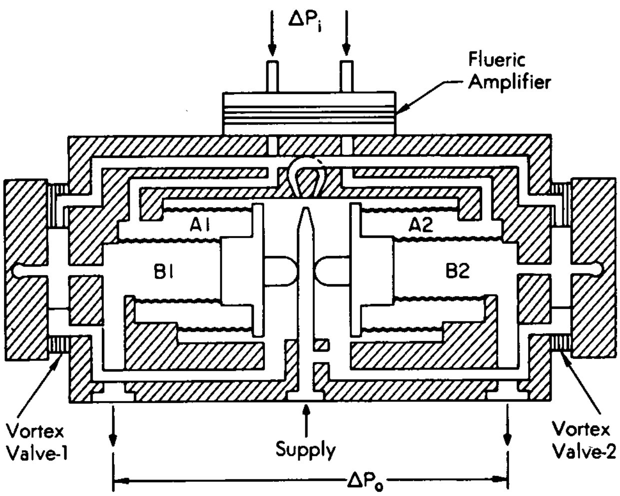
NASA TECH BRIEF
Ames Research Center

Vortex Servovalve for Fluidic or Electrical Input

The problem:

To design a frictionless, minimum hysteresis servovalve which is tolerant to contaminant particles and meets minimum standby flow requirements for applications such as rocket thruster nozzles.



The solution:

A proportional-pressure control servovalve consisting of a fluid amplifier bellows-driven jet-pipe first stage and a second stage consisting of two vortex valves operating in push-pull, with a pair of bellows for pressure feedback.

How it's done:

The vortex servovalve shown in the diagram is frictionless and has a minimum of hysteresis. Large apertures permit contaminant particles as large as 200 micrometers to enter and leave the first stage without causing malfunction of the valve.

The pure fluidic servovalve has a jet-pipe first stage driven by a fluidic amplifier — bellows system. The vortex valves are in the second stage, and a pair of bellows is used for servo output-pressure feedback. A differential pressure input into the standard flueric amplifier results in a proportional differential pressure in control bellows chambers A1 and A2, causing the jet pipe to deflect and modulate differentially the vortex control flow to vortex valves 1 and 2; this action modulates the second-stage output flow. The servo output flow (equivalent to flow for an orifice load) is sensed in bellows chambers B1 and B2, and is fed back through the bellows assembly to null the jet pipe position, thus producing output differential pressure or flow proportional to input pressure.

An electrofluidic version of the valve has been designed; it is essentially a modification in which the fluidic first stage is replaced with a conventional, electromagnetic torque-motor driven jet-pipe-receiver similar in design to that currently used in two-stage electrohydraulic and electropneumatic servovalves. The inputs to this version of the servovalve are a high-pressure gas supply from a storage bottle and electrical signals from an electronic servoamplifier. The output is a differential gas flow proportional to the electrical current input. The vortex valve output pressure (equivalent to thruster flow) is fed back to the torque-motor by means of the pressure-sensing arrangement of the bellows (as in the pure fluidic valve). The force applied to the bellows assembly is transmitted to the jet pipe and torque-motor armature by a force-feedback spring which connects the bellows assembly to the jet pipe.

The second-stage vortex-valve assemblies in both versions of the servovalve are mounted symmetrically

(continued overleaf)

on the ends of the valve as shown in the diagram. Stacks of metal laminates, chemically-etched from 0.010-cm stainless steel, are sandwiched between the endplates and servovalve body to form the vortex chamber, supply passages, and control nozzles. Both radial and button-type valves can be assembled by minor modification in the endplates and the arrangement of the laminates.

Notes:

1. The following documentation may be obtained from:

    National Technical Information Service
    Springfield, Virginia 22151
    Single document price $3.00
    (or microfiche $0.95)
    Reference: NASA CR-73304 (N69-29306),
    Fluidic Proportional Thruster System.

2. Requests for additional information may be directed to:

    Technology Utilization Officer
    Ames Research Center
    Moffett Field, California 94035
    Reference: TSP72-10173

Patent status:

No patent action is contemplated by NASA.

Source: Thomas S. Honda of
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