column

The Camless Concerto

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Camless engine design could offer 20 percent fuel savings.

An interesting – fascinating, really – development that has gone very quiet is the engine with valves but no camshaft.

You may recall back in 2000, International engineers completed a coast-to-coast drive in a model 8100 truck with a 530 engine that had valves actuated electro-hydraulically and not driven by the camshaft. The valve actuation mechanism was developed by Sturman Industries of Woodland Park, Colo., and is the brainchild of the brilliant Eddie Sturman.

The International engine was a natural for the technology, since it has a high-pressure hydraulic circuit for the HUEI injectors – hydraulically actuated, electronic unit injectors.

If you think about it, generating the pressure for a modern fuel system is a tough task. Opening and shutting valves is child's play by comparison.

De-coupling the valve actuation from crankshaft rotation and timing opens up all kinds of design opportunities of valve timing, lift, duration, event – you name it. Valeo, the French component supplier, has been pursuing camless engine design claiming it could offer 20 percent fuel savings in cars.

Given such savings, why has the concept not taken off like a bottle rocket?

Well, to quote Eddie Sturman, the problem is that engine designers sought to replicate conventional valve movement, using the hydraulic actuation instead of the camshaft. That's like taking a piano and playing a country music song. What's needed, says Sturman, are whole new symphonies.

In the absence of the new music, Sturman has come up with his own – a new cycle that is only possible with decoupled valve actuation. One that seeks to move diesel thermal efficiency from around 42 percent up to as much as 60 percent – with near-zero emissions and no aftertreatment.

The Sturman cycle retains exhaust in the cylinder at the bottom of the expansion stroke. Fuel is injected into this hot exhaust as the piston starts the compression stroke. Key to the engine's low emissions is that the fuel evaporates in the hot gas, truly atomizing, unlike high-pressure fuel even at 2,200 bar. It does not burn immediately, because the gas is inert.

However, combustion is initiated as the piston rises on the compression stroke by opening the inlet valves to a compressed air charge. As the piston heads down the expansion stroke, more air is mixed with the charge in the cylinder to maintain combustion and in-cylinder pressure. This gets more work out of the fuel charge, with far lower flame temperatures and injection pressures. And because the fuel is vaporized, there's no particulate matter like that formed when burning droplets of fuel.

Electronic/hydraulic manipulation of the valves means the engine is a two-stroke. And by varying valve timing and fuel delivery, cylinders can be power-producing or air compressing or just windmilling.

So now you have an engine with a fuel rail, hydraulics, air rail and high voltage (Internationals have 300V plus at the injectors). So you also have the right elements to pair the Sturman-cycle engine with compressed-air, hydraulic or electric hybrids.

More remarkably yet, because the engine cycle is controlled electronically (not by cam profile and timing chain), the power unit can switch back and forth between Sturman, diesel or HCCI cycles – or any other exotic cycle that can be created for the good old piston engine.

Is there no end to the camless engine versatility? Apparently not. It'll run on anything that can be squeezed through the injector, and that includes a bottle of pure canola oil that Eddie Sturman picked up at the store and took into the lab a month or so ago.

The pieces of the engine that make this all work are all in the head. So the technology is also retrofittable, and that may be how it first appears commercially, as a kit for a certain engine (not necessarily an International.)

Such a kit would bring an older engine up to current and future emissions standards without the need for additional particulate filters or other aftertreatment devices.

Hmmmm.