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The Journal

Albert Einstein Refrigeration patent and History
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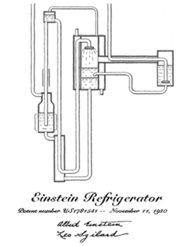


What the future of equipment looks like.

Oscartek® shows off widest variety at NAFEM 2023

Oscartek® Booth showing Custom design refrigeration, Meat dry aging, UV bonded glass

February 4, 2023 Orlando FL; Even though 2023 was the first NAFEM (North American Association of Food Equipment Manufacturers) show in four years there were a lot of familiar faces and industry solutions we saw peppered throughout the show floor, from kitchen essentials to smarter and more customized equipment and cutting-edge technology.

Here are some of the trends and products we saw on the NAFEM show floor that operators should be paying attention to:

Display Solution: Custom design refrigeration, Meat dry aging, Display cases with UV glass bonded with better view.

Labor solutions abound: The theme of the show was undoubtedly labor -saving products. Automation and customization have been taking a hold of the industry for a long time now as operators are looking to equipment to become more efficient. From pizza vending machines to robot arms that can fry French fries or sprinkle pepperoni and cheese onto a pizza, each of the robotics booths drew crowds of people.

But it's not just robotics either: There were multiple quick cold brew machines designed for use by cafes that can brew cold brew coffee and teas in a fraction of the time of a typical 12-hour cold brew process.

Pizza products: The show floor was peppered with several pizza equipment products. Besides the pizza vending machine and robot arms, there were also high-tech pizza ovens that are the next generation in pizza-making technology and can make multiple styles and pies of pizza at once, with little human intervention.

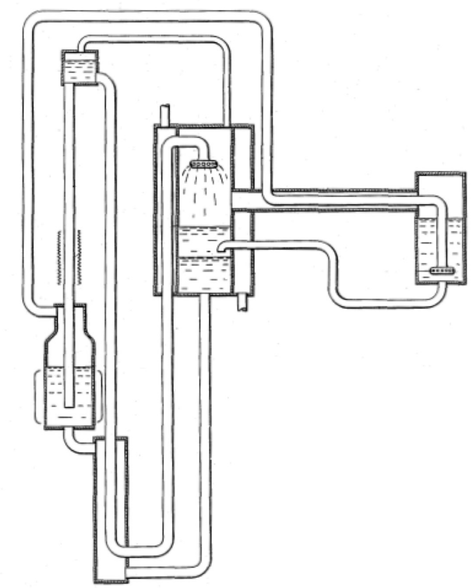
Are buffets coming back? Buffets got a bit of a bad rep during the pandemic, but they might be coming back with a vengeance with new sanitary measures, like a salad dispensing machine that can automatically dispense portions of lettuce, tomatoes and other salad ingredients for a salad bar, or a hot and cold buffet station that can keep foods at multiple temperatures on the same buffet line.

This cool new approach to refrigeration could replace harmful chemicals.

New method uses salt and an organic solvent to change a material's melting point.

By JENNIFER OUELLETTE - 1/12/2023

Scientists at Lawrence Berkeley National Laboratory have developed a novel potential means of alternative refrigeration ionocaloric cooling. The method involves electrically charged atoms or molecules (ions) changing the melting point of a solid material, much like adding salt to roads before a winter storm changes how ice will form. Their proof-of-principle experiment used salt made with iodine and sodium along with an organic solvent to achieve energy-efficient cooling according to a recent paper published in the journal Science.



Einstein Refrigerator

Patent number US1781541 -- November 11, 1930

Albert Einstein

Leo Szilard

"The landscape of refrigerants is an unsolved problem: No one has successfully developed an alternative solution that makes stuff cold, works efficiently, is safe, and doesn't hurt the environment," said co-author Drew Lilley. "We think the ionocaloric cycle has the potential to meet all those goals if realized appropriately."

There's a long history of scientists looking for better alternatives for refrigeration, including a refrigerator designed by physicists Albert Einstein and Leo Szilard. The impetus for the two men's collaboration occurred in 1926, when newspapers reported the tragic death of an entire family in Berlin due to toxic gas fumes that leaked throughout the house while they slept—the result of a broken refrigerator seal. Such leaks were occurring with alarming frequency as more people replaced traditional ice boxes with modern mechanical refrigerators, which relied on poisonous gases like methyl chloride, ammonia, and sulfur dioxide as refrigerants. Einstein was deeply affected by the tragedy and told Szilard that there must be a better design.

