International Journal of Research and Review
Vol.7; Issue: 7; July 2020
Website: www.ijrrjournal.com
Research Paper
E-ISSN: 2349-9788; P-ISSN: 2454-2237

Implementation of Thermoelectric Cooling Chip Cooling Fan System

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ABSTRACT

The traditional electric fan in summer, the wind blowing out is hot. In this study, thermoelectric cooling chips are used to cool the water. Then use the pump to put the ice water into the cold exhaust and blow out the cold air with a fan to achieve the effect of cooling the air.

Keywords: Thermoelectric cooling chips, pump, cooling fan

1. INTRODUCTION

With the development of science and technology, dozens of semiconductor materials suitable for thermoelectric power generation have been developed. The principle of cooling and power generation can be briefly described as follows, [1-3] as shown in Figures 1 and 2: Taking P-type semiconductor material as an example, under the temperature difference status, most carriers (holes) at the hot end have a higher probability of moving from the hot end to the cold end, and the overall performance is as if current flows from the hot end to the cold end; Same as the theory, the majority carriers (electrons) on N-type semiconductors are also the same. While the pair of P-type and N-type semiconductor materials is connected in series with conductive materials, the whole circuit forms a current.

To put it simply: using the temperature difference to control the direction of the movement of electrons and holes, and then form a current, which is the theory of temperature difference power generation. Similarly, the thermoelectric cooler principle can be briefly described as follows: When pair of P-type and N-type thermoelectric materials is connected in series, direct current is introduced. When the current passes through the P-type semiconductor material (the current direction is upward), the direction of the majority carriers (holes) in it moves in the same direction as currents are in the same direction. Therefore, most carriers in the P-type semiconductor material are equivalent to move upward.

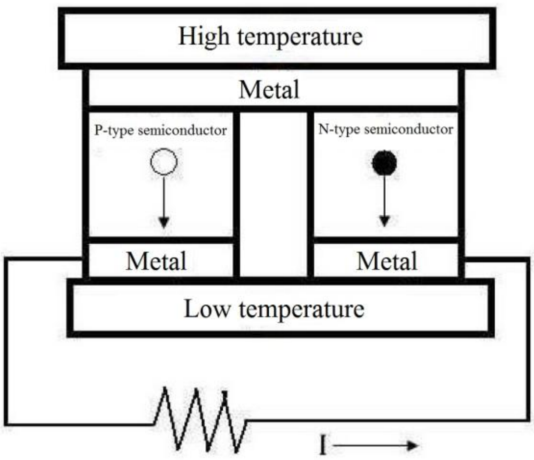

Figure 1: Thermoelectric module power generation principle

Next, when the current passes through the N-type semiconductor material (the direction of the current is downward), the direction of the majority of carriers (electrons) moving in the current is reversed. Therefore, most carriers in the N-type semiconductor material are also equivalent to move upward. To sum up, while a current is applied, the carriers (electrons and holes) with energy in P-type and N-type semiconductor materials move from bottom to top. This energy-carrying carrier accumulates on the upper end face, causing the temperature of the upper end face to rise, the so-called hot end. Conversely, energy-carrying carriers (electrons and holes) are far from the lower end surface, resulting in a lower temperature of the lower end surface, so-called cold end. To put it simply: through the direct current to control the direction of the movement of electrons and holes, and then form a temperature difference, this is the thermoelectric cooler theory.

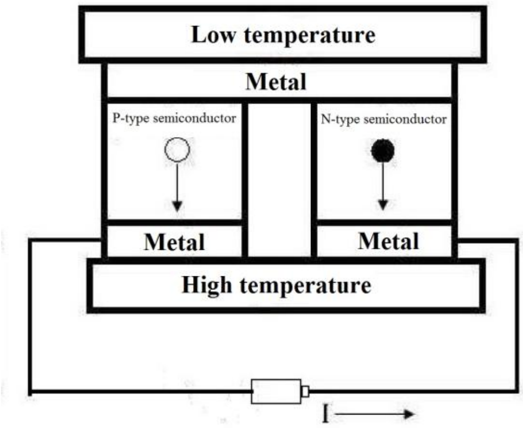

Figure 2: Thermoelectric module refrigeration principle

In Figures 1 and 2, P-type semiconductors and N-type semiconductors made of thermoelectric materials will have heat absorption and heat release at the junction of P-type and N-type semiconductors. And it can bring heat from one end to the other. This function is to transfer heat from one end to the other using the action of electrical energy, called a heat pump. When a temperature difference is provided to a component to generate current, which can be used to manufacture thermoelectric generators, as shown in Figure 1. Conversely, providing a current can produce a temperature difference, which can be used to make a thermoelectric cooler, as shown in Figure 2.

