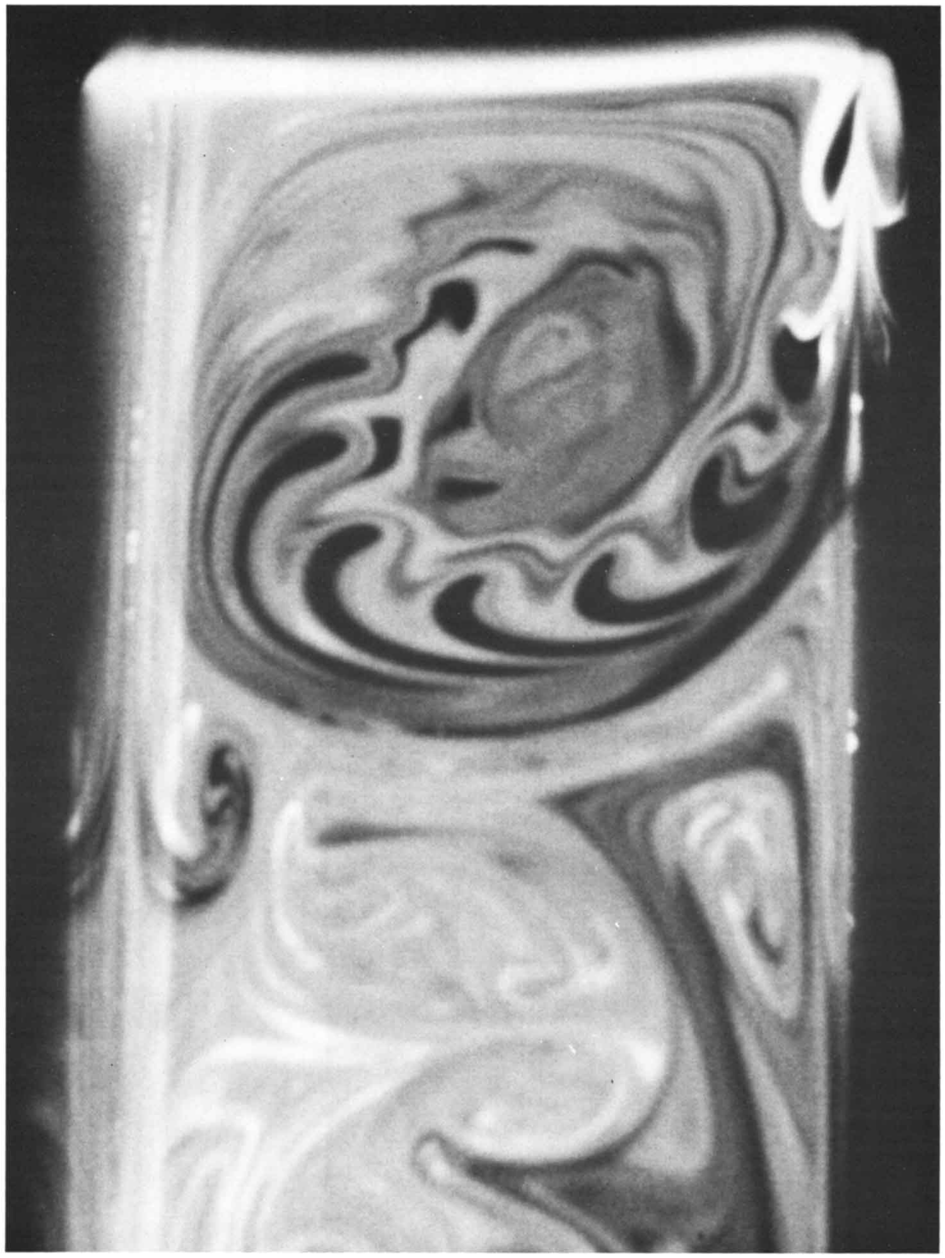

CONTROLLED CAVITY SHEAR LAYER OSCILLATIONS

Submitted by M. Gharib (University of California at San Diego) and A. Roshko (California Institute of Technology)

This photograph, which we obtained in a study[8] of the relation between the drag of a cavity and its separated shear layer, shows the flow in the upper half of an axisymmetric cavity on a body of revolution in a water tunnel. We studied the influence of external forcing by using a sinusoidally heated strip upstream of the cavity to excite Tollmien–Schlichting waves which, after amplification by the boundary layer, were introduced into the cavity shear layer. By choosing forcing frequencies within the range of shear layer receptivity, we were able to control the frequency and amplitude of the oscillation. For small values of cavity width for which the flow does not oscillate naturally, periodic oscillations could be induced by such forcing.

This picture shows such a case in which an oscillation with wavelength equal to cavity width is being excited; the phase difference between the two corners of the cavity is 2π; the amplitude of the wave increases exponentially from left to right. Its interaction with the downstream corner results in a recirculating flow on which the oscillation is imprinted as a series of intrusions of (dark) fluid entrained from the free stream. Their spacing, together with the measured phase velocity ($0.6U_\infty$) of the cavity, show that the recirculating, reverse flow velocity is $0.12U_\infty$. We created the flow visualization using the laser-induced fluorescence technique, which involves injecting fluorescein dye into the upstream boundary layer and exciting it with a 1 mm thick argon-ion laser sheet.