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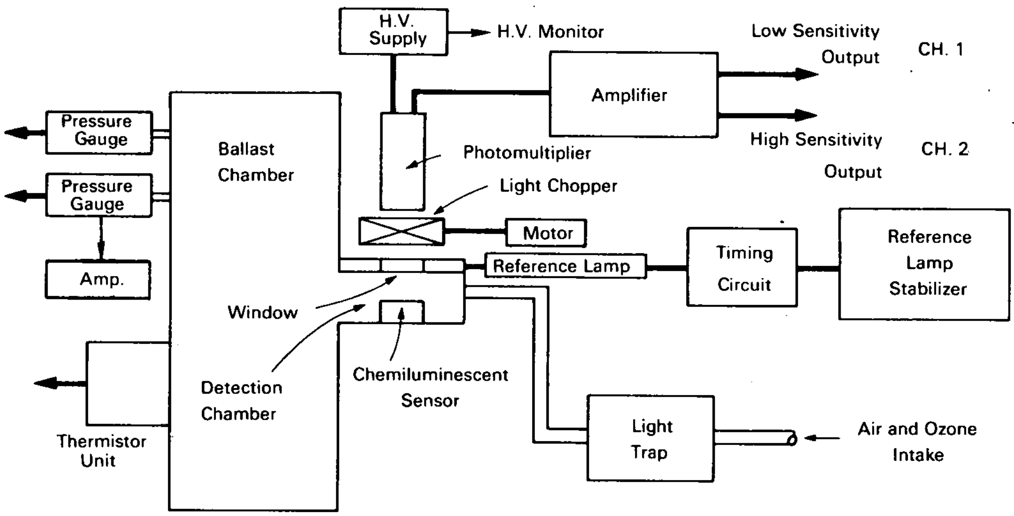
Rocket Sonde Measurements of Ozone in the Upper Atmosphere



The problem:

To perform high resolution ozone measurements in the mesosphere and stratosphere in day or night. Presently, soundings for ozone content are made by balloon ozone sondes, but only up to 30 kilometers. Some rocket probes can measure ozone in the upper atmosphere optically; however, they require the sun as a source of light.

The solution:

The technique for measuring ozone content in the mesosphere and stratosphere by means of a rocket sonde is accomplished by an in-situ determination of the ozone mixing rates as a function of altitude from approximately 65 km. to 20 km. A chemiluminescent detector is used as an ozone sensor. The atmosphere is sampled by a self-pumping method as the sonde is lowered from apogee by a special high-altitude parachute.

How it's done:

Exposure of a chemiluminescent material to ozone causes luminescence. This luminescence is proportional to ozone flux — that is, ozone concentration times flow rate.

The sample of air is introduced into the sensor by a self-pumping mechanism which operates as follows: A ballast chamber, connected to the external environment by an inlet pipe, is in pressure equilibrium with the ambient atmosphere. When the sensor is released from apogee and lowered by parachute through the atmosphere, the pressure inside a ballast chamber tends to "keep up" with the increasing external pressure, resulting in a net flow of gas through the inlet pipe. The detector, oriented along the tube, provides a continuous measurement of the atmosphere for ozone content.

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The inlet pipe is designed so its conductance is high, the time constant being less than one second, and includes a light baffle to exclude external light from the photometer. The air is sampled by the chemiluminescent detector, made up of rhodamine-B dye absorbed on a porous Vycor substrate. The luminescence is monitored by a photometer consisting of a photomultiplier with an S-20 response, and an amplifier. A small reference lamp near the photomultiplier provides a calibration signal every 40 seconds.

The sampled air then flows into the ballast chamber. Attached to this chamber are two diaphragm-type pressure transducers whose ranges are 0 to 5 mm –Hg and 0 to 100 mm –Hg. The pressure transducer outputs are processed to yield the pressure time derivative which is proportional to flow rate. A thermistor is also mounted on the chamber housing to indicate the temperature.

Magnetometers are included to indicate sonde altitude during the parachute descent.

Each sensor output is fed to a standard IRIG telemetry system using turnstile antennas.

The parachute, designed for high altitude operation, has high stability and provides a positive inflation to the canopy for high altitude deployment.

The launch vehicle is a Nike Cajun, 2-stage, solid propellant, unguided sounding rocket. The payload is despun immediately prior to sonde ejection and parachute deployment.

Notes:

1. Meteorologists may be interested in this innovation.
2. Documentation is available from:

   Clearinghouse for Federal Scientific
   and Technical Information
   Springfield, Virginia 22151
   Price $3.00
   Reference: TSP69-10077

Patent status:

No patent action is contemplated by NASA.

Source: Ernest Hilsenrath
Goddard Space Flight Center
(GSC-10580)