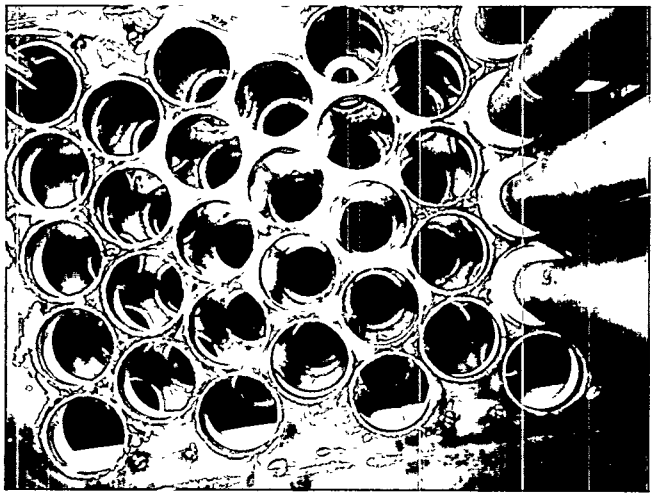
evenly and clean the outside of the finned tubes, thus reducing corrosion.

The first U.S. industrial fluidized-bed waste-heat recovery system has been operating for more than a year on an aluminum remelt furnace at an ALCOA plant. The system can save 13 billion Btus per year, representing 85% to 90% of the energy entering the waste-heat boiler. Aerojet General is now commercializing this technology, which could save about 40 trillion Btus per year by 2010.

High-Temperature Recuperators

Industrial processes that rely on combustion heating are highly energy-intensive. This is particularly true at high combustion temperatures, where more than 50% of the energy consumed as fuel is lost in the process exhaust. Recuperators can recover significant portions of this wasted energy by capturing heat from the exhaust and returning it to the combustion process in the form of preheated air. Conventional recuperators provide combustion air at a maximum temperature of 1300°F. The development of high-temperature burner-duct recuperators now allows recovery of heat from exhaust gases to produce preheated combustion air with temperatures as high as 2000°F. This significant increase in combustion air temperature results in correspondingly significant energy savings.



Bayonet-style ceramic tube assemblies are used in high-temperature burner-duct-recuperators to increase fuel efficiency.

Bayonet Ceramic-Tube Recuperator—DOE and Babcock & Wilcox Corporation developed a ceramic-tube recuperator for use in steel plants. The recuperator is a two-stage unit; the first stage is a ceramic recuperator that can withstand continuing high temperatures, and the second stage is a metallic recuperator that provides a higher level of heat recovery efficiency. A unit installed at a Pennsylvania steel mill in 1982 achieved fuel savings exceeding 40%. Projected annual savings for this type of recuperator in 2010 are estimated at 51.1 trillion Btus.

Cruciform Ceramic-Tube Recuperator—The cruciform ceramic-tube recuperator, developed by DOE and Garrett AiResearch, uses a unique design to recover heat in harsh combustion exhaust environments where conventional heat exchangers fail. By preheating combustion air to 2000°F, the recuperator can save up to 50% of the fuel consumed in the combustion process. The first production unit of the cruciform ceramic-tube recuperator was tested in a rotary forging furnace at Cameron Iron Works in Houston, Texas. Potential energy savings by 2010 are estimated at 65.7 trillion Btus per year.

Ceramic Recuperator—A new cross-flow, ceramic recuperator for use in high-temperature (1600°F to 2600°F), relatively clean exhaust environments was developed and tested by GTE with DOE support. The heat exchange core is composed of alternate layers of ceramic (magnesium aluminum silicate) passages oriented at right angles to each other. The recuperator is applicable to a wide variety of industrial furnaces in several industries with resultant energy savings of 26% to 50% over unrecuperated furnaces. As a result of DOE's technology acceleration program and the developer's marketing efforts, the recuperator is achieving widespread industrial acceptance and implementation. More than 700 recuperators of this type are currently saving industry an estimated 1.06 trillion Btus per year. Estimated 2010 energy savings are 26.2 trillion Btus per year.

Innovative Coil-coating Ovens

The coil-coating industry uses a significant amount of natural gas to cure solvent-based paints applied to metal coils. Gas-fired ovens evaporate the solvent and set the resin for each coat of paint. During this process, large volumes of preheated combustion air are required to keep solvent concentrations within safe