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Diodic Turbine

High-diodicity turbine mitigates backflow in rotating detonation engines, boosting efficiency without high-pressure fuel injection.

Rotating Detonation Combustors/Engines (RDEs) are an emerging technology in the fields of energy and transportation that could increase fuel efficiency in a number of propulsion systems, from NASA rocket launches to major cargo vessels. However, because of the rotating pressure wave that characterizes the design of RDEs, they are more likely than traditional propulsion systems to suffer from flow reversal or backflow, in which increases in downstream pressure cause fuel to flow backwards toward the injection site. Current options to mitigate this issue include introducing choke points and higher injection pressures, but these options cause a significant reduction in efficiency, limiting the viability of RDEs as a whole.

Another option is the use of a Tesla valve, which allows free movement in one direction while limiting flow in the other. These valves are known as "diodic" because they function as a two-way diode in the system, currently demonstrating "diodicity" levels around 1.4. Researchers at Purdue University have developed a diodic turbine that increases effectiveness by an order of magnitude. By including this new type of diodic turbine in emerging RDEs, numerous industries could introduce new combustion engines to their existing technologies, making them more sustainable.

Technology Validation:

Simulations have been conducted demonstrating improved diodicity of the disclosed turbine in conditions similar to real operating conditions. The disclosed technology was shown to have diodicity as high as 30, a massive increase over traditional technologies. Pressure contours have been measured and analyzed to explain these findings.

Advantages:

-Increased efficiency (diodicity) of diodic or Tesla-style valve

-Does not require high pressure fuel injection

Technology ID

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Category

Aerospace & Defense/Hypersonics & Propulsion Systems
Aerospace & Defense/Thermal Management & Combustion Optimization
Automotive & Mobility Tech/Micromobility & Smart Urban Infrastructure

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-Can manage high speed changes in pressure

-More fuel efficient than other methods of backflow management in RDEs

Applications:

-Improve the performance of RDEs, which can be implemented in existing technologies (jet propulsion, cargo vessels, automotives, and any other industry centered on combustion engine technology) to improve fuel efficiency, thereby reducing costs and increasing sustainability.

TRL: 2

Intellectual Property:

Provisional-Patent, 2024-05-23, United States

Utility Patent, 2025-05-23, United States

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