



TECHNOLOGY SOLUTION

Power Generation and Storage

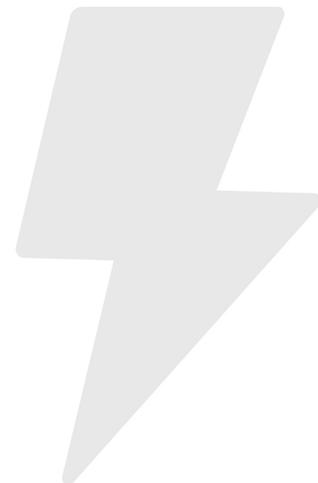
Double-Acting Extremely Light Thermo-Acoustic (DELTA) Convertor

Lightweight, high-frequency, high-efficiency convertor provides increased specific power

NASA's Glenn Research Center has developed a novel Double-acting Extremely Light Thermo-Acoustic (DELTA) convertor that operates at high frequencies (>400Hz) with greatly increased specific power and no moving parts. Conventional engine power systems grow substantially in size and weight as their power level increases, as they manage their required reactive force, produced centrifugal force, or achievable current flow. In contrast, the DELTA convertor enables an order of magnitude improvement in specific power compared to conventional engines. The DELTA convertor harnesses the power of thermoacoustics by relying on the relationship between the temperature and pressure oscillations present in sound waves. By using thermoacoustics to drive a double-action piston, this revolutionary DELTA convertor enables a lightweight, maintenance-free, high specific power system ideal for unmanned aircraft vehicles, next-generation aircraft, mobility on demand, and any power system in which efficiency, size, and weight are critical.

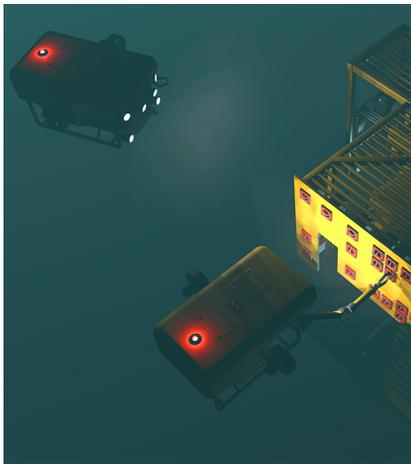
BENEFITS

- Features small size and weight
- Remains maintenance-free, with no moving parts and therefore fewer failure modes
- Generates an order of magnitude increase in specific power over conventional engines
- Yields unprecedented efficiencies compared to internal combustion engines
- Uses multiple frequencies up to 400Hz and is easily scalable



THE TECHNOLOGY

Glenn's innovative DELTA convertor uses a double-action push/pull piston, in which an acoustic wave - or sound wave generated by heat - pushes both ends of a single piston. When sound waves are propagated down a narrow tube, they transfer energy along the tube. Conversely, when a heat gradient is introduced, it will generate sound waves that will cause the push/pull piston to oscillate. Using thermoacoustics to oscillate the push/pull piston simplifies engine operation by eliminating moving parts such as hot displacers and heavy springs. The double-action piston is contained by multiple thermo-acoustic stages in series that form a delta-shaped triangular loop. One side of the piston creates an acoustic wave while simultaneously receiving acoustic power on the opposing side, enabling increased power on the single piston as compared to a single-action piston. The simple design consists of a helium-filled tube, heat exchangers, regenerators, and a single, non-contact, oscillating piston. Operating at 400Hz, this convertor can produce four times more power than conventional engines operating at 100Hz, with no hot moving parts, maintenance, lubrication, or electric feedback required. At this higher frequency, the output current is minimized and the specific power is maximized enabling an order of magnitude increase in specific power over conventional engines. Glenn's novel DELTA convertor offers this significantly increased specific power in a compact, lightweight, maintenance-free package that has considerable commercial potential.



Glenn's DELTA convertors combination of high specific power and lightweight, compact design make it ideal for use in myriad applications, including unmanned underwater vehicles



This DELTA convertor's novel thermoacoustic design allows it to work well with solar thermal collectors and other leading-edge energy generation applications

APPLICATIONS

The technology has several potential applications:

- Next-generation aircraft
- Unmanned aircraft vehicles
- Portable power packs
- Auxiliary power units
- Autonomous underwater vehicles
- Micro combined heat and power systems
- Co-generation
- Concentrated solar thermal power
- Mobility on demand

PUBLICATIONS

Patent No: 10,227,950