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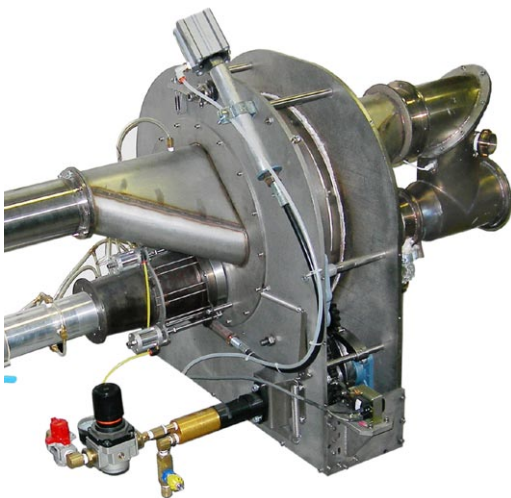
technologyfocus

POWER TRANSMISSION AND MOTION CONTROL

This section was written by
Associate Editor Alan S. Brown

Heat Exchanger Turns More Efficient

For a long time, engineers have thought they could improve turbine efficiency by using a rotating heat exchanger. The concept is simple. Start with a circular filter. Expose the top half of the filter to hot exhaust gases. Then spin that hot section down to the inlet duct to preheat incoming air. Instead of just relying on conduction, the system puts the heat in front of the incoming air. The result is a big jump in efficiency, especially for microturbine engines.



A prototype of Wilson TurboPower's heat exchangers uses a rotating ceramic core that boosts efficiency to 97.5 percent while reducing the size of the regenerator.

The problem is getting it to work. High outlet duct temperatures quickly degrade metals. In fact, most recuperators precool their exhaust stream before it enters the heat exchanger to prolong the unit's operating life.

Ceramics, on the other hand, stand up to high outlet temperatures. Their higher thermal capability enables them to recover and reuse more heat than metals can. Unfortunately, constantly rotating ceramic heat exchangers soon grind away their seals. This allows hot air to escape through the gaps, losing any efficiencies that switching to ceramics might have gained.

A Massachusetts Institute of Technology professor emeritus, David Gordon Wilson, believes he has found a way to use ceramics in rotating heat exchangers and has founded a company, Wilson TurboPower Inc. in Woburn, Mass., to commercialize the results. His idea? Instead of rotating the heat exchanger at a constant speed, he lifts the seals about 10 micrometers and turns the circular ceramic core only partway around. The seals then drop down to reseal the heat exchanger.

Lifting the seals solves the wear problem, since the ceramic core doesn't grind against them while it is in motion. To maintain efficiency, though, Wilson has to move the seals and core quickly. Wilson has patented a cam and spring indexed rotation mechanism to rapidly rotate the disk in precise increments. Springs lift the flexible seals for a fraction of a second as the core repositions itself and then snap them shut again. Limiting clearance to a few micrometers allows smooth movement without sacrificing efficiency to leakage.

The core itself consists of a honeycomb with 1,100 open passages

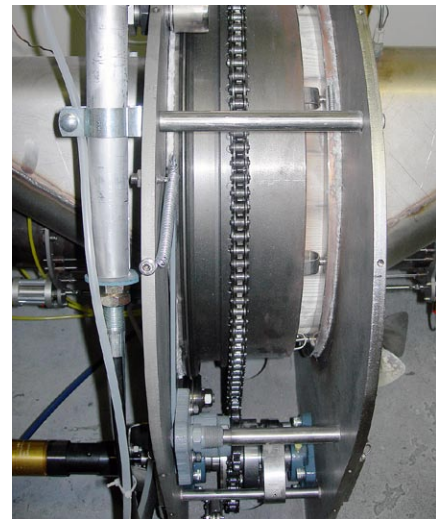
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Article focus

How Wilson TurboPower overcame previous limitations to develop a commercial rotating heat exchanger, and how ceramics permit higher process temperatures and greater effectiveness.



per square inch. It is made of cordierite, a ceramic used in automotive catalytic converters. This commercial application makes it widely available and relatively inexpensive. Cordierite also has a low coefficient of expansion, a high working temperature, and low conductivity. Users may be



An indexed cam and spring mechanism rotates the Wilson regenerator 90 degrees at a time.

able to coat its surface with catalysts to reduce the emissions of nitrogen oxides, carbon monoxide, and unburned hydrocarbons.

According to Wilson, the ceramic heat exchanger is 97.5 percent efficient, withstands high temperatures that burn away metals, and is much smaller and less expensive to manufacture than conventional units. The company plans to team the heat exchanger with a microturbine of its own design to produce highly efficient power.