Solid State Fan

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A solid state fan is an air propulsion device with no moving parts. This is often achieved using an electrohydrodynamic system that uses corona discharge to ionize air and an electric field to accelerate the ions. Existing electrohydrodynamic accelerators come in single and multi-stage variants, but all designs to date make use of a static electric field for accelerating ionized air molecules. This often makes high voltages necessary for usable flow rates, demanding large power supplies that are impractical for most applications. We propose a novel implementation using an oscillating field of relatively low voltage amplitude to accelerate ionized air molecules. We performed a theoretical analysis of the operating mechanics behind the use of an oscillating field, and fabricated the proposed design, which includes the custom driving electronics, to experimentally verify our proposal. Performance was examined, quantified by repeated flow rate measurements taken using a hot-wire anemometer, and analysed. The use of an oscillating field resulted in a safer, more compact and more robust electrohydrodynamic accelerator because the voltage requirement on the custom-built driving electronics was reduced. We also constructed and tested a prototype for a practical fan design using ten oscillating stages, and demonstrated that the oscillating field electrohydrodynamic accelerator performed comparably better than a static field electrohydrodynamic accelerator. We conclude that an oscillating field is relatively more effective than a static field in accelerating ionized air molecules and holds great promise for future designs.

Awards Won:

Fourth Award of $500