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Air Conditioning System in Car using Thermoelectric Effect

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***Abstract*:- According to International Institute of Refrigeration, air conditioning and refrigeration consumes around 15% of the total worldwide electricity and also contributes to the emission of CFCs, HCFCs, CO_2 etc.Due to the use of such refrigerants it leads to much harmful effect to our environment i.e. the global warming. For air conditioning use of fuel also increases and all these are affect on the car efficiency. To overcome the problem of emission and fulfill the mismatch between the demand and supply of energy consumption the thermoelectric Air conditioning can be used.This system is not going to be noisy, a there will be no hazardous emission to the environment so the system is totally ecofriendly. As the Peltier module is quite compact in size the design can be easily acquired according to space and need.**

Keywords: Peltier module, Thermoelectric air conditioner

1. INTRODUCTION

A thermoelectric module is an electrical module, which produces a temperature difference with current flow. The emergence of the temperature difference is depending on the Peltier effect designated after Jean Peltier. The thermoelectric module is a heat pump and has similar function as a refrigerator. It gets along however without mechanically small construction units (pump, compressor) and without cooling fluids. The heat flow can be turned by reversal of the direction of current. Thermoelectric cooling provides an alternative solution to the common compressor and absorber cooler. Thermoelectric coolers are used especially if small cooling power is required up to 500 W.

Our goal is to define the new HVAC system using thermoelectric couple which shall overcome all the drawback of current HVAC system. If this system comes in present HVAC system, then revolution will occur in the automobile. With rising population and pollution at an alarming rate this system has come to rescue as these are environment friendly and compact. Conventional compressor run cooling equipment have more limitations related to energy efficiency and Chloro-Fluro Carbon (CFC) refrigerants use. Both these factors indirectly point to the impending scenario of global warming. As most of the electricity generation relies on the coal power plants, which add greenhouse gases to the atmosphere is the more cause of global warming. Although researches are going on, best alternatives for the CFC refrigerants is still on the hunt. So instead of using conventional air conditioning systems, other products which can efficiently cool a person are to be planned. By using other efficient cooling device, we can save the electricity bills as well as control the greenhouse gases that are currently released into the surrounding atmosphere.

Although thermoelectric property was discovered about two centuries ago thermoelectric device save only been commercialized during current years. The applications of thermoelectric vary from small refrigerator.

2. LITERATURE SURVEY

2.1 Conditioning System in Car Using:

In present scenario, hvac system (commonly used in the air conditioners) is very efficient and reliable but it has some demerits. It uses refrigerants like freon, ammonia, etc. Due to the use of such refrigerants maximum output can be obtained butit leads to much harmful effect to our environment i.e. The global warming. That leads to the emergence of finding analternative of the conventional hvac system, i.e. Thermoelectric cooling and heating system. The present paper deals with thestudy of thermoelectric air conditioner using tec module. Thermoelectric cooling system have advantages over conventionalcooling devices, such as compact size, light in weight, low cost, high reliability, no mechanical moving parts and no working fluids.

2.2 Study of Thermoelectric Air Conditioning for Automobiles.

Air conditioning systems is used in many automobile applications. The conventional process using refrigerant can cause serious problems to the environment. In this study we developed the air conditioning system based on thermoelectric properties. In this air conditioning, there is no use of compressor and pump for the refrigeration. Thermoelectric module is an electrical module, which produces a temperature difference while current flow. The emergence of the temperature difference is based on Peltier effect. The thermoelectric module is a heat pump and has the same function as a refrigerator. The heat flow can be turned by reversal of the direction of the current. Our aim is to introduce the new HVAC system using thermoelectric module which shall overcome all the disadvantages of existing HVAC system.

