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Development of Turbocharging System for Diesel Engines of Power Generation Application at Different Altitudes

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Abstract

The environmental atmospheric density reduces with the increased altitude. For turbocharged diesel engines, boost pressure and mass flow rate of fresh air are decreased with the limited plateau self-compensation ability when the altitude increases to a certain value. The decreased air flow results in the reduction of output power of diesel engines, and the diesel engine performances affect the electric power of diesel generator set. Therefore, to solve the problem of diesel generator set operating at plateau, power recovery of diesel engines is essential for maintaining its performance. Boost pressure recovery provides an alternative solution to this problem. In this paper, a turbocharging system was developed for recovering the boost pressure according to a matching process. A control strategy of the waste-gate valve was confirmed, and two operating modes were determined based on the bypass flow ratio. The results show that boost pressure of the engine can be recovered with the matched turbocharging system at different altitudes. However, boost pressure recovery cannot make sure the power recovery of diesel engines due to the changing overall system efficiency and pumping process. Therefore, a method of fuel compensation was proposed, and it can achieve the power recovery target along with the valve control strategy for boost pressure recovery.

Keywords

Diesel engine, turbocharging system, power generation, different altitudes, power recovery

1 Introduction

The diesel generator set is widely used in thermal power generation and various industrial fields with its advantages of the smaller floor area and better economic benefit. The diesel engine operates to rotate the generator, and the electrical energy is generated by the rotor cutting the magnetic induction lines of the stator. The dynamic current of generator set is a function of the output power of diesel engines, the total efficiency of generator set, the rated voltage of generator, and the power factor. For a specific generator set, the output current is a linear function of the output power of diesel engines. Therefore, the output current of generator set is greatly affected by the output power of diesel engines.

The overall performances of turbocharged diesel engines can be ensured when turbine power ability can meet the requirement of compression power required by the compressor. However, the equilibrium relationship between turbine power ability and required compressor power can be altered by the changing speeds and loads. Turbine power can ensure the desirable boost pressure and provide enough compression power at the matching point. When the

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