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Scalable Vapor Condenser for Power Generation

A device and method for rapid vapor condensation to minimize energy loss, for applications ranging from electronics to power plants.

Georgia Tech inventors have significantly increased vapor condensation rates by as much as 60% by applying acoustic actuation (sound waves), such that acoustic energy is transferred to vapor bubbles in direct contact with the surrounding subcooled liquid, causing those bubbles to condense. This acoustic actuation affects the vapor-liquid interface and leads to the formation of small scale surface waves that increase the total rate of vapor condensation. This method is applicable over a broad range of vapor bubble scales, regardless of the size and curvature of the liquid-vapor interface. Ultimately, the increased condensation rate of the vapor can allow for a reduction of subcooling in the condenser, and therefore increase efficiency gains for the overall thermodynamic cycles found in power plants and elsewhere.

Summary Bullets

- **Reduced cost –** reduction of sub-cooling in the condenser allows increased thermodynamic efficiency gains for cycles
- **Reduced complexity –** simpler components, unlike conventional condenser technologies
- **Scalable –** applicable to utility scales ranging from small electronic devices to large power plants

Solution Advantages

- **Reduced cost –** reduction of sub-cooling in the condenser allows increased thermodynamic efficiency gains for cycles
- **Reduced complexity –** simpler components, unlike conventional condenser technologies
- **Scalable –** applicable to utility scales ranging from small electronic devices to large power plants

Potential Commercial Applications

- Large-scale thermoelectric power plants
- High-power electronic hardware
- Portable electronics, where condensers can operate at atmospheric and sub-atmospheric pressures

Background and More Information

Common condensers – devices that condense vapor into liquid form – are required in a wide variety of settings and industrial applications. For example, the electric power generation industry currently uses shell-and-tube condensers. Their function (in a thermal power plant) is to condense the exhaust steam to obtain maximum efficiency, so as to minimize energy loss, and to convert the steam into reusable water. However, many problems exist with current condenser technology, including the rate at which the vapor is condensing, low efficiency, condenser size, system complexity, and necessary maintenance. In turn, there is an estimated total loss of more than $1 billion per year for U.S. power plants due to surface condenser problems [1].

[1] Bharathan, Desikan, et al. 1992. "An Assessment of the Use of Direct Contact Condensers with Wet Cooling Systems for Utility Steam Power Plants." NREL, www.nrel.gov/docs/legosti/old/4514.pdf.

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Publications

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Images

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