

Development of a LNG Pump and its Application to Direct Injection LNG Engines

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Direct injection gas engines operated with liquid natural gas (LNG) looks promising because the energy density to volume ratio of LNG is three times higher than that of compressed natural gas (CNG) and pressurization of LNG to injection pressures is much easier and spends less energy. Based on these considerations, a prototype of LNG high-pressure pump, which can achieve a pressure as high as 20 MPa, was developed and was tested using nitrogen instead of LNG. It was confirmed that the energy consumption of the LNG pump to pressurize an amount of natural gas is one eighth the energy consumption of the corresponding CNG pump. A direct injection natural gas engine having a 108 mm bore and a compression ratio of 12 was developed for the evaluation of its performance and emissions. The result of an engine experiment made it clear that the indicated thermal efficiency of the gas engine is approximately 44 % over a medium and high load range, which is equivalent to that of the corresponding diesel engine. Since the energy required for pressurizing LNG to 15 MPa is 2 to 3 % of the indicated power of the engine, the LNG engine proposed is considered to have the same level of the brake thermal efficiency of the corresponding diesel engine. If a truck vehicle is powered by the direct injection LNG engine and carries a LNG tank with a capacity 1.5 times bigger than that of gas oil, the cruising distance of the vehicle could be the same as that of diesel truck.