Technology Offer

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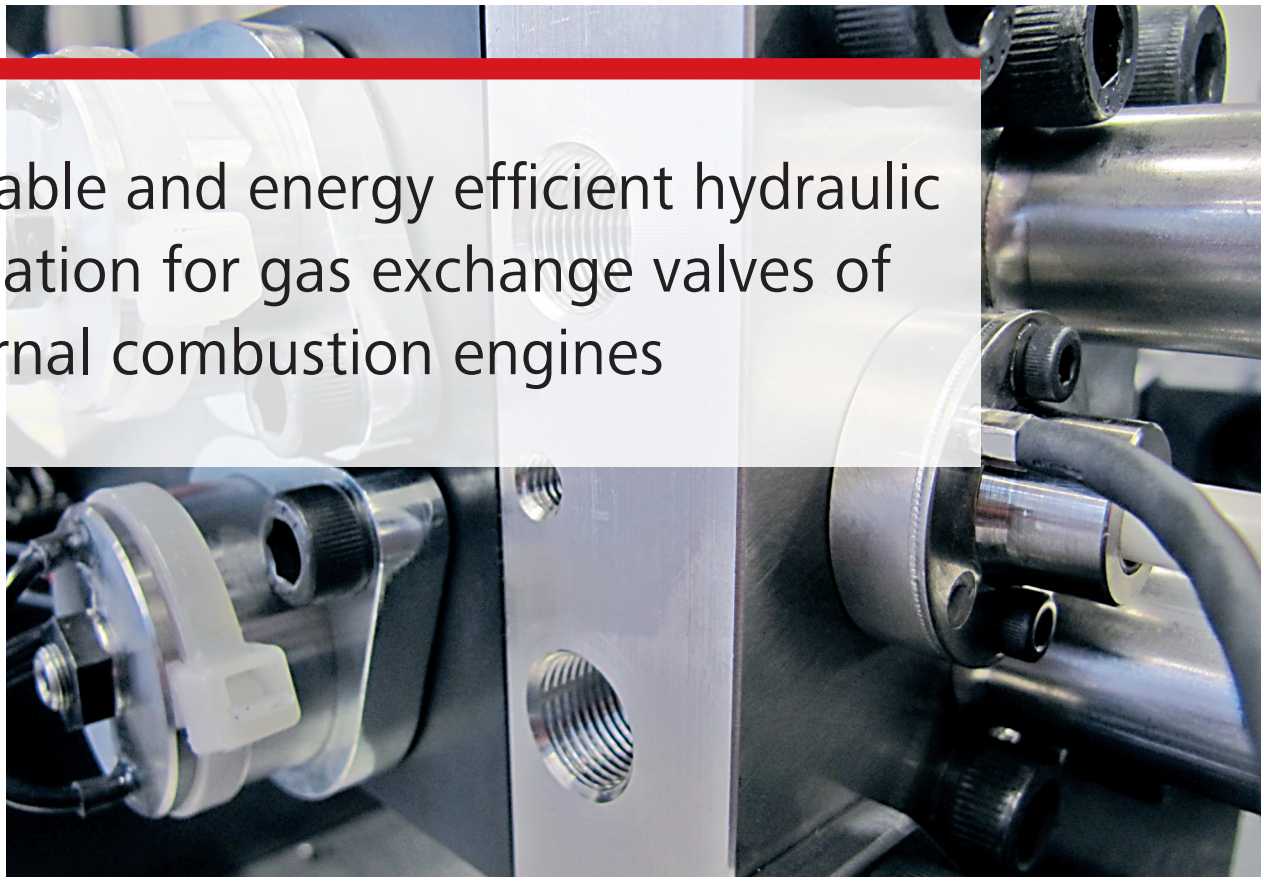
Materials Science and Technology

Variable and energy efficient hydraulic actuation for gas exchange valves of internal combustion engines



Invention

The invention consists of a hydraulic actuation method for gas exchange valves. The main advantage, compared to existing systems, is the ability to recuperate a large part of the valve's kinetic energy which results in a low overall dissipation. Additionally, the system can achieve fully variable valve curves with variable pressures for minimum energy losses and widely adapt to available hydraulic pressures, e.g. during transient phases.

Background

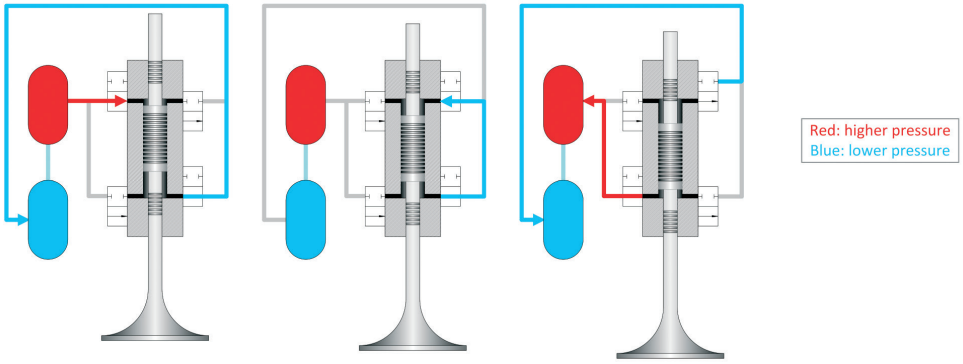
Internal combustion engines can profit from variable gas exchange valves in terms of efficiency and exhaust emissions. Conventional variable systems still need a camshaft and most solutions have a reduced variability regarding possible valve lift profiles. Most known systems control the valve movement by throttling the flow of the actuating fluid which leads to high dissipation. The invention overcomes throttling of the actuating fluid completely and allows to hydraulically recuperate energy. In addition it introduces the possibility of a ballistic valve movement phase which leads to lower peak velocities of the gas exchange valves. Due to this flexibility, the system can adapt to changing properties of the actuating fluid (pressure levels, viscosity).

Advantages

Fully flexible variable valve timing is a key for more efficient internal combustion engines with less pollution. Premixed- (spark ignition), diffusion-controlled- (compression ignition) as well as homogeneous combustion (HCCI) type of engines can profit, because

– the aspirated mass of an internal combustion engine can be controlled without throttling or with reduced throttling,
– the residual gas fraction or scavenging can be controlled,
– the effective compression and expansion ratio can be controlled,
– cylinder deactivation can be applied,
– pneumatic recuperation or propulsion can be applied,
– engine cycles can be omitted,
– valve timing and combustion can be controlled from cycle to cycle, and
– thermal management of exhaust gas treatment systems can be controlled.

With intake and exhaust valves operating hydraulically, no camshaft is needed and the quality of the lubricant can be optimized solely for the reciprocating engine parts. This can lead to fever additives and therefore to less poisoning of exhaust gas treatment systems. Since the invented system does not have a valve spring whose forces have to be overcome hydraulically, the system is able to operate with moderate hydraulic differential pressures. This leads to small actuating pistons, a cost-efficient hydraulic supply and light-weight valves. The energy dissipation for the valve operation is comparably low to purely mechanical systems.



Ownership

Empa, Swiss Federal Laboratories for Materials Research and Technology, Überlandstrasse 129, CH-8600 Dübendorf, *US, JP, EU patents granted.*

Keywords

Electro-hydraulic valve actuation, internal combustion engine, variable valve train, energy efficiency

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