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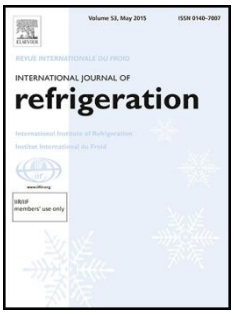

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Radial piston expander as a throttling valve in a heat pump: focus on the 2-phase expansion

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Highlights

- A radial piston expander is experimentally studied within a R134a heat pump
- The influence of the thermodynamic conditions and on the P-V cycles is estimated
- A numerical model to predict the two-phase expansion was developed
- A good agreement between the numerical and experimental data was achieved

Abstract

Two-phase expansion devices are a practicable solution for improving the energy efficiency of heat pumps. The study of the fluid behavior in such machines has not yet been investigated in detail. In the present study, a radial piston expander was used in a heat pump operating with R134a in place of the throttling valve. Special attention was paid to investigate both numerically and experimentally the behavior of the fluid inside a cylinder within a full cycle of the engine, at different inlet thermodynamic conditions and rotational speeds. The measured indicated cycles were compared with those predicted by a quasi-steady model and a rather large difference between them was noticed. Therefore, a non-isentropic model to predict the in-cylinder pressure trend during the expansion phase at closed valves, developed on the basis of a model proposed for water at atmospheric conditions was applied. The results achieved with the improved non isentropic model showed a significantly higher accuracy in predicting the experimental results along the expansion phase at closed valves, thus filling the gap registered with the full isentropic models, which lack in this part of the cycle.