A THROTTLE LOSS RECOVERY SUPERCHARGER FOR NATURAL GAS ENGINE APPLICATIONS

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Natural gas engines in urban bus and delivery truck applications operate at part throttle conditions most of the time. This can result in very poor fuel economy. If the engine is designed to operate unthrottled (lean operation), then emissions are likely to be high because of low exhaust temperatures and resultant low catalyst efficiencies. To overcome these difficulties, a novel device that enables stoichiometric operation, use of three-way catalyst, and at the same time minimizes throttle losses is described.

The throttle loss recovery supercharger replaces the conventional throttle plate. It works both as a rotary expander and compressor. It consists of oscillating vanes rotating in a casing eccentric to the center of rotation. Vanes "fold" in and out along the path of rotation without touching the casing, thus eliminating friction losses. Eccentricity and vane geometry results in the desired compression or expansion. The inlet and exhaust ports are movable, and their placement determines the expansion or compression ratio. The location of the port controls the amount of air flow into the engine and hence controls the load – performing the function of the conventional throttle. Instead of incurring throttling losses at part load, the expansion function of the device supplies power to the crankshaft through a belt. At high load conditions, the device draws energy from the crankshaft via the same belt and acts like a supercharger.

The paper discusses the fuel economy and emissions benefits of using a throttle loss recovery supercharger with natural gas engines. Alternative strategies, such as stoichiometric operation at part load and lean combustion at high loads, are discussed.