Gearheads Rejoice! The Internal Combustion Engine is Back

More specifically—an opposed-piston, internal combustion engine

Monty Cleeves, CEO
Pinnacle Engines

While all the transportation/energy innovation-related news of late has been dominated by the ongoing development of the electric engine, an old-wine-into-new-bottles alternative is making some unheralded headway into the conversation.

Please join the Addendum crew in saying "welcome back" to a century-old technology and power source that had been languishing for many years—the internal combustion engine. More specifically—an opposed-piston internal combustion engine.

That's the news gleaned from an April *New York Times* article by Todd Woody in the newspaper's energy special section. Cited in the article were three entrepreneurial-driven companies—Pinnacle Engines in Silicon Valley, Detroit-area-based Eco Motors and San Diego's Achates Power. All are intent upon developing and marketing a redesigned old-style engine into one that they believe will provide significant upgrades in fuel economy and reduced greenhouse gas emissions—at lower cost.

"While the buzz is all about electrics, the people who will actually adopt electrics are not a majority of the market," says Pinnacle president and CEO Monty Cleeves, who founded the company in 2007 and has intentionally run the operation in an under-the-radar mode. "The impact we will have over the next 15 to 20 years will be much larger than the impact of the electrics."

The *Times* article points out that while GM and Ford, for example, always have and probably always will design and manufacture their own engines, the global demand for fuel efficiency—especially for commercial vehicles—along with "climate change concerns and the rise of China and India as automotive markets, have opened the door to start-ups like Pinnacle."

"Many automotive houses don't buy engines from outside, but in the truck market people do," says Rohini Chakravarthy, a partner at NEA, a venture capital firm in Menlo Park, California., that has invested in Pinnacle. "In Asia, there's tremendous demand, and you're not going up against the same level of incumbents."

In fact, Pinnacle has already signed a deal to license their engine technology to an undisclosed overseas scooter manufacturer for production in 2013. Eco Motors—with backing from Khosla Ventures and Bill Gates—has signed a development agreement with Navistar and a Chinese company—also unnamed—and Achates Power is currently pitching automakers, says David Johnson, Achates CEO, who added that he had also met with potential customers in China and India.

The design magic of the opposed-piston engine is that it eliminates the cylinder head—i.e., the combustion chamber for a conventional engine. Rather, two facing pistons and the space between them form the combustion chamber where fuel is ignited. The average weight of a car engine is 600 lbs.—and much heavier, of course, in commercial vehicles—with much of that weight attributed to the cylinder head. Discarding that component enables lower-cost, lighter engines and an overall lighter vehicle—either for personal or commercial operation. As with virtually any power-supplying component in use today, much of an engine's energy usage and loss are generated by heat. The nimbler opposed-piston design, however, has a more robust energy source to operate a vehicle.

However, making the opposed-piston engine vehicle-friendly has been the greatest challenge thus far, something that Cleeves has been grappling with since his days as a mechanical engineering student.

"I stayed 30 years in (the) semiconductors (industry) as my day job, but worked on cars in the garage as my passion in the evenings," says Cleeves.

That passion is now represented by an in-testing prototype—an iteration of a one-cylinder, four-stroke opposed-piston gasoline engine—designed, the *Times* article states, "to power scooters and three-wheel auto rickshaws in Asia."

Pinnacle executives claim that 500 hours of "independent" testing verified that the engine "was 30 percent more efficient than current scooter engines, while emitting fewer pollutants." Further, the company says that an automotive version of its "Cleeves Cycle Engine" would "increase the fuel economy of a Fiat 500 from 33 gallons to 59 miles a gallon—with "no performance loss."

For its diesel version, Eco Motors is touting an "up to a 50 percent improvement in efficiency for its two-stroke, diesel-opposed piston engine now in development for heavy-duty vehicles and equipment." (Today's conventional two-stroke engines emit more greenhouse gases and are commonly found in scooters, lawnmowers and outboard boat engines.)

The key, says Donald Runkle, EcoMotors' chief executive and a General Motors émigré, is a high-power output and an electrically controlled turbocharger that allows for a small, lightweight engine with emissions comparable to a four-stroke power plant.

At Achates Power, CEO David Johnson says his company's version of the two-stroke, opposed-piston diesel engine "would most likely be used in commercial vehicles, but it also could be installed in plug-in, electric-hybrid cars like the Chevrolet Volt."

"The Volt needs a better engine," says Johnson, stating that "1,600 hours of testing had shown Achates's engine was 15 percent more efficient than conventional diesel counterparts."

And Ron Hoge, a Pinnacle chief executive, says even more dramatic change is needed.

"It's the challenge of incremental thinking versus radical thinking," says Hoge, previously at engine maker Cummins. "If we're only going to make incremental improvements, we're not going to solve our problems in the world, so someone has to step forward."