2.3 Thermoelectric Air Cooling For Cars

I am trying to overcome these demerits by replacing the existing HVAC system by newly emerging thermoelectric couple or cooler which works on peltier and seebeckeffect.Thermoelectric cooling can be considered as one of the major applications of thermoelectric modules (TEM) or thermoelectric coolers (TEC). The main objective of this project is to design a cooling system installed on a conventional blower of car AC. The idea of cooling is based on Peltier effect, as when a dc current flows through

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TE modules it generates a heat transfer and temperature difference across the ceramic substrates causing one side of the module to be cold and the other side to be hot. The purpose of the project is to make use of the cold side to cool the ambient air to a lower temperature, so that it can be used as a personal cooler. Testing and measurements are also performed using on car (Maruti Suzuki Zen). A simple temperature controller interface with the cooling system has also been incorporated. Based on an analysis of sizing and design of the TEC air cooling for car, it can be deduced that the cooling system is indeed feasible. Readings taken during testing also testify to the fact that the TE cooling for car can lower the ambient temperature by 7 degree Celsius.

3. PROPOSED SYSTEM

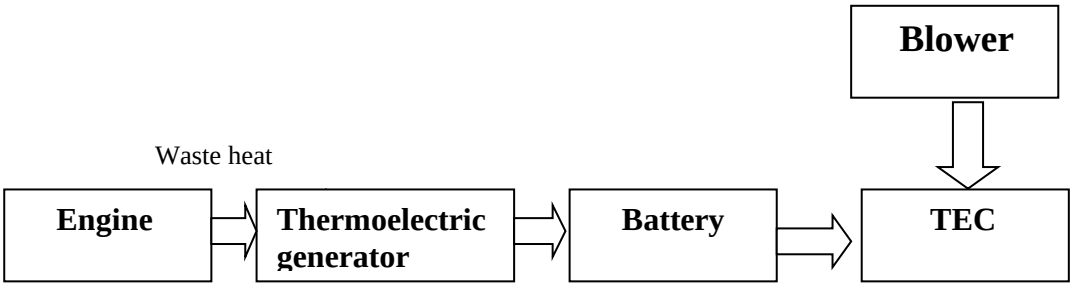

Fig.1. Block Diagram

3.1. Thermoelectric generator:

A thermoelectric generator (TEG), also called a Seebeck generator, is a solid state device that converts heat flux (temperature differences) directly into electrical energy through a phenomenon called the Seebeck effect (a form of thermoelectric effect). Thermoelectric generators function like heat engines, but are less bulky and have no moving parts. However, TEGs are typically more expensive and less efficient

Thermoelectric generators could be used in power plants in order to convert waste heat into additional electrical power and in automobiles as automotive thermoelectric generators (ATGs) to increase fuel efficiency. Another application is radioisotope thermoelectric generators which are used in space probes, which has the same mechanism but use radioisotopes to generate the required heat difference.

Seebeck effect

A thermoelectric circuit composed of materials of different Seebeck coefficient (p-doped and n-doped semiconductors), configured as a thermoelectric generator. If the load resistor at the bottom is replaced with a voltmeter the circuit then functions as a temperature-sensing thermocouple. A thermoelectric circuit composed of materials of different Seebeck coefficient (p-doped and n-doped semiconductors), configured as a thermoelectric generator. If the load resistor at the bottom is replaced with a voltmeter the circuit then functions as a temperature-sensing thermocouple.

The Seebeck effect is the conversion of temperature differences directly into electricity and is named after the Baltic German physicist Thomas Johann Seebeck. Seebeck, in 1821, discovered that a compass needle would be deflected by a closed loop formed by two different metals joined in two places, with a temperature difference between the junctions. This was because the metals responded to the temperature difference in different ways, creating a current loop and a magnetic field. Seebeck did not recognize there was an electric current involved, so he called the phenomenon the thermo magnetic effect. Danish physicist Hans Christian Ørsted rectified the mistake and coined the term "thermoelectricity".

The Seebeck effect is a classic example of an electromotive force (emf) and leads to measurable currents or voltages in the same way as any other emf. Electromotive forces modify Ohm's law by generating currents even in the absence of voltage differences (or vice versa); the local current density is given by,

$J=\sigma(-\Delta V + Eemf)$

Where is the local voltage and is the local conductivity. In general, the Seebeck effect is described locally by the creation of an electromotive field

$Eemf = -S\Delta T$

Where S is the Seebeck coefficient (also known as thermo power), a property of the local material, and ΔT is the gradient in temperature T.

