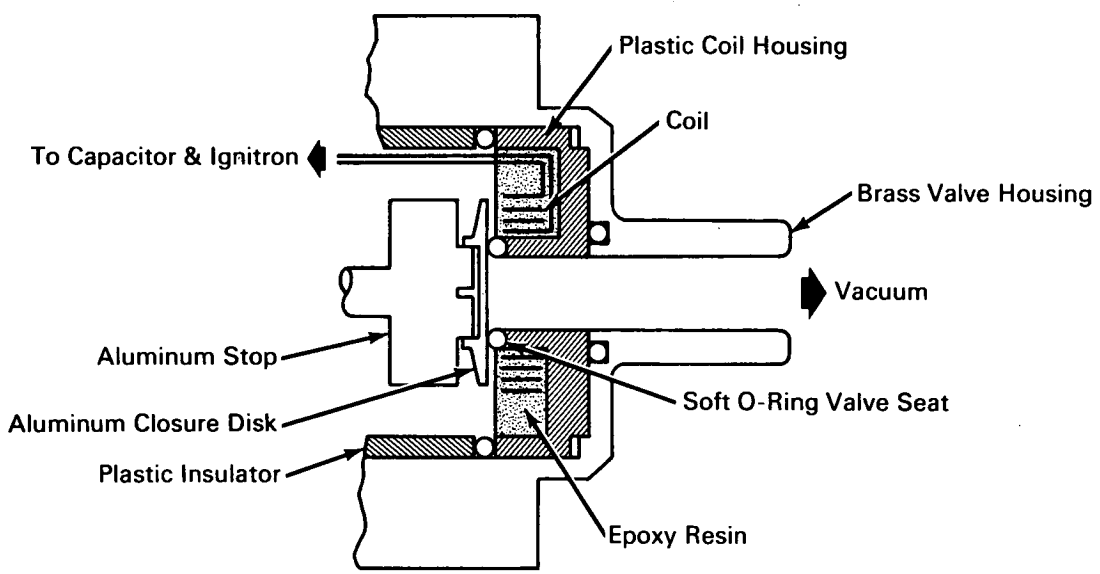
NASA TECH BRIEF

Gas-Injection Valve Operates at High Speed



The problem:

Many plasma acceleration experiments require the injection of a short pulse of gas into a vacuum chamber. For this purpose, there is a need for a valve that can be opened during a brief and controllable period, usually of the order of 100 microseconds.

The solution:

A new type of fast acting gas valve incorporating a lightweight closure disk that is forced away from the valve seat when an electromagnetic coil is momentarily energized; the disk immediately rebounds from a stop back onto the seat.

How it's done:

The closure disk, made of aluminum, is held on the O-ring valve seat by a gas pressure of 1 atmosphere or more. The O-ring, consisting of a soft silicone elastomer, is adhesively attached to the plastic coil housing. The coil, consisting of 4 turns of 0.7 mm X 4 mm ribbon, is potted in epoxy resin for electrical insulation and mechanical positioning. Insulated coil leads from the valve chamber are connected across an ignitron switch and a 8.5 microfarad capacitor, which is normally charged to 7.0 kilovolts. The current through this circuit rings with a frequency of 55 kc and is damped out in 90 microseconds. The valve is normally positioned sidewise, and the disk is prevented from creeping away from the seat by a short cylinder that protrudes from the aluminum stop into a recess in the disk. An adjustable gap between the stop and the disk is normally set at 0.3 mm.

(continued overleaf)

Upon discharge of the capacitor through the coil, the disk is electromagnetically accelerated toward the stop, opening the valve for about 100 microseconds and admitting a burst of gas into the vacuum chamber. On striking the stop, the disk rebounds onto the O-ring, keeping the valve closed until the ring becomes decompressed (a period of 300 to 400 microseconds). This closure period is long enough for most plasma measurements, before the valve reopens for a briefer period as a result of decompression of the O-ring.

Notes:

1. The advantage of the valve consists of its short opening time and good reproducibility. However, subsequent openings of the valve due to compression and decompression of the O-ring will limit the measurement time to approximately 400 microseconds. It should be possible to modify the basic design of the valve to prevent undesirable openings.
2. Inquiries concerning this innovation may be directed to:

   Technology Utilization Officer
   Headquarters
   National Aeronautics and Space Administration
   Washington, D. C. 20546
   Reference: B66-10381

Patent status:

No patent action is contemplated by NASA.

Source: R. S. Lowder and F. C. Hoh
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