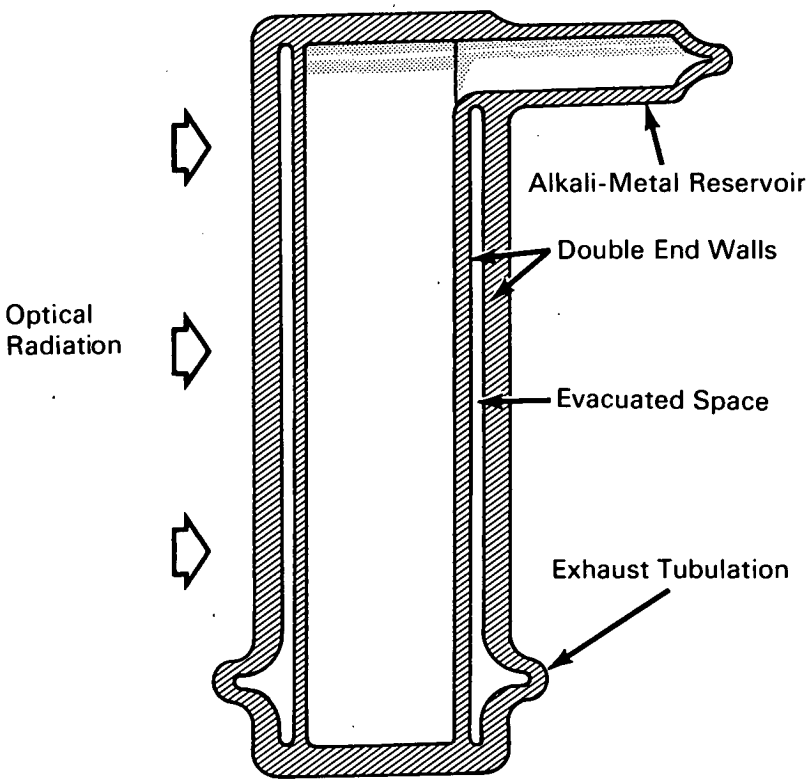
July 1968 Brief 68-10230

NASA TECH BRIEF

Improved Atomic Resonance Gas Cell for Use in Frequency Standards



An atomic resonance gas cell has been designed to maintain a stable operating frequency in the presence of pressure fluctuations in the ambient atmosphere. In earlier designs, the effects of atmospheric pressure fluctuations on the operating frequency of the cell were somewhat reduced by providing the cell with domed, instead of flat, end walls. The new design, employing a double-wall construction, accomplishes an order-of-magnitude reduction in pressure sensitivity as compared to the domed end-wall cell.

The new atomic resonance gas cell includes an envelope which is transparent to radiation in the optical region and to microwave energy at the atomic resonance frequency of the alkali-metal vapor (e.g., rubidium or cesium mixed with an inert buffer gas) within the envelope. The end walls consist of an inner disc-shaped partition and an outer disc-shaped partition which enclose an evacuated space. This space serves to prevent atmospheric pressure from being transmitted through the end wall structure to the gas

(continued overleaf)

within the cell. The alkali metal is coated on the inside wall of a tubular extension which serves as a reservoir for the metal. At the operating temperature of the cell (85°C for rubidium), the alkali metal is vaporized into the cell proper.

In use, the gas cell is arranged within a microwave cavity resonator so that the microwave fields at the atomic resonance frequency are coupled through the cell walls into the buffered alkali-metal vapor. Optical pumping radiation is passed axially through the cell to raise the vapor to a nonequilibrium energy state from which microwave energy transitions may be induced to obtain microwave atomic resonance of the vapor. In a frequency standard, the microwave cavity is tuned for resonance at the resonance of a hyperfine field-independent transition, and microwave resonance of the gas is detected to derive a frequency-standard output.

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 Varian Associates, 611 Hansen Way, Palo Alto, California 94303.

Source: G. R. Huggett
of Varian Associates
under contract to
Manned Spacecraft Center
(MSC-11666)