

Siemens VDO Develops Advanced Piezo Unit Injection System

May 2 2005

Siemens VDO Automotive AG will be presenting the development phases of an efficient piezo unit injection system with the potential to master future environmental requirements at the 26th International Vienna Motor Symposium. Through the consistent deployment of piezo technology, the system being presented also succeeds in considerably reducing the typical noise of diesel engines in idling mode. Modern diesel vehicles with engines at work under the hood using high-performance, electronically controlled Siemens VDO Automotive injection systems will be better positioned to meet future emission standards.

Advanced diesel injection systems optimally atomize fuel, reduce the work and expense necessitated by exhaust gas aftertreatment and enable higher efficiency. Siemens VDO utilizes its experience with piezo actuators for unit injector elements in order to improve fuel consumption and emission levels.

A unit injector element integrates the fuel injection pump and nozzle in a single assembly. The engine's camshaft drives the pump pistons through a roll rocker arm. Together with Volkswagen, Siemens VDO has developed piezo unit injectors that facilitate even more precise management of the injection characteristics and quantity. Piezo actuators controlling the valve needle are three times faster than solenoid-based solutions. As a result, very flexible multiple injections can be achieved along with correspondingly efficient emissions levels.

In close collaboration, the engineers of Volkswagen and Siemens VDO succeeded in creating a piezo unit injection system enabling an injection pressure of more than 2000 bar, which also meets the Euro 4 exhaust standard right from the start. Moreover, the system should fulfill a crucial criterion for the driver: the lowest noise possible while idling. However, the challenge the innovative piezo-based system overcomes is the associated louder engine when employing greater fuel injection pressures.

Initial studies have shown that using piezo technology makes it possible to overcome this contradiction and make the engine more economical, efficient and quieter. To achieve this, the injection pressure in idling mode diminishes to less than 200 bar by hydraulically supporting the spring that opens and closes the valve. This is facilitated by an additional bore between the fuel feed and spring chamber. The fuel, which continues to flow at high pressure, increases the spring force. Since the valve is opened and closed more quickly by using the piezo actuator, the intervals between the pilot injection and main injection are more precise and flexible, which leads to significantly reduced emissions output.

The first generation of piezo unit injectors went into series production in November 2004 in Stollberg/Saxony. They are manufactured in a plant jointly operated by Volkswagen and Siemens VDO called Volkswagen Mechatronic.

In Vienna, Siemens VDO is introducing the next development of the injection element featuring an integrated ball valve. Among other things, it ensures the hydraulic closing force at the spring piston does not fall and maintains the pressure in the nozzle spring chamber beyond the injection phase. The valve increases the closing force again further shortening injection time. The sharp end of the injection substantially contributes to re-duc-ing emissions.

With a peak pressure of 2200 bar, the Siemens VDO piezo unit injector offers the highest pressure currently achievable for a mass-produced automobile diesel engine.

The current development also demonstrates the additional potential of this technology. According to Siemens VDO Automotive AG Managing Board Member and head of the Powertrain business unit Dr. Klaus Egger: "Injection pressures of up to 2500 bar appear feasible without having to incur poor hydraulic efficiency. It is conceivable that even more flexible injection characteristics can be achieved". The requirements of homogeneous diesel combustion processes give additional impetuses to the continued development of piezo controls for unit injector systems. Siemens VDO will further optimize the interaction of piezo actuators and engine management and is ideally situated for the forthcoming fuel consumption and exhaust gas emissions efficiency requirements.

Citation: Siemens VDO Develops Advanced Piezo Unit Injection System (2005, May 2)
retrieved 26 April 2024 from <https://phys.org/news/2005-05-siemens-vdo-advanced-piezo.html>

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