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Air Multiplier with Air Cooling System

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Abstract

Normally table or ceiling fan is low cost option for cooling purpose in summer for office and home. In summer, temperature of air increases, and also fan blade gets heated due to continuous use. After rise in temperature of blade as well as atmospheric air, it blows hot air. In normal fan safety is also issue. So table fan must have safety rings for protection. Again that safety ring and blade attracts dust thus it doesn't provide clean air. Air multiplier is one type of fan, which is different from conventional fan. It has no blades. Air multiplier uses brushless electric motor, which provides precise control of fan speed. It is relatively noiseless compared to brushed motors. But again air multiplier doesn't provide cool air just recirculate atmospheric air. Though temperature of air doesn't increase in it but also it doesn't decrease, that is the need of summer. So in this research air multiplier with air cooling system is proposed. Combination of air multiplier and air cooling system using Peltier effect is developed to get cooler air in summer. It is developed for small cabinet of office for single person or maximum two people.

Keywords: Air Multiplier, Peltier Effect, Peltier Module, Bladeless Fan, Office Fan

I. INTRODUCTION

Electrical fans have been in use from century. Electric fans with blades create thermal comfort by producing a flow of air and directing it in particular direction. The main disadvantage of fan is it doesn't reduce its temperature. Air multiplier is advanced fan in which air doesn't passes through blade. So they are also known as bladeless fan. There is no dust attraction problem in air multiplier so supplies clean air. Air multiplier also sucks air and supply it to users like any normal fan but it doesn't cool the air. So Peltier module is attached along with inlet of air multiplier. Cooling effect is produced by means of Peltier effect.

II. LITERATURE REVIEW

Initially Dyson Company has invented bladeless fan called air multiplier. It uses friction in air to push the air. [1]. There is small opening (1 mm or so) around the rim of circular fan. From this small opening air flows with velocity nearly 88.51 km/h. That thin stream of air pulls more air into stream. At same time, air that gets pushed away from ring towards person creates area of low pressure. That low pressure pulls in more air from behind the fan (filling the gap) which is then in turn drawn into the air stream.

Mohammad Jafari et al. [2] has published Numerical investigation of geometric parameter effects on aerodynamic performance of Bladeless fan. Effect of five geometric parameters, namely height of cross section of the fan, outlet angle of the flow relative to the fan axis, thickness of airflow outlet slit, hydraulic diameter and aspect ratio for circular and quadratic cross sections were considered. Airflow through this fan was analyzed by simulating Bladeless fan. Analysis of flow field inside fan and evaluation of its performance were obtained by solving conservations of mass and momentum equations. The results for outlet thicknesses of 1, 2 and 3 mm showed that Discharge ratio increased significantly when the outlet thickness decreased.

III. CONSTRUCTION

A. Insulated Ice Box

It is nothing but an ice box made from thermacoal. Shape of box is rectangular having size of 3×2×2 feet. It is selected because of low cost and it is easily available. Whole box is covered with insulated adhesive tape to reduce heat loss.

Fig. 1: Insulated Ice Box

B. Bladeless Fan Ring

It is made from plastic. Its cross section is hollow circular having a small gap inside it from which outlet air flows. It is also insulated by using adhesive tape to reduce heat loss. Its specifications are: Outside diameter: 350 mm, inside diameter 300 mm, thickness: 3 mm. Size of gap is very important to create flow of air. The gap is kept 1 mm.

Fig. 2: Bladeless Fan Ring

C. Brushless A.C. Motor

It is purchased part. It directly works on AC supply. Its specifications are: Diameter: 15 cm, Height: 20 cm, speed: 2400 rpm, power: 40 watts, voltage: 220-240 V, 50-60 Hz, air inlet: up to 27 litre of air drawn in per sec. It is connected at bottom of bladeless fan ring.

Fig. 3: Brushless A.C. Motor

D. Peltier Module & Water Block

Two Peltier modules are used. It works on Peltier effect. This effect says, when cooling of one junction and heating of other and electric current is maintained in a circuit of material consisting of two dissimilar conductors, effect is even stronger in circuits containing dissimilar semiconductors. If battery joined by two pieces of copper wire to length of bismuth wire, temperature rise at

junction where current passes from copper to bismuth, and temperature drop occurs at junction where current passes from bismuth to copper. In 1834, physicist Jean-Charles-Athanase Peltier discovered effect [3]. Our requirement is to obtain cool air using Peltier effect. When electricity is supplied to Peltier module, its one side becomes hotter (known as heat source) and other side becomes cooler (known as heat sink). To collect heat from heat source and heat sink, aluminum water blocks are used. Cool air is used as input for fan. Due to high temperature of hot side whole system temperature may get increased. So to control heat source temperature heat is continuously rejected into cold water. To control the temperature, new fresh water is circulated continuously by using small pump.

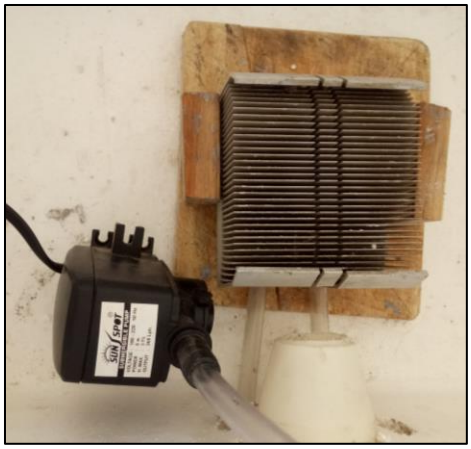

Fig. 4: Peltier Module

Fig. 5: Water Block

E. Pump

It is use for rejection heat from Peltier module. It's operated by 24 V DC battery. Its specifications are: Operating voltage: 165-220V, 50 Hz – 6W, Maximum head: 3 feet, Output: 360 lit/hr.

Fig. 6: Pump

IV. WORKING

First Peltier module is connected with electric supply. After sometimes heat sink becomes cooler and heat source becomes hotter. By using DC battery and pump water is supplied to heat source side. Cooling water is circulated continuously to keep the heat source temperature lower. When temperature of heat sink becomes lower, start the air multiplier. Now it gives continuously cool air. If temperature of cooling water increased, it may be changed.

Fig. 7: Air Multiplier with Cooling System

V. RESULT & DISCUSSION

Experiment is done by varying number of Peltier module and water block. With one module and one water block we get temperature difference of 2.2˚ C. With two and two water block we get temperature difference of 5.5 ˚. With increasing in number of Peltier module and water block, effectiveness of cooling increases. We can increase the number of according to our need up to certain extent.

Table - 1
Results of Temperature Difference

No	***No. of Peltier***	***No. of water block***	***Room temperature*** (˚C)	***Fan outlet temperature***(˚C)	***temperature difference***
1	***1***	***1***	***34.5***	***32.3***	***2.2***
2	***2***	***2***	***34.5***	***29***	***5.5***

VI. CONCLUSION & FUTURE SCOPE

Experiment is done by varying number of Peltier module and water block. So as number of Peltier module is increased outlet temperature of fan reduced. With increased in Peltier module and water block, also water temperature is increased (its reading is not taken), so more fresh water is required. Up to certain limit Peltier and water block can be increased after that size becomes too large. This the limitation of Peltier cooling system after certain limit size and water required is increased. Also arrangement of pettier module can be made in such a way that heat source side (hot side) kept outside the block. In this way cooling water doesn't need to replace frequently and that water can be used for other heating applications.

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