



STURMAN INDUSTRIES

A COMPANY THAT SEEKS TO DIGITIZE THE MECHANICAL WORLD

MENLO PARK IS KNOWN AS THE BIRTHPLACE OF THE electric lightbulb. Bell Laboratories is where transistors were invented. Los Alamos produced the atomic bomb. Sturman Industries, located at the base of Pikes Peak, is home to an invention of just as much, if not more significance. Sturman's digital valves have the proven ability to change the way mechanical things (including diesel engines) work.

When *Diesel Power* got the chance to interview Eddie Sturman at his Colorado facility, we found he's created an open and creative corporate culture where everyone's input (from the machinist to the

CEO) is valued. Everyone works in the same comfortable environment—the entire place is as clean as a hospital. While the company's headquarters has a lodge-like feel, Sturman's facility contains some of the most advanced analysis, electronics, testing, and machining capabilities found on the planet. To us, this was like going into Superman's Fortress of Solitude.

THE STURMAN STORY

We could feel the creative energy as we sat and listened to Eddie Sturman tell us how he got to where he is today. His quest to improve the world began back in Israel where he was born. Water was very

STURMAN



Back in 2000, a joint venture between Sturman Industries and International produced the first camless engine to race to the summit of Pikes Peak. In another demonstration that same year, Sturman Industries piloted a heavy-duty truck 10,000 miles across the United States.

precious and dangerous to control at that time in Israel's history because snipers would shoot people as they turned the water valves in the fields on and off by hand. Always a problem solver, Sturman developed a valve that could be opened and closed electronically without wires—removing people from harm's way. Sturman held on to this idea, and it later went on to serve in the Apollo space program.

Then, in 1985, he got a call from a major American diesel engine manufacturer that was interested in his technology. Sturman wasn't into engines back then, so he didn't even recognize the company's name. He told the company to send him the specifications it needed, and he'd take a look. When the schematics and design criteria arrived, Sturman was shocked. The pressures required were 10 times more than what he was used to. At the time, he thought 100 million cycles of his digital valves was impressive, but the diesel engine he was asked to work on would need 3 billion cycles.

He knew the project was going to be a challenge but took it head-on anyway. "So which diesel engine company was it?" you ask. It was Cummins.

WHAT ARE DIGITAL VALVES?

Think about computers and how much better they became after going from analog to digital. Sturman wants that same change to happen to



Parked out in front of Sturman's dream-like Colorado facility was this Volkswagen Jetta TDI, equipped with Sturman Industries' hydraulic valve actuation.

WHAT THE INTERNAL COMBUSTION ENGINE MIGHT LOOK LIKE, IF IT WERE INVENTED TODAY

THE KEYS TO A GREAT ENGINE ARE FLEXIBILITY, STRENGTH, AND BRAINS. STURMAN Industries has running engines that demonstrate all three things because they can digitally control the air and fuel, instead of just relying on fixed actuation like conventional engines. Sound confusing? OK, then think about how different driving a mechanically injected diesel truck is compared to driving one with electronically controlled common-rail fuel injection. The difference between the two engines' performance, noise, fuel economy, and emissions characteristics comes from the common-rail injection's flexibility and brains.

Still, precise fuel injection control is only a third of the equation. With most modern engines, air is introduced with a mechanical camshaft that's pretty crude in comparison to digitally controlled intake valves. The intake valves on Sturman's camless engines are decoupled from what's happening with the pistons and are free to direct the engine like a symphony conductor. The last third of the equation is freeing the pistons from the crankshaft, so they can act directly on a hydraulic fluid creating a free piston engine—but that's a story for another issue!



Sturman Industries is working to make the interface between electronics and mechanical components better. Here Sturman himself showed us how electronic circuit boards could replace the wires on today's injectors, making them more robust.

STURMAN INDUSTRIES

mechanical things like diesel engines. There are two criteria that are required to make something digital. The first is that the mechanical thing being controlled has to have an on and off mode. The second is that the mechanical part can only require energy to change between the on and off mode. The mechanical component cannot use any energy to hold itself in either mode. This allows the components to be much more efficient and extremely fast—we're talking milliseconds.

At one point during our interview, Sturman picked up a tiny spool valve from a nearby table and demonstrated how residual magnetism makes his technology possible. A small battery was used to make the valve open, and then he took the battery away and had us try and move it—to no avail. **DP**



Here is the room where Sturman engineers take their measurements. Notice the thick, stone table that absorbs vibrations. This room is also kept at a constant temperature regardless of outside conditions.



In one of the test cells, we saw this eddy-current dynamometer. The combustion air supply unit is able to simulate operating conditions between sea level and 8,640 feet. The test cell's temperature control system can vary the room's temperature from 50 to 100 degrees F (+ or - 1 degree). Humidity is also adjustable between 10 and 90 percent (+ or - 2 percent).



This cylinder head is equipped with Sturman digital hydraulic valve actuation.

“Sturman’s facility contains some of the most advanced analysis, electronics, testing, and machining capabilities found on the planet. To us, this was like going into Superman’s Fortress of Solitude.”

BENEFITS OF STURMAN'S CAMLESS ENGINE:

- Independent valve lift and timing control allows mixed-charge combustion
- Low parasitic loss, since most of the conventional valvetrain (including the camshaft) is eliminated
- High-speed engine operation (up to 12,000 rpm)
- Enables homogeneous charge compression ignition (HCCI) combustion
- Enables cylinder de-activation and cylinder balancing
- Scalable to any engine size and can be retrofitted to older engines since all the technology is in the head
- Compatible with any fuel type
- A square lift pattern compared to the lobe profiles a camshaft requires
- Can be used to create an internal EGR system
- Promises up to 60 percent thermal efficiency
- Can be used to help eliminate the need for an exhaust aftertreatment
- Only system able to run the Sturman Combustion Cycle

STURMAN'S CUSTOMERS HAVE INCLUDED:

- General Motors
- International
(6.0L Power Stroke and DT466 fuel injection systems)
- Department of Defense
- TARDEC
- TACOM
- New A.C.E.
(Japanese automotive research institute)
- Oak Ridge National Labs
- University of Michigan
- California Energy Commission
- Houston Advanced Research Center
- Tenneco

Source

Sturman Industries
(719) 686-6000
www.sturmanindustries.com