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Minimization of Jet and Core Noise by Rotation of Flow

The results of experimental investigations of hot jet exhausts with and without combustion processes suggest that jet and core noise can be reduced and that flame lengths may be significantly decreased when exhaust gases are caused to rotate or swirl about the longitudinal axis of the exhaust. Combustion in rotating flows is steady and quiet, and is not accompanied by the pulsations or violent fluctuations that are characteristic of straight-flow burning. Mixing and turbulent phenomena in jet engines are greatly influenced by the pressure gradients induced by rotation or swirl of gases; in particular, experimental results have shown that the centrifugal forces produced by rotation of gases significantly increase the efficiency of mixing and are especially effective in reducing exhaust noises.

Jet engine noise is reduced when radial vane structures, movable wall casings, or exhaust-flow intercommunication passages are introduced into the flow stream so as to impart to the exhaust gases a rotation component or swirl about the engine's longitudinal axis. The rotary component in the exhaust gases substantially suppresses the buildup of sound energy normally produced by an axial-flow exhaust system.

The results of experimental investigations with large-scale jet exhausts indicate that thrust loss is minimal when the jet exhaust is rotated, and a significant lowering of sound pressure levels can be achieved when only a small percentage of the total primary mass flow is in a swirling mode.

In contrast with other jet-noise suppressors, the apparatus required to induce swirling exhausts is simple, easy to fabricate and maintain, and provides no external drag penalty to the aircraft; moreover, the apparatus does not interfere with a jet-engine thrust-reversal system. The weight penalty to the engine is minimal, less than 1/10 the weight of other suppressors. The ratio of db sound reduction to percent thrust loss is approximately 3 to 1 for subsonic jets; other known suppressors provide only a 1 to 1 ratio. It offers a greater range of flexibility to trade off noise reduction for engine performance.

Note:

Requests for further information may be directed to:

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Reference: TSP 75-10131

Patent status:

This invention has been patented by NASA (U.S. Patent No. 3,830,431). Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to:

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