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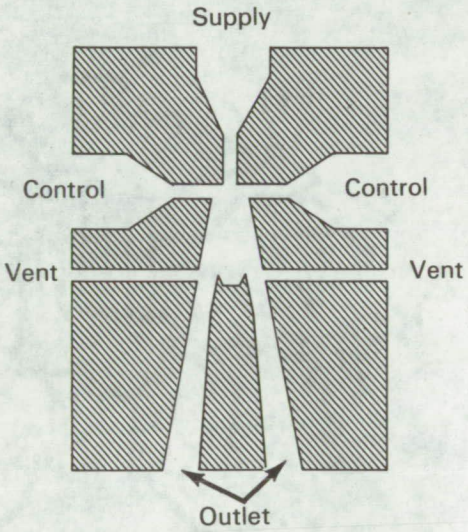
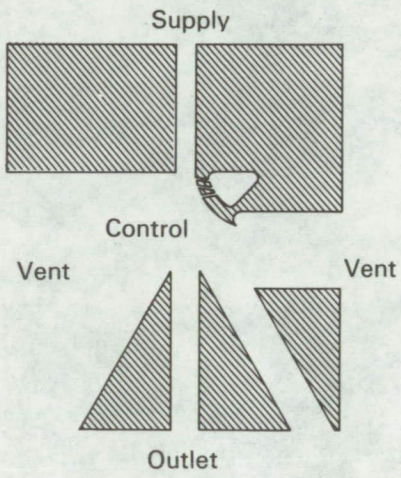
NASA TECH BRIEF

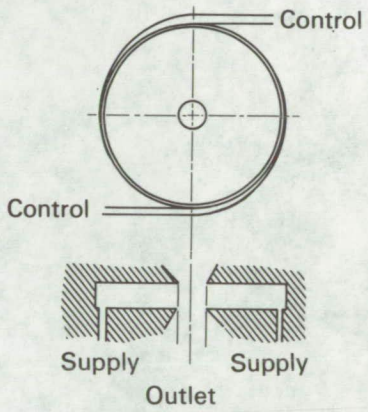
Experimental Scaling Study of Fluid Amplifier Elements



BISTABLE ELEMENT



BOUNDARY LAYER CONTROL
PROPORTIONAL ELEMENT



VORTEX AMPLIFIER

This study examines some of the scaling parameters of three fluid amplifier elements. The elements are a bistable device, a boundary layer control device, and a vortex device. The basic idea in all these devices, as in all fluid amplifiers, is: A supply of fluid enters a box which has one or more outlet holes, one or more control flow holes, and one or more auxiliary holes. For some fixed supply condition, for example, a fixed reservoir pressure from which the supply flow comes, the relatively large amount of fluid which leaves through an outlet hole is determined by a relatively small amount of fluid entering through a control flow hole.

This study is concerned primarily with the manner in which the performance scales; that is, how the performance varies with size, fluid, and other conditions. It is not concerned with element design. For the purpose of determining the scaling laws the non-dimensional performance of geometrically similar elements are examined experimentally, choosing designs which have previously been developed. Consideration has been restricted to single fluid operation (that is the surrounding atmosphere consists of the same kind of fluid as the supply fluid), and report on experiments in air and in water. For the most part sufficiently low fluid speeds are considered so that air can be regarded as incompressible. As is common in fluid amplifier work, consideration is restricted to geometries in which the intended operation is two-dimensional; consequently similarity means maintain-

(continued overleaf)

ing similar planforms. Since physical elements do not behave two-dimensionally, effects of varying the length perpendicular to the representative plane of the planform are examined to some extent; only the steady flow is considered.

Even with the restrictions imposed, the number of variables remains too large for convenient use. Consequently a major object of this study is the determination of ranges of operation in which some of the variables are not very important, and the establishment of ways of compacting the data. Hopefully these simplifications can be applied to other elements. Obviously, an important byproduct of the attempt to establish scaling laws is the actual performance characteristics of the particular elements investigated.

Complete details of this study are contained in: "Experimental Scaling Study of Fluid Amplifier Elements," by I. Greber, C. Taft, and J. Abler, Case Institute of Technology, March 1966.

Note:

Copies of this report are available from:

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Patent status:

No patent action is contemplated by NASA.

Source: I. Greber, C. Taft, and J. Abler
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