RISE:2018
RESEARCH, INNOVATION AND SCHOLARSHIP EXPO

Graduate
Category: Engineering & Technology
Degree Seeking: MS in Energy Systems
Abstract ID# : 2053

Northeastern University

A Household Fan with Cooling and Heating Capabilities, a Cheap Alternative to AC

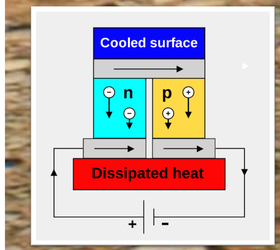
Harsh Rajendrakumar Engineer

Opportunity

According to the British Journal 'THE LANCET', there were 74 million deaths reported between 1985 and 2012 due to hot and cold temperatures. Due to the increasing Global Warming, the magnitude of those temperatures will also increase, which will also increase that death toll. Now the rich and upper-class community are equipped with Air Conditioner and heating systems to adopt such a climate change, but there are communities who don't have access to these technologies. This solution will provide those communities with a technology, which can help them cope with such harsh climate changes and that too at affordable rates. This project proposes a low energy consuming fan ,which will be equipped with Thermoelectric Modules(TEM). This TEMs will generate hot and cold sides, which will heat and cool respectively, the air from the fan. TEM will generate hot & cold sides depending on the direction of the current provided to it.

Results/Data

Here, when either a 110, 230 AC or a 12 DC supply is given to the fan, the TEMs and fan motor will turn. Now there will be a regulator for the fan speed and then it will have either a switch or a regulator for dealing with the temperature. The TEMs will generate a hot and cold side and the degree of the temperature rise will be dependent on the amount of energy given to the TEMs. The effect on which it works is known as Peltier effect. The following figure shows the Peltier effect in a TEM.



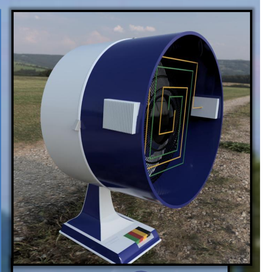
Specifications:

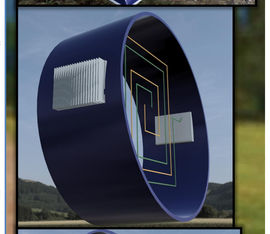
Parameters		
Internal resistance	1.9Ω ± 10%	
Imax.	15.4A	
Vmax.	35.8V	
	Th=25°C	
Qmax.	340W	
⊿Tmax.	68°C	
Solder Melting Point	138°C	
Max. Compress	1MPa	
Operating Temperature	-90°C to +110°C	
External Depth	3.9mm	
External Length / Height	50mm	

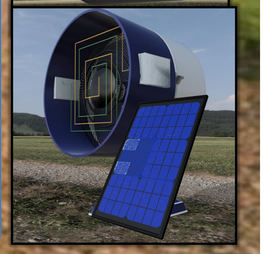
From the figure it can be easily seen how a hot and cold surfaces are generated when a potential difference is applied to the TEMs. The other picture is about the specification of a TEM available in the market. Thus, with the help of hot and cold junctions created, the heat can be transferred to the coils shown in the picture in the center ,which will be responsible to transfer the heat to the air. Thus, in this manner micro-climate can be generated with the help of this fan.

Approach

The tentative conceptual design of the fan is shown in the figure. The positions of the TEC won't be the same in the final design as shown in the above design. The above design is for the basic understanding of the working of the original design. They work on the concept of Peltier Effect. It is an effect whereby heat is emitted or absorbed when an electric current passes through the junction between two materials. In simple words, side A of the TEM will be cold and side B will be hot in one current direction while the side A will be hot and side B will be cold in the opposite current direction. The cold side of an average TEM can approximately reach up to -5 degree Celsius while the hot side can approximately reach up to 70 degree Celsius. Here, Two TEMs will be used for cooling purpose while the other two TEMs will be used for heating purpose. The TEMs are equipped with heat sinks to allow the proper heat flow through the TEMs. Now the faces of the TEMs will be attached with highly thermally conductive metal tube, which will be filled with a highly thermally conductive fluid. So with the cooling and heating of the sides of the TEMs, the liquid will also be cooled and heated accordingly. There would be a number of such liquid filled tubes attached to the TEMs. These tubes are on the front grill of the fan, Thus, the air will pass touching these tubes and Thus, the air will either will be cooled or be heated accordingly. The design of the tubes and the position of the tubes are not shown in the above-given design. The fan will be designed to work on a grid supply as well as on a 12V or 24V battery. Now, the TEMs are already used in many places for cooling purposes like for cooling the CPU of computers on one side and also releasing heat on the other side and that's one of the main sources of heat generated by computers. For the heating purpose, they are being used in Cooler/Warmers to keep the hot food hot and cold drinks cold and many other such devices. The heat produced from the other side can be used for heating the fluid in the tube ,which will ultimately heat the air. Thus, without burning of fuel and emission of CO_2 we can achieve heating and cooling of the air. There is no such compact household fan available in the market right now that can provide both hot and cold air with this kind of scientific approach. The only things, which are available are A/C, Coolers and Electric Heaters, which are really costly in comparison to this fan. Moreover to increase there is also a retrofit designed, which can be mounted on existing fans and also it can work on solar panels and have an inbuilt battery in it.







Impact

The unique feature of my innovation is a cheaper way to create micro-climates for afflicted communities.

The actions will be taken in the developing countries like India, Brazil, Bangladesh etc. Even the poor communities of developed countries like the USA can take benefits of this solution.

- This Fan can be provided to the poor families living in villages and also in Slum areas who suffer from extreme hot and cold temperatures and some of them are losing their lives because of it.
- It can be provided to Government Schools of the developing countries giving proper facility to students so that they can focus on their education and not be affected by the adverse climatic conditions in, which they are living.
- Refugee Camps and the hospital tents can be benefitted by this fan and it can give comfort to refugee patients of those camps.
- Similarly, it can be deployed in the Disaster Relief Camps like in Puerto Rico and Caribbean Islands.

This solution will not only help the people without a proper A/C system to face the adverse climatic change but it will also uplift their living standards. It will decrease the death toll of such people due to very high & low temperatures. According to a Recent Berkeley National Laboratory Study, in the US alone, nearly 100 million tons of Carbon dioxide is released every year by Air Conditioning Systems. While this system does not generate any kind of emissions as it does not burn any kind of fuel and gives clean heating and cooling with the use of electricity. Thus, it harnesses the power of energy to provide thermal comfort to all.

Recognitions

HULT PRIZE

MIT Climate CoLab

UN environment