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2D25卧式柴油机冷却水套结构的CFD模拟优化

CFD simulation and optimization of cooling water jacket structure for 2D25 horizontal diesel engine

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中文摘要:

针对高效低污染卧式柴油机的技术要求，为了设计合理的冷却系统，结合冷却水流动试验，采用计算流体动力学（CFD）三维模拟的方法建立了冷却水流动仿真模型，分析了2D25卧式柴油机强制冷却闭式循环系统的冷却水套结构对冷却水流场的影响，优化了卧式两缸柴油机冷却水套结构。研究结果表明：合理布局缸体进水孔方案可以改善缸体水套内冷却水的流动和冷却效果，减少流动损失，降低水泵的功率损耗。合理设计和布置缸盖入水孔，可以大大提高缸盖水套内冷却水的整体流动速度，减小各缸冷却效果的差异，改善热负荷高的鼻梁区以及排气侧的冷却效果。对原冷却水套结构优化后，水套整体平均流速提高了40%，整体平均换热系数提高了41.7%，在公共水腔和缸体水套上方没有出现原方案的水流撞击和大漩涡，热负荷最高的缸盖底面和鼻梁区冷却水流速和换热明显增强，各缸均匀性变好。

英文摘要:

In order to fulfill the technical requirements of a high-efficiency low-emissions off-road horizontal diesel engine and design a rational cooling system, combined with the cooling water flow test, a numerical simulation model of the coolant flow was built by using three-dimensional Computational Fluid Dynamics (CFD) simulation method and was verified by the comparison between the measurement data and the CFD simulation data. The impact of cooling water jacket structure on coolant flow field in 2D25 horizontal diesel engine with a forced-cooling closed-loop cooling system, and the cooling water jacket structure was finally optimized. The results indicated that the rational design of the water inlet holes in the cylinder block can improve the coolant flow characteristics and cooling effect in the water jacket, reduce the flow losses and the water pump power loss. Rational design of the water inlet holes in the cylinder head can greatly increase the overall coolant flow velocity in the cylinder head water jacket, reduce cylinder-to-cylinder variation in cooling, improve the cooling in the critical valve bridge area in the cylinder head to sustain high thermal loading, and enhance the effectiveness of cooling at the exhaust port side. After optimization, the overall spatial average velocity and the overall spatial average heat transfer coefficient of the coolant in the water jacket increased by 40% and 41.7% respectively compared to the original design. There are no large vortices any more in the shared water chamber and the upper region of each cylinder water jacket. The flow velocity and heat transfer in the critical valve bridge area in the cylinder head were significantly enhanced, and the uniformity of cylinder-to-cylinder was improved.

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