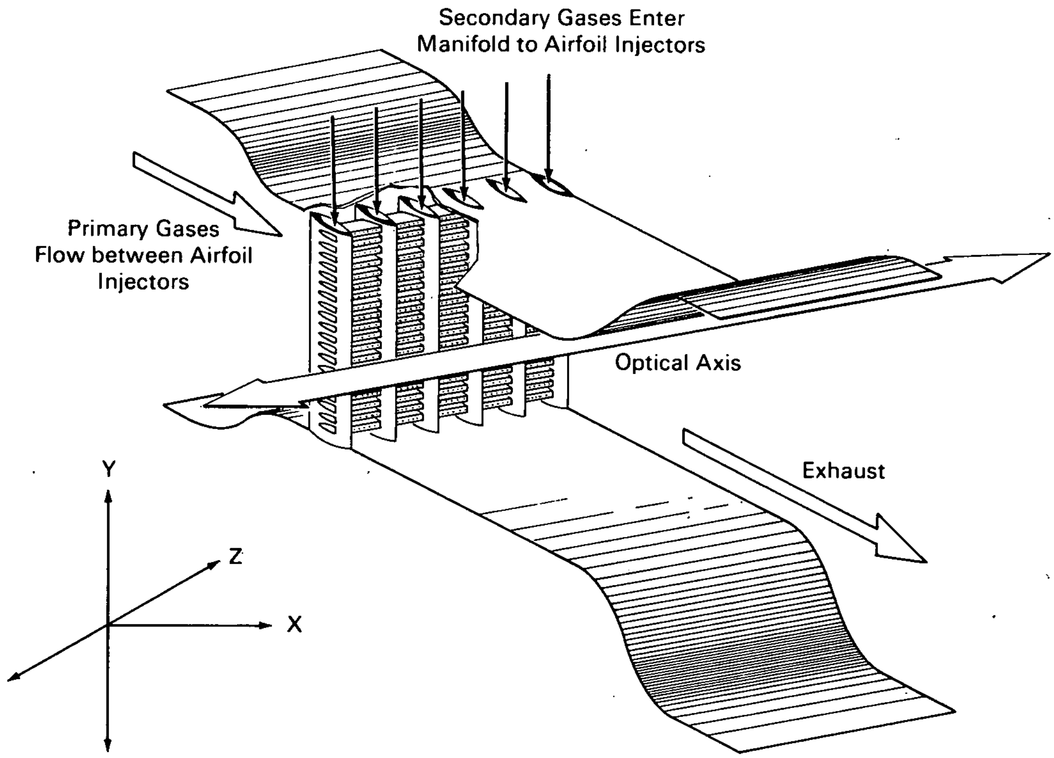
NASA TECH BRIEF

Fluid Mixing Technique Increases the Gain and Output Power of CO_2 Laser Systems



The problem:

Carbon dioxide lasers which use conventional slow flowing or nonflowing gas systems are limited in gain, tube size and ultimate output power by the properties of the surrounding surfaces.

The solution:

A high speed flowing gas system has been developed that provides uniform mixing in times that are short (on the order of 10^{-4} sec) when compared to flow transit times and CO_2 vibrational relaxation times. This type of high speed flowing gas system minimizes the effects of the surrounding surfaces and provides a uniformly high gain that is independent of dimensions transverse to the flow direction.

How it's done:

Injectors with openings or slits along their length are stocked in a parallel array shown in the figure, such that a gas enters the injectors from manifolds located at the injector ends. Another gas or gas mixture flows through the space between adjacent injec-

(continued overleaf)

tors. The injectors and openings are of such size and spacing that mixing by diffusion is more rapid than the characteristic collisional relaxation times for excitation energy of the mixed gases at typical (1 to about 100 torr) pressures in gas laser systems. Additionally, there is no appreciable loss of excitation energy to the wall surfaces from the insignificant wall collisions at the injector surfaces by particles in the gas flow.

Multiple injector arrays are formed by multiple manifold-injector combinations. The procedure of adding manfold sets with their axes lying alternately in the X and Y directions can be indefinitely continued, subject to the finite pressure drop associated with the gas flow through the manifolds, injectors and openings. Thus the gases passing between adjacent injectors may be prepared in special ways (e.g., excited by an electrical discharge, heated, dissociated, ionized, etc.) and retained in the prepared state with minimum destruction at wall surfaces.

Among the important advantages offered by this high speed flow system are: (1) a uniform and low translational gas temperature can be maintained by rejecting unused energy with the exhaust flow rather than having this energy dissipated at the wall surfaces; and (2) a more uniform electrical excitation can be achieved by minimizing ion losses produced by surface recombination.

This high speed fluid mixing technique can also be used in air pollution studies, gaseous combustion systems and fundamental investigations that deal with gas kinetics.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
Headquarters
National Aeronautics
and Space Administration
Washington, D.C. 20546
Reference: TSP70-10108

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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