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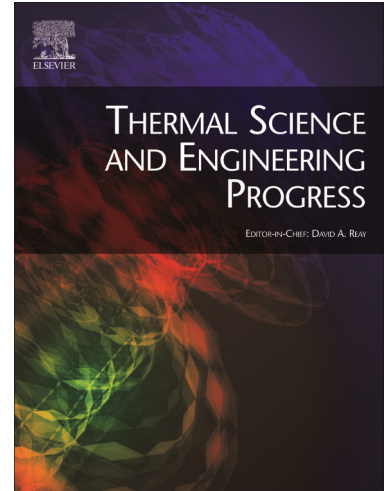
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A review on Vuilleumier machines

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Abstract

Vuilleumier machines exhibit some attracting features such as electricity independency, ability to operate environmentally friendly and long lifetime. Moreover, they can also operate continuously with low noise, low vibrations, a variety of fuels or biofuels (or no fuel at all at solar systems), at a wide range of temperatures and with inert working gases. Apart from operating as heat pumps, with the appropriate design they can additionally produce work output. At the early years of their development, the focus of the researchers was placed on refrigeration at cryogenic temperatures. The first Vuilleumier cryogenic refrigerators were built during the 60s for space and military applications. At the same time, theoretical models for the analysis of the performance and efficiency of the machines were developed. The refrigerators that were manufactured could provide few Watts of cooling power at a temperature range of 10 – 77 K.

During the 80s, the interest of utilizing the Vuilleumier cycle for cryogenic refrigerating applications reduced and the use of the cycle for residential heating and cooling increased. Many research institutions and manufacturers investigated the Vuilleumier heat pumps which in the most cases used some type of hydrocarbon gas as the source of energy. Typical values of the heating or cooling power that they could provide was 20 kW and they could reject almost 1.6 times more heat than the external combustion provided. However, their cost was higher than other available technologies at that time.

The development of both Vuilleumier cryogenic refrigerators and heat pumps is an ongoing process which is aided by advanced computer design and computational softwares. Concerning the refrigerators, efforts are made to accomplish temperatures below 5 K to utilize phenomena such as the superconductivity. New materials for the regenerators are investigated. For the heat pumps, the target is to manufacture an efficient and environmentally friendly machine with competitive cost and low maintenance.

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