Efficient, low-consumption cooling systems work with solar air conditioning

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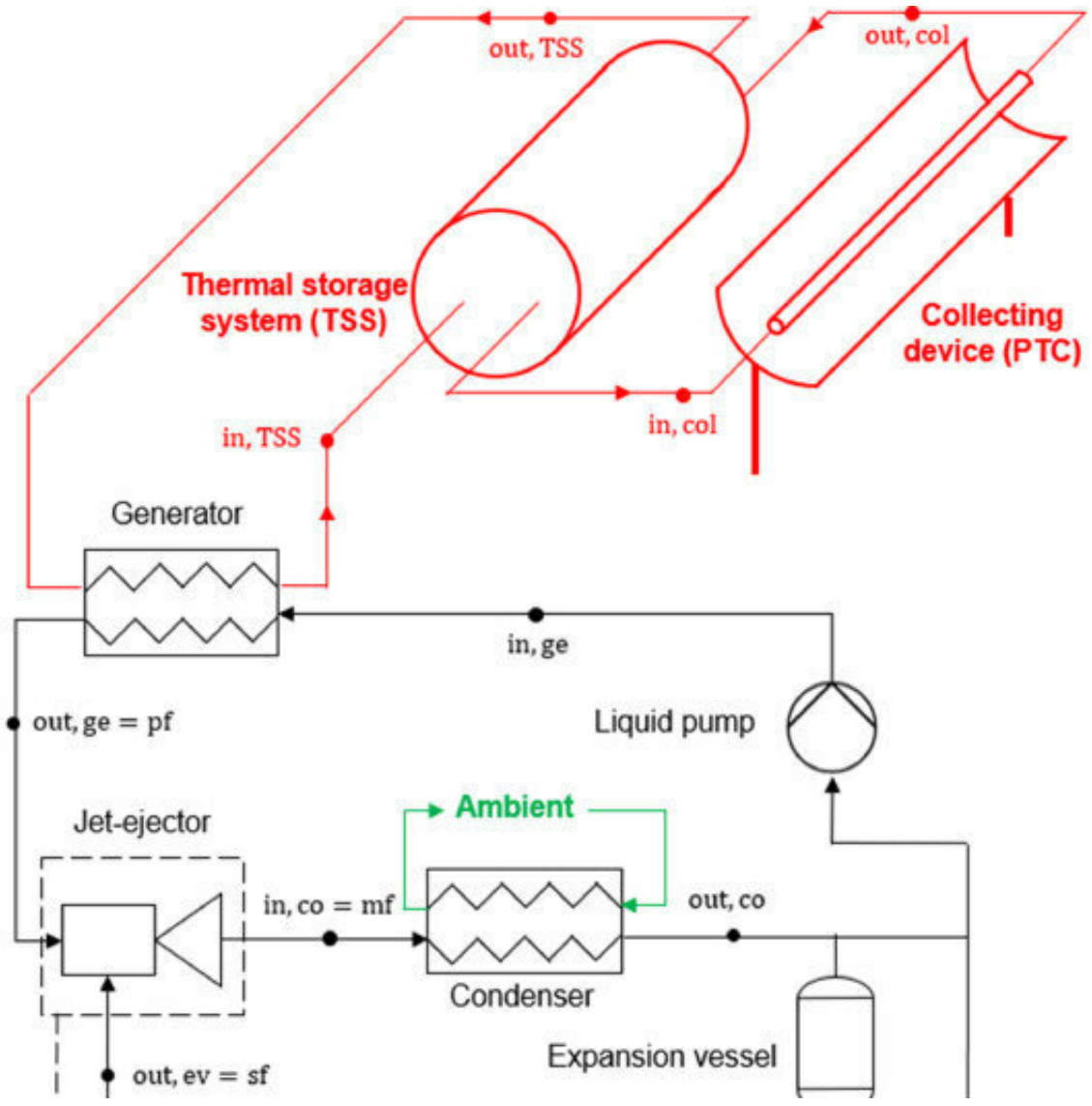

Fig. 1. Solar-assisted jet-ejector refrigeration system with a thermal storage tank.

This equipment would help tackle the increase of electricity bills during the summer. They are based on using thermo-solar panels to cool the room.

