AUTOMATIC COMPRESSOR LESS FRIDGE USING PELTIER MODULE

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Abstract

In order to preserve the freshness of the food inside, a refrigerator is a big metal container that is typically maintained chilly by electricity. The globe over, refrigeration is a vital method of food preservation. Although some refrigerants, like chlorofluorocarbons (CFCs), harm the ozone layer, others are extremely potent warming gases. In actuality, one kilogramme of the refrigerant R410a has the same greenhouse effect as two tonnes of carbon dioxide, or driving your automobile for six months. There have been several studies done to replace the conventional refrigerators; these include high-quality cooler boxes, zeer pots, propane refrigerators, and Peltier refrigerators. The Peltier refrigerator was created as a consequence of numerous studies. Peltier refrigerators, also known as Peltier coolers, have several advantages over conventional refrigerators. They have no moving components and are totally solid-state, making them robust, dependable, and silent. The lack of ozone-depleting chlorofluorocarbons makes them possibly more environmentally friendly than traditional refrigeration. Compared to compressor-based systems, they can be substantially more compact. Peltier coolers provide for precise temperature control (0.1°C). In contrast to traditional refrigerators, they are less efficient. Due to their inefficient thermal heat dissipation, Peltier Fridges have a poor efficiency. Several projects involving Peltier Fridges that used natural air cooling had a lower efficiency as a result. Using water cooling and an automatic temperature controller, project has been scaled down to a 5L volume, 12V, 8A Peltier Module.

1. INTRODUCTION

1.1 GENERAL

Environmentally sustainable cooling solutions are the sole foundation of this project. Because we decided to use a Peltier cooling system, our refrigerator is referred to as an automatic

compressor-free refrigerator employing a Peltier module. Using a W-1209 automatic temperature controller, we automated this refrigerator. In addition, we designed a cooling system that circulates coolant through water blocks placed behind Peltier modules to radiate heat produced by the Peltier effect. The thermal and electrical efficiency of the numerous semiconductor cooling initiatives, however, was subpar. It is anticipated that this project will increase electrical and thermal efficiency from the previous projects by 20% and 30%, respectively.

1.2. PROBLEM STATEMENT

High-quality cooler boxes, zeer pots, propane fridges, and Peltier fridges are only a few of the research done to replace the ordinary refrigerators. The Peltier fridge was made possible by extensive study. The Peltier fridge, commonly referred to as a Peltier cooler, is nothing more than a semiconductor thermoelectric cooler that has several advantages over regular refrigerators. With no moving components and being totally solid-state, they are robust, dependable, and silent. They may provide a more environmentally friendly option to traditional refrigeration since they don't contain any ozone-depleting chlorofluorocarbons. They can be substantially more compact than compressor-based devices. Peltier coolers enable precise temperature control. Unfortunately, they are less efficient than regular refrigerators. Due to the limited thermal heat dissipation of Peltier Fridges, their efficiency is low. Several projects involving Peltier Fridges that used a natural air-cooling system had reduced efficiency as a result.

1.3 PROPOSED SYSTEM

A Peltier thermoelectric cooler was theoretically modelled, built, and tested as part of this project. The specified cooler's schematic is shown in Figure 1. A foam box was used to build the body of a miniature thermoelectric cooler. The Peltier thermoelectric module, which was made up of an exterior heat sink and a Peltier thermoelectric cell (TEC), was situated in the middle of the cooler box's upper side. The thermoelectric module was first mounted, sandwiched between two heat sinks, with the installation of two cooling fans coming next, mounted on the heat sinks' body. To improve the cooling of the box, one of the heat sinks was

inserted, while the other one provided a stronger effect of heat rejection. The module was constructed with the TEC in the centre and parallel to the wall, the internal heat sink inside the cooler box, and the external heat sink exposed to the environment.

1.4 OBJECTIVE

This project's goal is to maximise efficiency both thermally and electrically by using water cooling and automatic temperature controllers (ATC). We can automate the Peltier refrigerator's turn-on and turn-off times based on the temperature of the inside volume by using ATC. This project has also been scaled back to a 5L capacity, 12V, 3A Peltier Module, and ATC will be used for control. We achieved the anticipated results in maintaining thermal and electrical efficiency after testing the final product.

2. BLOCK DIAGRAM

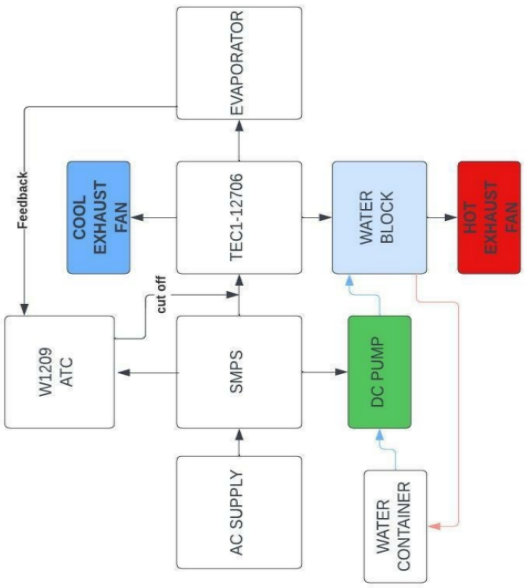

Fig 1. Block Diagram

3. IMPLEMENTATION (WORKING PROCEDURE)

To power the refrigerator, a 12V DC 7.5 power supply is used. The refrigerator is activated when the switch is turned on, and an off-glow LED light indicates its readiness. Now, the two

Peltier Devices (TEC1-12706) insulated on both sides of the refrigerator (i.e., insulated thermoplastic box) provide cooling on the inside while dispersing heat on the outside. A heat sink and cooling fan are used on the heat side of the device to dissipate heat from the Peltier unit to the environment. The Peltier device is properly installed in a good insulation system and heat sink to provide an effective chilling effect constantly when the refrigerator is turned on. The Peltier device within the refrigerator produces a cooling effect that is automatically detected by a thermostat located near the cooling side of the device. The cooling rate is then digitally displayed on a digital metre. While the primary battery powers the Peltier device and thermostat, the 12 V DC 7.5 A secondary battery powers the thermostat and digital metre. The switch can be turned off to turn the refrigerator OFF, which also turns off the LED light that glows to indicate that the appliance is turned off.

4. RESULT

Fig 2. Front View

Fig 3. Rear View

Applications:

1. In isolated locations: It can be used in underdeveloped, off-the-grid areas where electricity is scarce.

2. It can be used in restaurants or hotels to keep perishable goods fresh.

3. Laboratory: It can be used to preserve a variety of compounds for use in space as well as scientific equipment.

4. Medical and pharmaceutical equipment can be used to keep medications and injections at a low temperature, particularly in pharmacies and primary health care facilities without reliable power.

5. CONCLUSION

It is not commonly utilised because Peltier cooling is somewhat inefficient and because of the limited size of its applications. It was only used for cooling electronics, etc. Yet, as we have shown, there is a vast area for research in this area regarding the production of thermoelectric materials and the design of heat sinks, among other things. Because Peltier coolers have greater potential, researchers are focusing on minimising irreversibility in systems. Based on previous tests and temperatures recorded at random times, we concluded that our invention, "Automatic Compressor less Fridge Using Peltier Module," provides a maximum cooling range of 6.50C to 90C. While working on this project, we came close to meeting the projected thermal efficiency improvement of 30% and electrical efficiency improvement of 20% for the planned Peltier fridge.

6. REFERENCES

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