The Seebeck coefficients generally vary as function of temperature, and depend strongly on the composition of the conductor. For ordinary materials at room temperature, the Seebeck coefficient may range in value from −100 μV/K to +1,000 μV/K (see Seebeck coefficient article for more information).If the system reaches a steady state where J=0, then the voltage gradient is given simply by the emf $-\Delta V=S\Delta T$. This simple relationship, which does not depend on conductivity, is used in the thermocouple to measure a temperature difference; an absolute temperature may be found by performing the voltage measurement at a known reference temperature. A metal of unknown composition can be classified by its thermoelectric effect if a metallic probe of known composition is kept at a constant temperature and held in contact with the unknown sample that is locally heated to the probe temperature. It is used commercially to identify metal alloys. Thermocouples in series form a thermopile. Thermoelectric generators areused for creating power from heat differentials

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3.2. Battery:

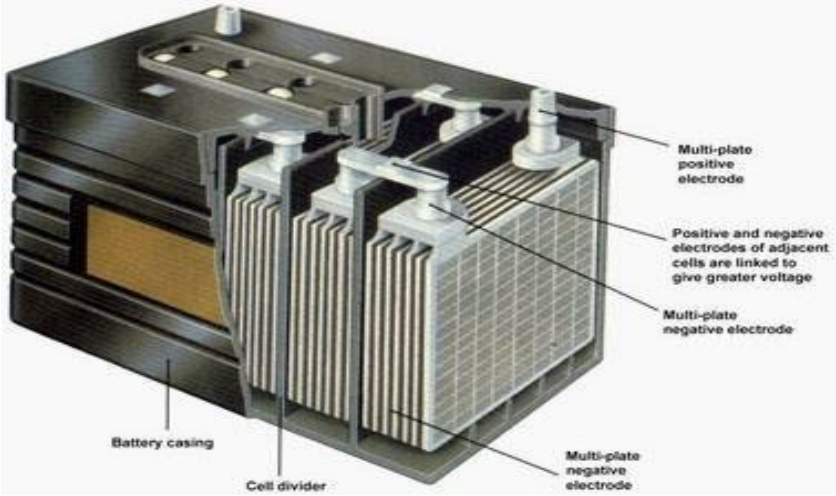

Fig.2. Battery

In an internal combustion engine -powered vehicle, the battery is used mainly to start the engine. It is quite small but still pretty heavy, say **15kg**- using **lead-acid** chemistry and will have a capacity of **40–100Amp-hours** (Ah). Lead-acid is a very well established technology, it's inexpensive and reliable. A car's electrical power system is rated at **12 volts**. When cranking the engine it will supply the starter motor with about 60–100Amps - which is a massive current requiring very thick cable - but only for a couple of seconds. It can also power the lights and radio when the engine is switched off - when the engine is running all the electrical accessories are supplied from the alternator. The alternator also charges the battery so it is ready for use the next time you want to start the car.

3.3. Thermoelectric cooler

Peltire Plate:-

Thermoelectric cooling has quickly become a practical proposition for many types of electronic equipment. Devices on the market today are compact, efficient and – with the benefit of advanced internal construction – overcome the traditional reliability challenges that have restricted opportunities for this type of device in the past.

Keeping electronic components like laser diodes or image sensors at a stable temperature is vital to ensure instruments such as high-power lasers, laboratory references, spectroscopes or night-vision systems can function correctly. In some cases, cooling to below ambient temperature may be required. Simple passive cooling, using a combination of a heat sink and forced-air, can struggle to satisfy either of these demands; response to changes in thermal load can be slow and imprecise, and cooling relies on a thermal gradient where the heat source temperature is higher than ambient.

As alternative to commonly used passive cooling techniques, thermoelectric cooling can offer numerous advantages. These include accurate temperature control and faster response, the opportunity for fanless operation (subject to heat sink performance), reduced noise, space savings, reduced power consumption and the ability to cool components to sub-ambient temperatures.

