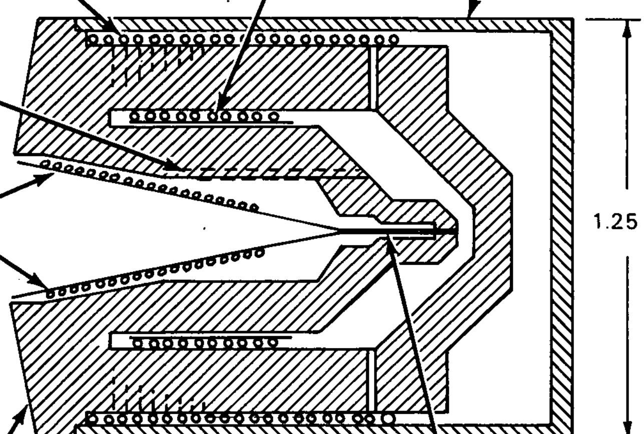
NASA TECH BRIEF

Improved Cavity-Type Absolute Total-Radiation Radiometer



An improved conical cavity-type absolute radiometer, that has been developed, is capable of measuring the intensity of radiant energy to an accuracy of 1 to 2 percent when operated in a vacuum of 10^{-5} torr or lower. The radiometer exhibits a uniform response over the ultraviolet, visible, and infrared range. Since it is an absolute radiometer, it requires no calibration or comparison with a radiation standard. To measure a radiation intensity requires only an accurate knowledge of the aperture area, the temperature of the conical cavity, and the electrical power needed to maintain the cavity at a preset constant temperature. The basic elements of this radiometer are not new. The improvements are due to refinements in design details, selection of the best materials, and the use of modern electronics.

Physical description. The measuring element of the radiometer is a receptor made by winding enameled platinum wire (1.5 mils in diameter) over the outside surface of the hollow cone. The cone is made of 0.005-inch-thick silver foil which is rolled to shape and silver-soldered at the edges. The high thermal conductivity of the silver foil minimizes thermal gradients in the cone and also ensures rapid temperature equalization after any thermal change. The platinum wire (cone resistor) serves both as a sensitive resistance thermometer and as an electrical heating element for the cone. The internal surface of the cone is coated with Parson's black lacquer or with gold or platinum black. The cavity formed by the cone (23.5 deg total angle) is estimated to act as a perfect blackbody to better than 99.5 percent for all wavelengths between 0.2 and 40 microns.

(continued overleaf)

The cone, supported by a glass fiber and glass-tipped centering screws, is surrounded by a massive copper thermal guard which is gold-plated on its inside and outside surfaces. The guard minimizes temperature gradients and radiant heat exchange with the receptor cone. Located in good thermal contact with the guard is a second platinum wire winding (guard resistor) which has the same electrical resistance as the cone resistor. The guard resistor serves as a resistance thermometer for accurate comparison of the guard and cone temperatures. A heater coil on the external surface of the guard is used to maintain the guard at a desired constant temperature. A thermocouple placed in the inner portion of the guard provides an absolute measure of guard temperature, and by means of an electronic control the guard is maintained at the desired temperature.

The electronic circuit devised for the radiometer maintains the thermal guard at a known constant preset temperature; supplies precisely enough electrical heating power to the cone (equal to the difference between the thermal energy radiated from the cone aperture and the thermal energy received by it from the radiant source to be measured); and accurately measures the electrical heating power to the cone.

Notes:

1. As presently constructed, the radiometer has a response time of approximately 2 seconds and is capable of measuring a maximum radiation intensity of approximately 0.3 watt/cm^2 (0.25 Btu/ft^2/sec), which is a little more than double solar intensity at 1 astronomical unit.
2. Inquiries concerning details of the radiometer and electronic circuitry may be directed to:
   Technology Utilization Officer
   Jet Propulsion Laboratory
   4800 Oak Grove Drive
   Pasadena, California 91103
   Reference: B67-10557

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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