Researchers from the Universitat Politècnica de València (UPV) belonging to the CMT-Motores Térmicos (Thermal Engines) group are working on developing new more efficient cooling systems that draw from what is known as solar air conditioning, which will help address the increase of electricity bills in the summer. Their work has been published in the *International Journal of Refrigeration.*

"The 'perfect storm' has been happening in the last month in all that surrounds the electricity bill. On one hand, the so-called rate change, being divided in three segments and, on the other, the peaks in consumption that take place in the summer in the hottest days of the year. In these days with high temperatures, air conditioning units and cooling systems increase the consumption of electricity, significantly increasing the cost of electricity—without going any further, the price of electricity surpassed its annual record last Saturday. Solar air conditioning, as well as being an impactful oxymoron, can be a solution to this perfect storm," says José Ramón Serrano, researcher at the CMT-Thermal Motors of the UPV.

Solar air conditioning equipment

Solar air conditioning refers to equipment that uses solar energy to cool a space. As Serrano explains, there are two main groups: on one hand, those that use photovoltaic panels to make traditional air conditioning units work. The problem with these solutions is their low efficiency: it barely reaches 10%, meaning that the close to 1,000 W per square meter that we receive during the summer at the times of day with the most solar irradiation, only produce 100 W of electricity. "In a traditional cold unit, this represents around 300 W of cooling power," explains Serrano.

Meanwhile, there are solar thermal cooling systems, which are more efficient and versatile. In this case, instead of photovoltaic panels, thermo-solar panels are used which, using receiving surfaces that absorb or concentrate solar radiation, warm a liquid. These systems are used to heat the sanitary water in homes and for solar heating systems during the cold months of winter. The CMT-Motores Térmicos researchers focus their work on the latter, in order to also use them in the summer.

From their laboratories, they suggest coupling these panels to absorption or ejection cycles that make it possible to cool the room using the sun's heat as the source of energy. In these cases, the 1,000 W per square meter received can be turned into 500 W of heating power with the thermal oil that flows through the thermo-solar panels. Then, these 500 W can be turned into 600 W of cooling power in high-efficiency absorption cycles.

"With this equipment, one benefit is that the cooling capability increases along with the solar radiation, which in turn coincides with the moments of higher cooling needs," says Vicente Dolz, UPV professor and CMT-Motores Térmicos researcher.

Perfect combination

Alberto Ponce, researcher at CMT-Motores Térmicos adds that the goal is to achieve the perfect combination between the different systems and ways to use the equipment, so that they offer versatility and high efficiency at the same time.

"We are studying how to combine ejection and traditional air conditioning cycles in a simple way, so they make it possible to improve the efficiency of traditional cooling without solely depending on the solar air conditioning equipment. Meanwhile, in the line of operative strategies, an interesting solution is to use the tank of thermal oil at high

temperatures to store heat. This makes it possible to have a source of energy for the cycle in the hours that need cooling the most or when solar irradiation eventually decreases," adds Vicente Dolz.

And how would this make it possible to save on electricity?

A household air conditioning unit in the living room has around 3,500 W of cooling capacity. With the proposal of the UPV researchers, with around 6 m^2 of thermo-solar panels coupled to an absorption cycle, during the hours of highest irradiation (midday in the summer), these values can be reached in order to fully replace the traditional air conditioning unit with the absorption cycle.

"In order to obtain the 3,500 W of cooling power, a traditional air conditioning unit consumes around 1,170 W of electricity. The technology that we propose would make it possible to remove said consumption from our bills, enjoying the most comfort possible thanks to the combination of solar panels and absorption cycle," concludes Vicente Dolz.

In any case, Dolz stresses that the solution proposed by CMT-Motores Térmicos can also be implemented as a hybrid system, where the solar air conditioning system provides part of the cooling capacity for the traditional system or improves its efficiency, while also decreasing the global electricity consumption.

More information: José Galindo et al, Numerical assessment of the dynamic behavior of a solar-driven jet-ejector refrigeration system equipped with an adjustable jet-ejector, *International Journal of Refrigeration* (2020). DOI: 10.1016/j.ijrefrig.2020.10.019