



CATI

Center for Advanced Technology and Innovation

Lightweight and Compact Thermoelectric Heating/Cooling Device

Thermoelectric Module Usage: Thermoelectric (TE) modules are increasingly incorporated into heating and cooling devices and systems. Solid-state TE modules are currently available in a range of sizes and typically are used in heating and cooling applications where device size, weight, and reliability are important concerns (i.e. aerospace, military, industrial, healthcare industries, etc.). TE devices also have the capability of taking the energy used in heat transfer and converting that energy to electric energy. The difficulty with TE modules is that while they are available in small sizes, additional components necessary to support the operation in a TE heating or cooling device add undesirable size and weight. This apparatus minimizes or eliminates the need for additional heat sink components.

Patent Listing:

1. **US Patent No. 6,580,025**, Issued 06/17/03, “Apparatus and methods for thermoelectric heating and cooling”

Technology Benefits: This apparatus, developed by The Boeing Company, is adaptable for heating and for cooling a fluid such as air. It includes at least one thermoelectric module and at least one rotating heat sink that transfer(s) heat between the thermoelectric module(s) and the fluid. The heat sink(s) include a plurality of thermally conductive impeller blades. The direct contact between the thermoelectric module(s) and the rotating heat sink allows heat to be transferred into and out of the device more efficiently. The impeller blades move air as well as acting as additional heat sinks, eliminating the need for additional heavy components. The size and weight of the entire apparatus are drastically less than other conventional devices

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Thermoelectric Heating and Cooling Device Market:

Thermoelectric devices are used in a wide variety of applications. Their durability, quietness, and lack of vibration make them ideal for heating and cooling in sensitive environments.

Currently thermoelectric devices are used for cooling in:

- Electronics
- Lasers and telecommunication
- Medical/biological/pharmaceutical applications
- Automotive uses
- Instrumentation, sensors and detectors
- Aerospace/military/defense applications
- Space cooling

Due to the nature of thermoelectric devices, they are able to carry more load in a heating capacity than in a cooling capacity. Simply by reversing the current into the device, the thermoelectric device becomes a heater instead of a cooler. Some current uses of thermoelectric heaters are:

- Aquariums
- Increasing the efficiency of space heaters
- Hot plates
- Water heaters

The other application for thermoelectric devices is power generation. Temperature changes of small amounts lead to energy production that thermoelectric devices can convert to electricity in a completely clean and efficient manner. These devices are highly reliable (over 250,000 hours according to DARPA), compact, lightweight, and have decreased life cycle costs.

Current Market Size:

The current market size for thermoelectric devices is difficult to determine. Currently EIC Solutions Inc., a leading producer of thermoelectric coolers, estimates the total global market of thermoelectric devices to be between \$300 and \$500 million for all products from all producers with thermoelectric air conditioners accounting for \$40 to \$100 million of that total. *“EE Times”*, a leading electronics magazine, estimates that thermo electronics could eventually become a multi-billion dollar industry.

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