Figure 3: Heat sink

2. THE PRINCIPLE OF OPERATION

When the cooling chip is thermally connected to the heat sink of Figure 3, the heat is discharged to the other end of the atmospheric environment. We have cool the water through the cold end of the cooling chip, through the water circulation pump as shown in Figure 4. Water makes circulation.

Figure 4: Water circulation pump

Figure 5: Water tank

The cold water is driven into the water tank as shown in Figure 5, and the cold wind is blown out through the fan of the water tank. In this way, the purpose of cooling the temperature for thermoelectric cooler chip can be achieved.

Figure 6: Fan and water tank

Figure 7: Thermoelectric cooling chip

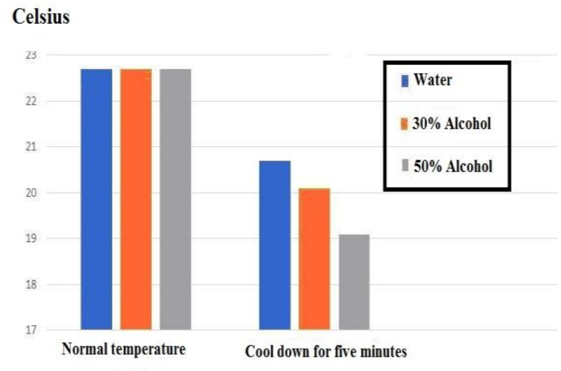

Figure8: Data graph of cooling test experiment

Water has been circulating to do heat exchange, and the role of water in this system is as a temperature-absorbing medium. Figure 5 shows the water tank for supplementing water. The water tank in Figure 6 uses four fans to blow out cold air. The cooling chip is shown in Figure 7. Two chips are used in this system. The cooling efficiency of the cooling chip will not be reduced much. We did not set the temperature and just used it as a cooling fan, based on the concept of directly blowing with the power supply.

Figure 9: The room temperature has not been cooled

Figure 10: Add the cooling effect of ordinary water

3. RESULTS & TESTING

For the cooling test, we used different cooling media, namely ordinary water, water containing 30% alcohol, and water containing 50% alcohol, to conduct a cooling test for 5 minutes. The experimental data is shown in Figure 8.

Figure 11: The cooling effect of water with 30% alcohol

Figure 12: The cooling effect of 50% alcohol water

The test point is at the fan outlet of the water tank. The room temperature is not cooled at room temperature is 22.7 ℃, as shown in Figure 9. After a five-minute cooling test, the normal temperature of the ordinary water chamber is 20.9℃, as shown in Figure 10. The normal temperature of the water chamber containing 30% alcohol is 20.1℃, as shown in Figure 11. The normal temperature of the water chamber containing 50% alcohol is 19.1℃, as shown in Figure 12.

4. CONCLUSION

The physical diagram of the system is shown in Figure 13. Although the cooling fan system of the cooling chip may reduce the efficiency of the cooling chip due to factors such as environment and temperature changes, it can still meet the functional requirements of the cooling system, but it takes longer. If you want to speed up the cooling rate, you can increase the number of cooling wafers to speed up the cooling rate. The advantage of the cooling fan of the cooling chip is that it saves electricity compared to the air conditioner. Our wind is directly blown, which can make people feel cool but not consume too much electricity, which can avoid unnecessary waste.

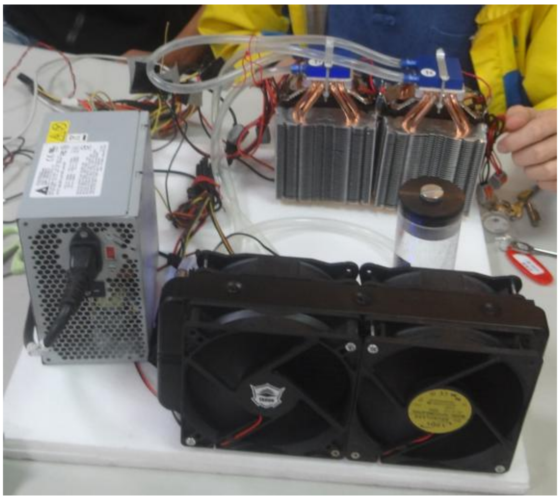

Figure 13: System physical diagram

ACKNOWLEDGMENTS

This work is supported by the Industry-University Cooperation Plan of Fareast University in Taiwan, Republic of China (grant 10803-08-36-002).

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How to cite this article: Lin WB, Yarn KF. Implementation of thermoelectric cooling chip cooling fan system. International Journal of Research and Review. 2020; 7(7): 307-311.

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