

# NASA TECH BRIEF



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## Piezoelectric Linear Actuator

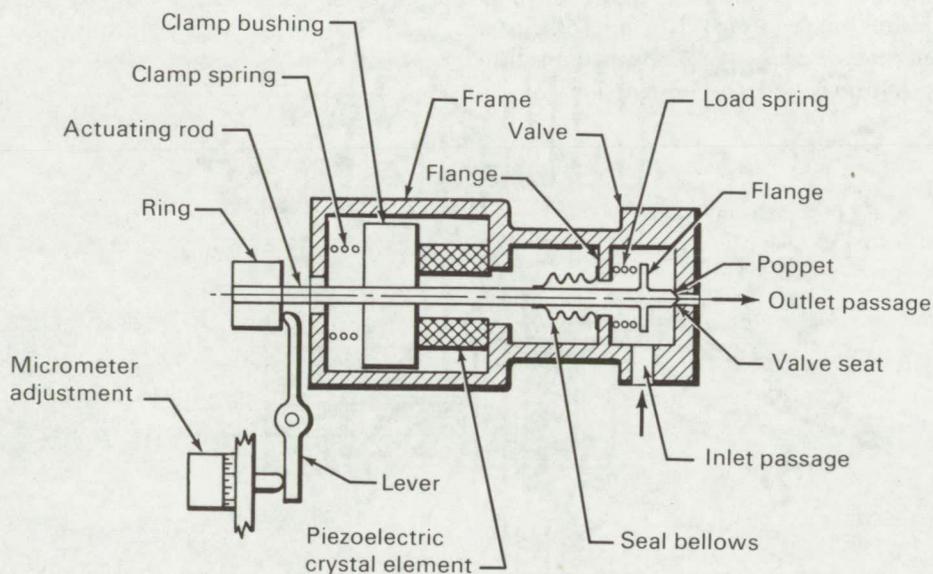


Fig. 1. Cross section of linear actuator having a single hollow cylindrical piezoelectric-crystal element

### The problem:

Design of a linear actuator suitable for precise control of valves.

### The solution:

A novel actuator can exert linear force that is controllable and reproducible to microinch tolerance.

### How it's done:

A controlled voltage is applied across a piezoelectric-crystal element (either a single crystal or a stack of such crystals) to change the dimension of the element in the direction of the applied voltage. One end of the element is held fixed; the other end is connected

to an actuating member such as a rod. The rod may be adjusted relative to the element and then locked in such position, or the whole element and actuating rod may be adjusted.

For control of a poppet valve the actuating member may be a rod extending in the direction of movement and terminating in a poppet that initially engages a seat to close the valve. The end of the crystal, facing the valve, is stationary, and expansion of the crystal, under applied voltage, opens the valve minutely and to a controllable degree.

The new actuator is constructed for extremely accurate control of a valve with adjustment over a

(continued overleaf)

very small range of openings; with it one could study, with assurance and repeatability, valve leakage at very low rates of flow. The actuating rod can be used to effect the same miniscule, controlled, linear movements for other purposes also; its use should not be considered to be restricted to valve control. Figures 1 and 2 show two forms of the actuator in conjunction with a valve.

The actuator may interest those concerned with control systems or with instrumentation; it may find use (1) as a precise control for a gas-regulating valve—including remote positioning of the needle of a high-pressure regulator; (2) as a variable venturi meter; (3) in fluidics for fine control of jets in proportional-type amplifiers; (4) as a micropositioner—as for remote control of the position of radioactive or otherwise hazardous material; (5) as a microthruster for precise metering of gases, monopropellants, bipropellants, or hybrids; and (6) in reaction-control systems.

**Note:**

Documentation is available from:  
 Clearinghouse for Federal Scientific  
 and Technical Information  
 Springfield, Virginia 22151  
 Price \$3.00  
 Reference: TSP69-10469

**Patent status:**

Title to this invention has been waived under the provisions of the National Aeronautics and Space Act [42 U.S.C. 2457 (f)], to the Astrosystems Incorporated, One Goddard Drive, Rockaway, New Jersey 07866.

Source: Stanley Lehrer of  
 Astrosystems International Incorporated  
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 Manned Spacecraft Center  
 (MSC-13194)

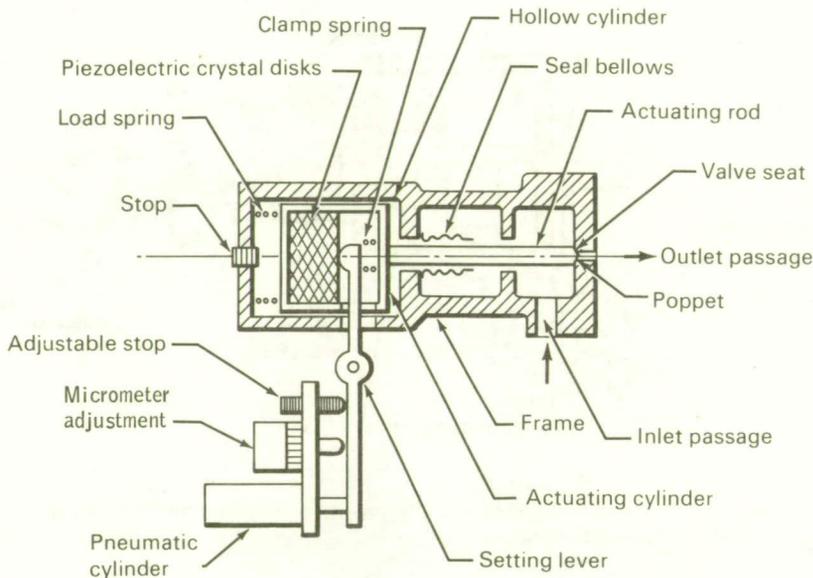


Fig. 2. Cross section of linear actuator having a stack of piezoelectric-crystal disks in a hollow cylindrical housing