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NASA TECH BRIEF

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Miniature Carbon Dioxide Sensor

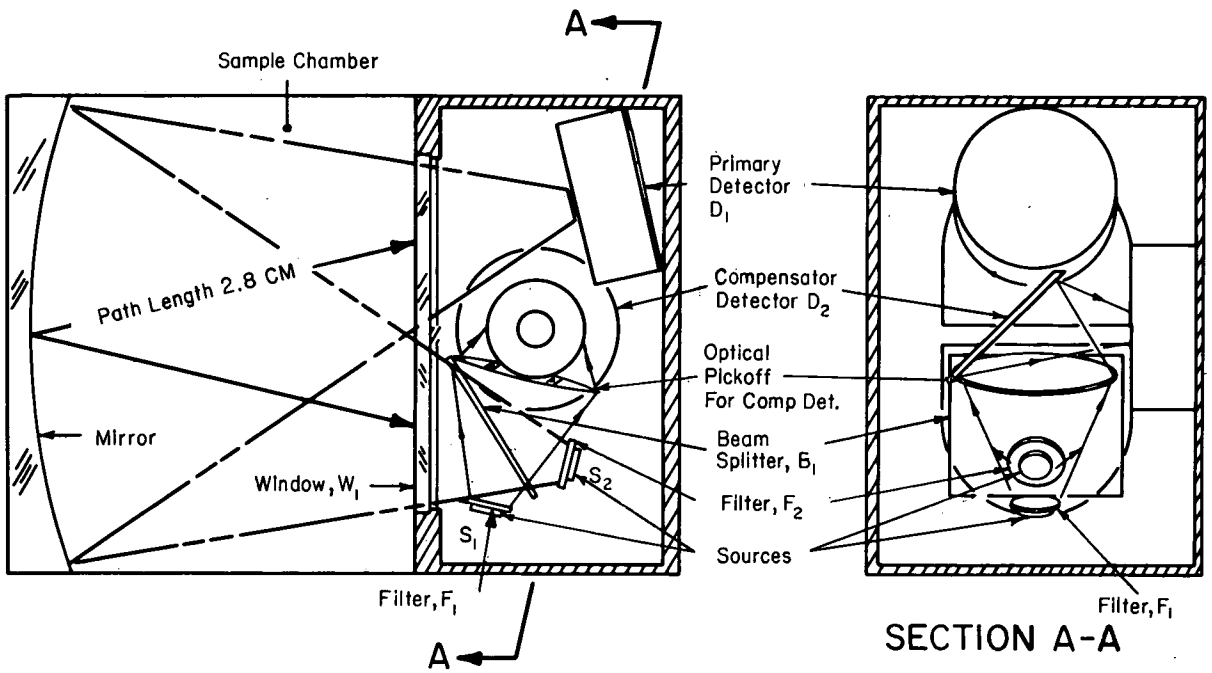

Figure 1. Schematic of Optical Configuration

A miniature sensor with no moving parts measures carbon dioxide partial pressures of 0-40 mm Hg for total pressures up to 14 psia with a full scale accuracy of 5%. The sensor compares the radiation received in two spectral regions, one of which is absorbed by carbon dioxide. The 4.3 micron region is used as the absorbing channel since the absorption is strong in this region, and the 4.0 micron region is used as the other channel since it corresponds to an atmospheric window with no substantial infrared absorption. An infrared detector is positioned to detect radiation from the two spectral regions alternately. When a signal occurs it corresponds to carbon dioxide absorption and accordingly carbon dioxide concentration.

Figure 1 illustrates the optical mechanical configuration. The sources, S_1 and S_2, are provided with filters F_1 and F_2 which are centered at 4.3 and 4.0 microns respectively. The sources are alternately switched on by an astable multivibrator source switch as shown in the schematic of Figure 2. Radiation is

(continued overleaf)

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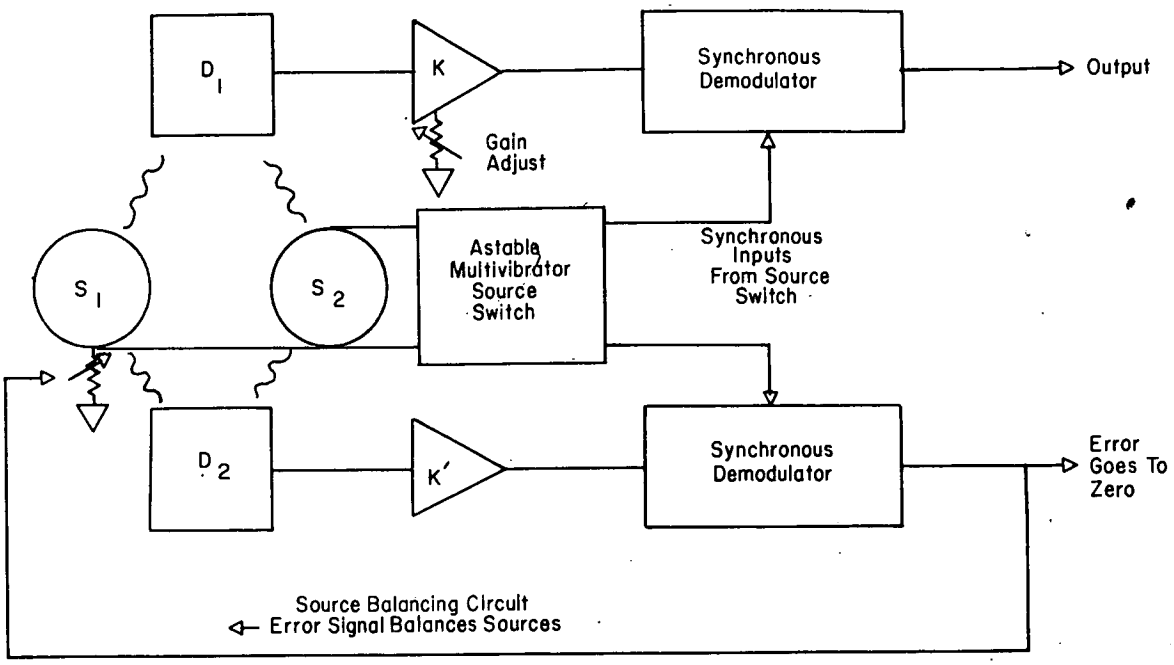

Figure 2. Schematic of Measurement Circuitry

directed by a beam splitter, B_1, made of a thin piece of germanium through a window, W_1, to a spherical mirror. The area between the window and the mirror is the sample chamber containing air and carbon dioxide.

The mirror images detector D_1 on the apparent source. The compensating detector D_2 is imaged on the sources through the beam splitter via the optical pickoff. Radiation from S_1 and S_2 detected at D_1 is amplified and synchronously demodulated to produce an output. If no carbon dioxide is present, D_1 views essentially the same sources and the output is zero. If carbon dioxide is present, the difference in the incident signals produces an output from which the carbon dioxide concentration can be calculated. Radiation from S_1 and S_2 is also alternately applied to the compensating detector D_2 whose output is amplified and synchronously demodulated. If the sources are matched there is no output but if there is a difference in the radiation from S_1 and S_2, error signals are produced and fed back to the source S_1 to produce a null and match source intensities.

This information should be of interest to those organizations concerned with environmental monitoring and control.

Note:

Requests for further information may be directed to:

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Reference: TSP71-10536

Patent status:

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