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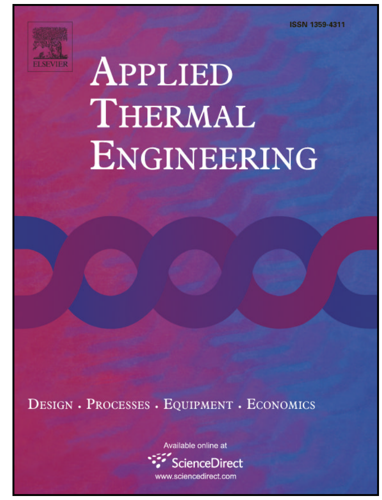

Research Paper

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Abstract: HPGHP (Hybrid power gas engine-driven heat pump) is a novel air conditioning system, which combines traditional heat pump with hybrid technology. In this paper, the transmission ratio of a coaxial parallel-type hybrid power gas engine-driven heat pump is firstly optimized considering the differences between refrigeration and heating conditions, based on the instantaneous optimization control strategy of engine optimal torque curve. The results of the optimization are as follows: under the high, medium and low load conditions, the ratio is 2.4, 1.5 and 1.3 respectively under cooling conditions and 2.7, 1.7 and 1.4 respectively under heating conditions. Secondly, the related performance parameters of HPGHP are analyzed with particularly established simulation model including SOC and SOH parameters of the battery. The experimental and simulative researches indicate that: After a simulation cycle where the load is evenly distributed within 3600s, the battery SOC value increased from 55% to 59.85%, SOH value from 1 to 99.942%. The average thermal efficiency in the three modes is 0.26664, 0.27594 and 0.27831, respectively. Compared with the results of Wang et al, it has been improved by 1.49%, 6.47% and 4.85%. Finally, an economic objective function including gas consumption and battery loss is introduced and the overall operating costs of HPGHP and GHP systems are analyzed and compared. Furthermore, considering the similarity between the HPGHP system and GEHP system, the PER is used as the index to compare the two systems. The comparison show that the average PER of HPGHP is about 12.1% higher than that of GHP.

Keywords: HPGHP; optimal torque curve; transient optimization; SOH; economic analysis

1. Introduction

GHP (Gas engine-driven heat pump) has been demonstrated to be a kind of cost-effective, energy-saving and environmental protection air conditioning equipment [1-2].Nevertheless, in practical applications, significant fluctuations in loads keep the engine rotational speed exceeding its operational range, or even causing idle operation, thus to reduce the thermal efficiency and to increase heat loss and emissions.

Considering the common shortcomings of the GHP, L. Cai et al in Southeast University applied the hybrid power technology [3-5] to the GHP system, further designed a new type of HVAC equipment: a hybrid power gas engine-driven heat pump (HGHP) [6-7]. Through the coordination of the torque, speed and the reasonable distribution of the power among the gas engine and the motor, the HGHP system has been kept running in the fuel cost-optimal zone [8-10]. Y. Wang [11] has established a coaxial parallel-type hybrid power gas engine-driven heat pump (HPGHP) system for