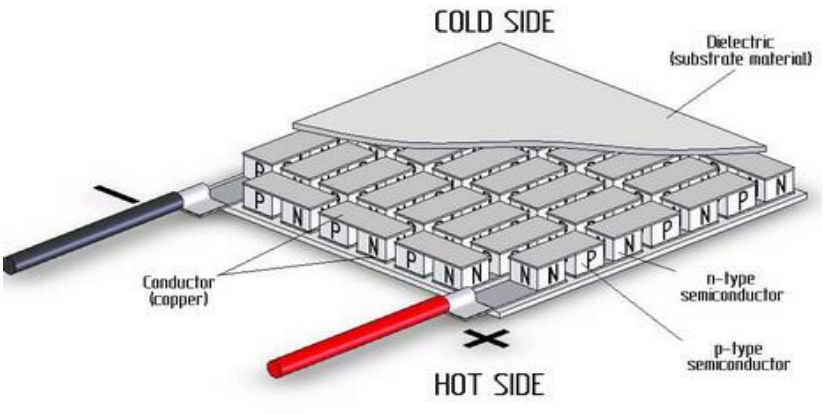

Fig.3. Peltier Plate

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4. METHODOLOGY

4.1. Peltier Thermo-Electric Cooler Module - 12V 5A :-

Specification:

- Max current: 6A @ 12V
- Suggested Voltage range: 12V to 15.5V
- Maximum temperature differential (Tmax @ Qc = 0): 66°C
- Maximum cooling power (Qcmax) @ 15.3V: 97W
- 127 Peltier elements
- DC Resistance: 2.5 ohms
- Silicone seal
- Dimensions: 40mm / 1.57" x 40mm / 1.57" x 3.5mm / 0.13"
- Wire Length: 339.72mm / 13.32"
- Weight: 20.68g

4.2. Thermoelectric Generator

Feature:

colding side posts with the words heating side is empty red wire to positive , black wire to the negative , it generate electricity when the temperature difference happened .

Specification:

- Model: SP1848-27145
- Color: white
- Lead Length: about 30CM
- Size: 40MM x 40MM x 3. 4MM
- 20 degree temperature difference: open-circuit voltage 0. 97V, generated current: 225MA
- 40 degree temperature difference: open circuit voltage 1. 8V, generated current: 368MA
- 60 degree temperature difference: open circuit voltage 2. 4V, generated current: 469MA
- 80 degree temperature difference: the open circuit voltage 3. 6V, generated current: 558MA
- 100 degree temperature difference: open circuit voltage 4. 8V, generated current: 669MA
- The above values are for reference only, the wiring in actual use, and the step-up board, there will be loss of current Package included: 1 x 40x40MM Thermoelectric Power Generator Peltier Module.

5. FUTURE SCOPE

In future scope of view the thermoelectric Air conditioning is replacement of HVAC system. The thermoelectric generator generate the voltage with help of heat produced by the engine. This voltage is stored in battery and supply to the thermoelectric cooler which made up of peltier plate which can gave us an cooling effect by the use of voltage . this method is very convinent and low in cost .by the using this system we can save the petrol and disel of the car .For themprature sensing we use digital temperature sensor .we can control the cooling effect by controlling the speed of the blower .now a days the cars are runs on petrol but in future electrical cars are produced more so this air condition is very efficient for electric cars than the petrol cars.

6. CONCLUSION

After the study of thermoelectric refrigeration system, we could demonstrate the cooling ability of the Peltier module and its use as an alternative to refrigerant based cooling systems. The study concludes that there are a no. of places where TEC can play a more promising role than the conventional ACs with the added advantage of not using the refrigerants and hence protecting the ozone layer. With its reliable cooling and precise temperature control, this solid-state cooling technology can replace conventional cooling in a multitude of applications. Also with the advancements in material technology, there shall be a drastic rise in the cooling performance. This project was just an effort to demonstrate the need and means of replacing the conventional systems due to their adverse environmental effects and to highlight the future scope of the Thermoelectric Cooling Devices.

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