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Bimorph Piezoelectric Device Functions as Flapper Valve

A flapper valve using a bimorph piezoelectric ceramic bender has been designed to convert an electrical input into a pneumatic output signal capable of operating fluidic logic elements in a decoder and display system. An experimental unit produced sufficiently great pressure changes in the cavity feeding the control port of a fluidic element to switch the fluidic element when a 25 V ac signal was applied to the piezoelectric bimorph bender. The highest frequency at which the unit was tested was 1200 Hz, although the design goal was to obtain a pneumatic output of sufficient magnitude to switch a fluidic element with a 20 V signal of 15-msec duration.

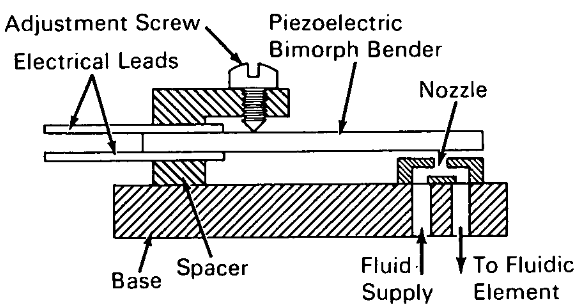

Figure 1.

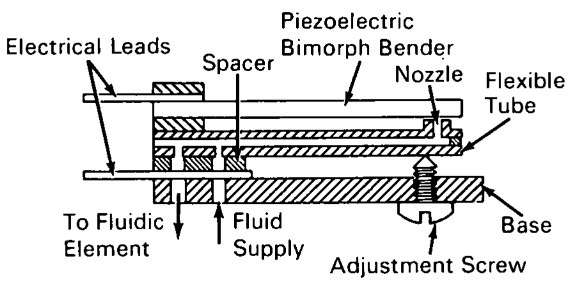

Figure 2.

As shown in the schematics (Figs. 1 and 2), the flapper valve incorporates a piezoelectric bender consisting of a commercially available lead zirconate-lead titanate piezoelectric ceramic. The bender consists of two transverse-expanding plates of the piezoelectric ceramic cemented together in such a manner that one plate contracts and the other expands when a voltage is applied to electrical contacts on the bender. When supported as a cantilever beam, the bender will bend or deflect in response to the applied voltage.

In its application in the experimental flapper valve of Figure 1, the free end of the bender is positioned above a fluid outlet nozzle in a cavity. Another outlet orifice is connected to the control port of a fluidic element. The fluid supply is connected to a third orifice in the cavity. Deflection of the bender changes the opening of the nozzle and the fluid impedance "seen" by the nozzle output flow. This impedance change will correspondingly change the pressure inside the cavity, and hence the output flow to the control port of the fluidic logic element.

In the first experimental design (Fig. 1), the bimorph bender was clamped onto a base and positioned at approximately the required distance from the nozzle with a spacer. Final setting of the bender distance was done with an adjustment screw. The effective length of the bender and hence the deflection obtainable with this design is limited by the position of the adjustment screw. An improved design is shown in Figure 2. In this design, the nozzle is part of a flexible tube of metal. The adjustment screw therefore regulates the position of the nozzle with respect to the bender, and thus allows the maximum effective length of the latter to be used.

(continued overleaf)

Note:

The following documentation may be obtained from:

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Reference:
NASA-CR-86105 (N68-36418), Fluidic Decoder and Display Device

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