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Non-Confidential Description - PSU No. 3452
"Back Wall-Impedance Tunable Resonators-Dipole Flow Driven Resonator Configuration"

Keywords:

noise reduction and control, turbomachinery, dipole resonator, fans

Links:

Inventor Website

Inventors:

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Background

Axial turbomachinery noise is prevalent in many products, ranging from large scale turbofan engines and compressor/turbine arrays to HVAC systems and computer cooling fans. Noise generated by turbomachinery arrays has both broadband and tonal components. For subsonic axial fans, broadband noise results primarily from turbulent boundary-layer scattering over a blade's trailing edge (TE), and tip-clearance noise. Tonal noise results from rotor/stator interactions with time-invariant flow distortions and direct field interaction of rotor/stator arrays and generally radiate axially from ducted fans as a dipole-like source. When dominant, blade tones are of primary concern in noise control applications since they are annoying for human hearing.

Invention Description

The disclosed invention is the first known demonstration of a tunable, flow-induced dipole resonator source. By using flow-excited, tunable quarter-wavelength resonators, the disclosed technology has effectively reduced plane wave propagations by orienting resonator chambers axially on either side of the blade region, enabling a dipole-like secondary sound field to be passively generated. The resonator sources are then tuned in terms of magnitude and phase to reduce bi-directional propagations of blade tone noise. Blade passage frequency (BPF) noise reductions of 12.9 dB and 11.6 dB were achieved simultaneously in the upstream and downstream directions, to levels within 5 dB of the broadband level.

Advantages/Applications

- Substantially reduces BPF tones radiated by axial fans
- Can be back fit to existing axial fan systems
- Allows for simplified flow-driven resonator tuning, no active sound source required

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