Einstein and Szilard focused their attention on absorption refrigerators, in which a heat source—in that time, a natural gas flame—is used to drive the absorption process and release coolant from a chemical solution, instead of a mechanical compressor. An earlier version of this technology had been introduced in 1922 by Swiss inventors, and Szilard found a way to improve on their design, drawing on his expertise in thermodynamics. His heat source drove a combination of gases and liquids through three interconnected circuits: pressurized ammonia, butane, and water, with no need for electricity to operate the appliance (depending on your choice of heat source) and no moving parts.

One side contained a flask filled with butane (the evaporator), which was injected by a new vapor (the ammonia) just above the butane, creating that all-important differential. This would decrease the boiling temperature, and as the liquid water boiled off, it sapped energy from its surroundings, chilling the compartment in the process. Einstein and Szilard's refrigerator concept never became a commercial product. The introduction of the non-toxic refrigerant, Freon, in 1930 proved more economical.

But Freon and other hydrofluorocarbons used in today's refrigerators produce emissions that contribute to global warming. That's why there is much interest in exploring so-called "caloric" cooling alternatives, in which solid materials are manipulated via magnetic, electric, or mechanical forces to make them absorb or release heat. There are several different methods for achieving this. They work much like the Carnot cycle (the fundamental principle underlying refrigerators), replacing increases and decreases in pressure with increases and decreases in magnetic or electric fields or mechanical energy. For instance, magnetic refrigeration exploits the magnetocaloric effect. The refrigerant material warms up when a magnetic field is applied, reabsorbing that heat when the magnetic field is removed.

The electrocaloric effect is also a candidate for caloric cooling, as well as thermoacoustic engines. In fact, in 2004, a Ben and Jerry's ice cream store in New York City celebrated Earth Day by unveiling a prototype "thermoacoustic chiller" using sound waves instead of vapor compression. The underlying effect has been known for more than 100 years since glass blowers in the 19th century observed that tones were generated by hot glass bulbs attached to a cool tube. Sound waves travel by compressing and expanding the gas (air) in which they are generated. This mechanical energy can be used to cool and heat stacks of metal plates in the path of the sound wave. Some get hotter, some get colder, and the result is that critical temperature difference that gives rise to usable energy. Adding a couple of heat exchangers yields a cooling chamber.

Ionocaloric cooling takes a different approach, essentially using ions to induce a solid-to-liquid phase change. Applying an electrical current moves the ions and changes the refrigerant material's melting point. As the refrigerant melts, it takes in heat from the surrounding environment. Removing the ions makes the material re-solidify and re-absorb that heat.

The goal is to balance the global warming potential (GWP) of the refrigerant, the energy efficiency of the system, and the cost of the equipment. Lilley and his co-author, Ravi Prasher, first worked out the theoretical calculations for the ionocaloric cycle. The results were promising, suggesting that the cycle could equal or even exceed the efficiency of today's gaseous refrigerators. Then they tested the theory with an experiment using salt and ethylene carbonate, commonly found in lithium-ion batteries. "There's potential to have refrigerants that are not just GWP-zero, but GWP-negative," Lilley said. "Using a material like ethylene carbonate could actually be carbon-negative, because you produce it by using carbon dioxide as an input. This could give us a place to use CO_2 from carbon capture.”

In their first experiment, Lilley and Prasher achieved a temperature change of 25° Celsius, which required less than one volt to achieve. That's a significant improvement over other caloric alternatives to refrigeration. Changing the refrigerant's phase from solid to liquid also means it can be pumped through the system, making it easier to remove or return heat.

The next step is to develop a prototype based on their application for a provisional patent. The authors foresee potential applications in water heating or industrial heating, as well as refrigeration. “We have this brand-new thermodynamic cycle and framework that brings together elements from different fields, and we’ve shown that it can work,” said Prasher. “Now, it’s time for experimentation to test different combinations of materials and techniques to meet the engineering challenges.”