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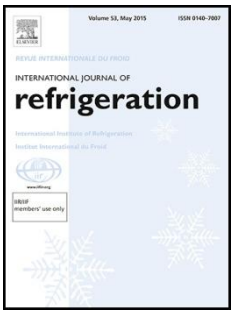

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Using an air cycle heat pump system with a turbocharger to supply heating for full electric vehicles

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Highlights:

Comment [MGP1]: AUTHOR: There are two version of Highlights section and one in the manuscript has been used. Please confirm that this is correct.

- A new air cycle heat pump system integrated with a turbocharger, a blower and a regenerated heat exchanger is developed.
- A thermodynamic model for this system is first represented and the relationships between the system performance and the operating parameters are illustrated.
- The performance of this system is numerically simulated and it can save more power than the PTC system under the same conditions for full electric vehicles.

Abstract

Air cycle heat pump has large potentials in heating applications. However, a key challenge faced nowadays is the matching problem between its expander and compressor. This paper presents the performance evaluation of an air cycle heat pump system integrated with a turbocharger, a blower and a regenerated heat exchanger. A thermodynamic model for this system is first developed and the relationships between the system performance and the operating parameters are developed. Then, the performance of three different air cycle heat pumps with a blower installed before the compressor, and a blower installed before the turbine, and with an expander, are numerically simulated. The results indicated that the blower installed before the compressor can achieve a higher heating capacity and thus a higher COP. Finally, the heating power consumption of air cycle heat pump was compared with the PTC and the vapor compression heat pump of the full electric vehicle.

Keywords: Air cycle; Heat pump; Turbocharger; Heating

Nomenclature

Nomenclature			
c_p	specific heat at constant pressure (J kg^{-1}K^{-1})	COP	coefficient of performance
h	enthalpy (J kg^{-1})	q_H	heating capacity (W)
m	massive flow rate (kg s^{-1})	p_r	pressure ratio
p	pressure (Pa)	T	temperature (^{o}C/K)
R	gas constant (J K^{-1}mol^{-1})	v	specific volume (m^3 kg^{-1})
w_f	power consumption of blower (W)	w_c	power consumption of compressor (W)
Greek symbols		Subscripts	
η	effectiveness	c	compressor

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