



Figure 1

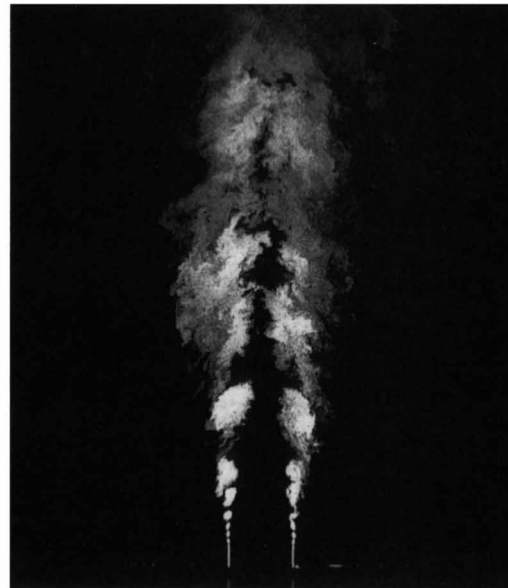


Figure 2



Figure 3



Figure 4

FORCED INSTABILITY MODES IN A ROUND JET AT HIGH REYNOLDS NUMBERS

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These photographs are instantaneous cross sections of an acoustically excited, 2 cm diam, air jet at Reynolds numbers (Re) up to 100 000 and flow velocities up to 75 m/sec.⁵ The acoustic excitations are axial ($fD/U = 0.55$) and helical ($fD/U = 0.27$) perturbations produced by an array of four, properly phased, compression drivers whose outputs are directed at the jet exit. A copper-vapor laser (2 mJ/pulse) was used to illuminate the cigar smoke marking the shear layer.

Since the Reynolds number is fairly high

($Re = 100\ 000$), even the unexcited jet exhibits pronounced three-dimensional behavior (Fig. 1). The waviness of the flow at the end of the potential core suggests the presence of a helical instability. Axial forcing produces the array of vortices seen in Fig. 2 ($Re = 50\ 000$). The smallest vortices correspond to the shear layer's initial axisymmetric instability whose most-amplified frequency is a factor of 10 greater than the forcing frequency. In Fig. 3, the deformation of the jet's shape and the asymmetric alignment of the vortex structures are consequences of helical forcing ($Re = 100\ 000$). Finally, Fig. 4 shows the dramatic changes as a result of combined axial and helical forcing ($Re = 50\ 000$). Adjacent vortices tilt away from each other resulting in an increased jet spreading angle.

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