INVENTIONS & INNOVATION

Project Fact Sheet

MICROTUBE STRIP HEAT EXCHANGER

BENEFITS

- By increasing power plant efficiency only 27%, annual fuel savings of up to $25 billion could be realized
- Specific power densities in the MTS exchanger can be on the order of 100 to 10,000 times greater than many current heat exchanger designs
- Expected to cost significantly less to produce than conventional exchangers due to lower material usage and lower costs of welding of the tubes to the tube sheet
- Increases industry's ability to manufacture gas-to-gas heat exchangers economically

APPLICATIONS

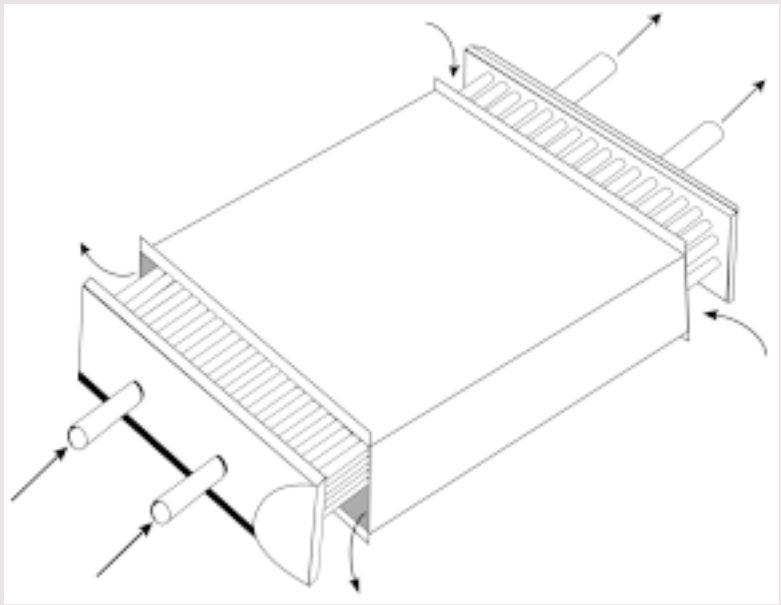
The MTS exchanger is applicable in many situations, most effectively in engines in power plants. However, the exchanger can be used in smaller applications as well, such as in cryocoolers for desktop computers requiring cryogenically cooled processors and in sensors in defense reconnaissance satellites. It is also suitable for use in recuperated gas turbines for applications in automobiles, ships, and aircraft.

NEW CONCEPT IN HEAT EXCHANGER DESIGN INCREASES EFFICIENCY WHILE REDUCING COSTS

Heat exchangers, devices used to transfer heat from one fluid to another without mixture, are an important part of most stationary power plants and some mobile power units. Some of the more prevalent examples include steam power plants, open-cycle gas turbines for on-site power generation, and nuclear-powered submarines. Total system efficiency of power plants using heat exchangers ranges from 30% to 55%, while gasoline and diesel engines (which don't use heat exchangers in the same sense) achieve efficiencies of only 16% to 26%.

A new Microtube Strip (MTS) heat exchanger, developed by Doty Scientific, is significantly smaller and more effective than currently available heat exchangers for a wide range of applications, including both open and closed Brayton-Cycle turbine engines. The MTS exchanger helps overcome the impediments that block greater commercialized use of efficient gas turbines for both power generation and ground transportation power. Its smaller size and more efficient design increase the ability to control and optimize the combustion process in turbine engines. This new approach to heat exchanger design suggests that these exchangers will create a substantial increase in efficiency per unit cost.

MICROTUBE STRIP HEAT EXCHANGER



Doty Scientific's Microtube Strip (MTS) heat exchanger is smaller and more efficient than conventional heat exchangers used in power plants.

Project Description

Goal: The primary goal of this project was to explore the limits of miniaturization of economical, robust heat exchangers.

The MTS heat exchanger module consists of a number of heat transfer tubes connected parallel to each other. Each exchanger contains 8-15 rows of 50-200 tubes, each of typically 0.8 mm outside diameter and 0.2 m length. The tubes are metallurgically bonded to rectangular header tube strips at each end. Manifold caps are welded over the ends. Fluid flows in counterflow fashion over more than 95% of the tube length. The essence of the MTS design is an optimal, manufacturable method of parallel manifolding of extremely large numbers of very small tubes in a way that maintains high uniformity of flow, both tube-side and shell-side.

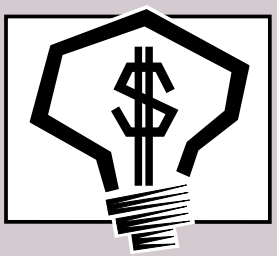
Doty Scientific, Inc., developed this new technology with the help of a grant funded by the Inventions and Innovation Program through the Department of Energy's Office of Industrial Technologies, with additional Small Business Innovation Research (SBIR) funding from DOE, and with private funding.

Progress and Milestones

- Demonstrated the feasibility of higher specific conductance by a factor of five over any other work in high-temperature, gas-to-gas exchangers.
- Current design appears to be amenable to mass production techniques, but considerable process development remains.
- DOE and NASA are interested in the MTS exchanger for use in reverse Brayton Cycle cryocoolers.
- Doty Scientific is negotiating with a potential partner in the power industry.
- Currently in the prototype development stage.
- Protected by U.S. patent 4,676,305 since June 30, 1987.

Economics and Commercial Potential

- The MTS exchanger could have a significant, indirect impact on the national energy situation because availability of this technology will greatly facilitate the development of high-tech energy converters based on gas turbine engines.
- A low-cost, ultra-compact heat exchanger could have an enormous impact on industry in the areas of cryocoolers and energy conversion.
- Compact cryocoolers based on the reverse Brayton Cycle (RBC) will become practical with the availability of compact heat exchangers like the MTS exchanger.
- Reduction in materials usage and improved heat exchanger performance should be of significance in advanced engine designs, as well as in cryogenics.
- The MTS exchanger is commercially feasible with a well-defined market.



The Inventions and Innovation Program works with inventors of energy-related technologies to establish technical performance and conduct early development. Ideas that have significant energy savings impact and market potential are chosen for financial assistance through a competitive solicitation process. Technical guidance and commercialization support are also extended to successful applicants.

Project partners

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