Although reliability is somewhat application dependent, the life of typical TE coolers is greater than 200,000 hours.
- **Electrically "Quiet" Operation:** Unlike a mechanical refrigeration system, TE modules generate virtually no electrical noise and can be used in conjunction with sensitive electronic sensors.
- **Convenient Power Supply.** TE modules operate directly from a DC power source. Modules having a wide range of input voltages and currents are available.
- **Ability to Generate Electrical Power:** When used "in reverse" by applying a temperature differential across the faces of a TE cooler, it is possible to generate a small amount of DC power.
- **Environmentally Friendly.** Conventional refrigeration systems cannot be fabricated without using chlorofluorocarbons or other chemicals that may be harmful to the environment. Thermoelectric devices do not use or generate gases of any kind.

6.CONCLUSION

A thermoelectric Air conditioner has been fabricated. Therefore the concept of applying thermoelectric current by eliminating condenser and compressor in order to cool the room seems to be reliable and possible for commercial development. The power supply requirements for the systems are around 300 watts.

We made this setup to run on two major sources, we operate the fan using Ac current supply and supply electric current to peltier module by means of 12V battery and thus we can save around 75% of power consumption of a conventional Air conditioner we use nowadays. The performance of thermoelectric module depends on the material used for thermoelectric module and we concluded that bismuth telluride is found to be the suitable thermoelectric material in comparison with other thermoelectric materials

We conclude that thermoelectric air conditioners are eco friendly and does not emit any toxic gases and by using 10 TEC's we can achieve a better cooling than previous thermo electric air conditioners and increase in performance is achieved. The material also plays a big role in cooling and considering that we conclude hat aluminum is suitable for heat transfer properties as it absorbs heat at a very high rate.

7. REFERRED JOURNALS

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