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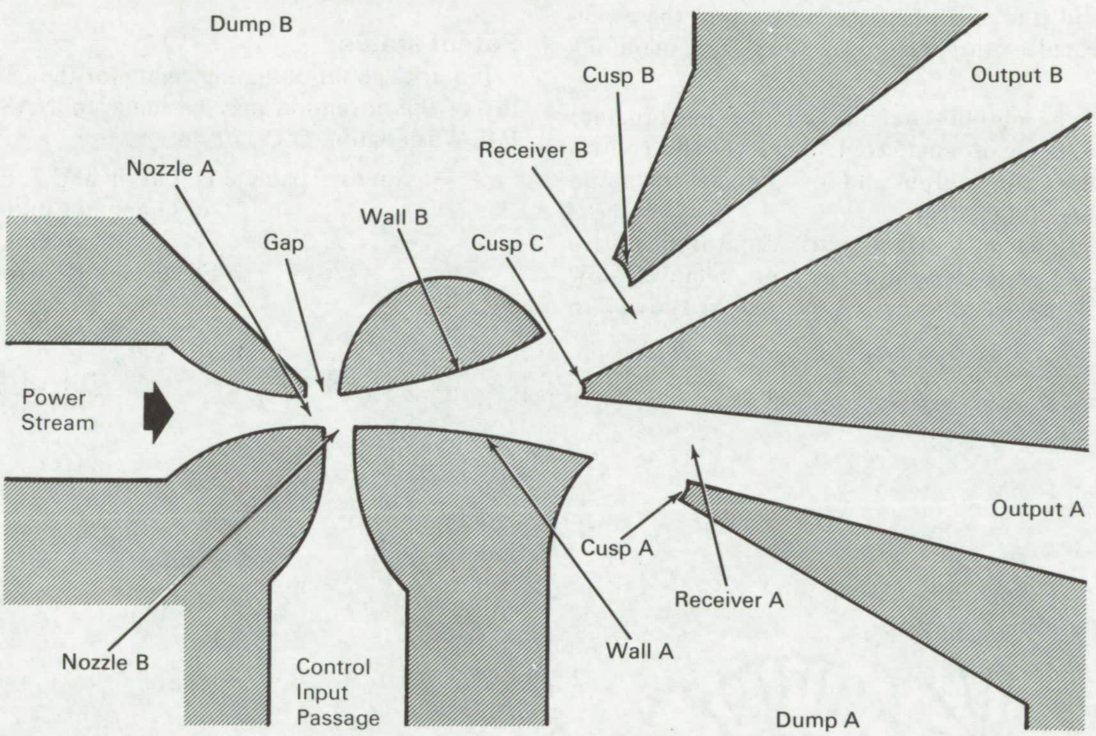
NASA TECH BRIEF

Binary Fluid Amplifier Solves Stability and Load Problems



The problem:

To design a digital fluid amplifier with the characteristics of load insensitivity, high stability, and the capability of operating at low Reynolds numbers.

The solution:

A fluid amplifier with specially designed nozzles to provide uniform exit-velocity profiles and to ensure jets of low turbulence.

How it's done:

A continuous supply of working fluid (e.g., air) issues from power nozzle A. A control signal, which would normally be the output from another fluid device, may be applied through the control input passage to emerge as a jet from nozzle B. When no control flow is present, the jet from power nozzle A follows the curvature of wall A and enters receiver A. When control flow is present, the power jet is forced away from wall A to wall B. The power jet then follows the curvature of wall B and enters receiver B. Receivers A and B lead to passages that supply fluid to the control nozzles of other fluid state elements or sensors. Surplus fluid is vented to a low-pressure

(continued overleaf)

manifold via dumps A and B. Cusps A and B allow a relatively noise-free "peeling off " of the surplus air not required by the fluid devices attached to outputs A and B. A gap opposite the control input passage allows for entrainment of low-pressure manifold fluid and permits the power jet to detach from wall B when the control signal from nozzle B is removed. Cusp C enhances the bistability of the power jet by creating a vortex that inhibits flow into the two receivers simultaneously.

The design of nozzles A and B and the curvature and location of walls A and B are such that under conditions of zero flow through the control input passage, the pressure in this passage is equal to the pressure in the return manifold (or the environment in an open system). Similarly, under conditions of normal operation in a binary circuit, the flow in outputs A and B is zero when the pressure in these outputs is equal to the pressure in the return manifold.

Notes:

1. When the outputs are blocked, the performance of the device is unaffected; there will be control pressure at one output and low pressure (manifold pressure) at the other.
2. The design is such that outputs A and B may drive one fluid state element each. Since relatively low gain is utilized, the device has low sensitivity to dirt in the fluid supply or to slight variations in element geometry. This feature lends itself well to the concept of integrated circuits in which many elements are formed in a single sheet of material.
3. Since the device utilizes no techniques that depend on the presence of a turbulent boundary layer or even on turbulence in general, its performance is satisfactory at low Reynolds numbers. There appears to be no upper limit to the Reynolds number at which the device will operate.
4. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Electronics Research Center
   575 Technology Square
   Cambridge, Massachusetts, 02139
   Reference: B66-10177

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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