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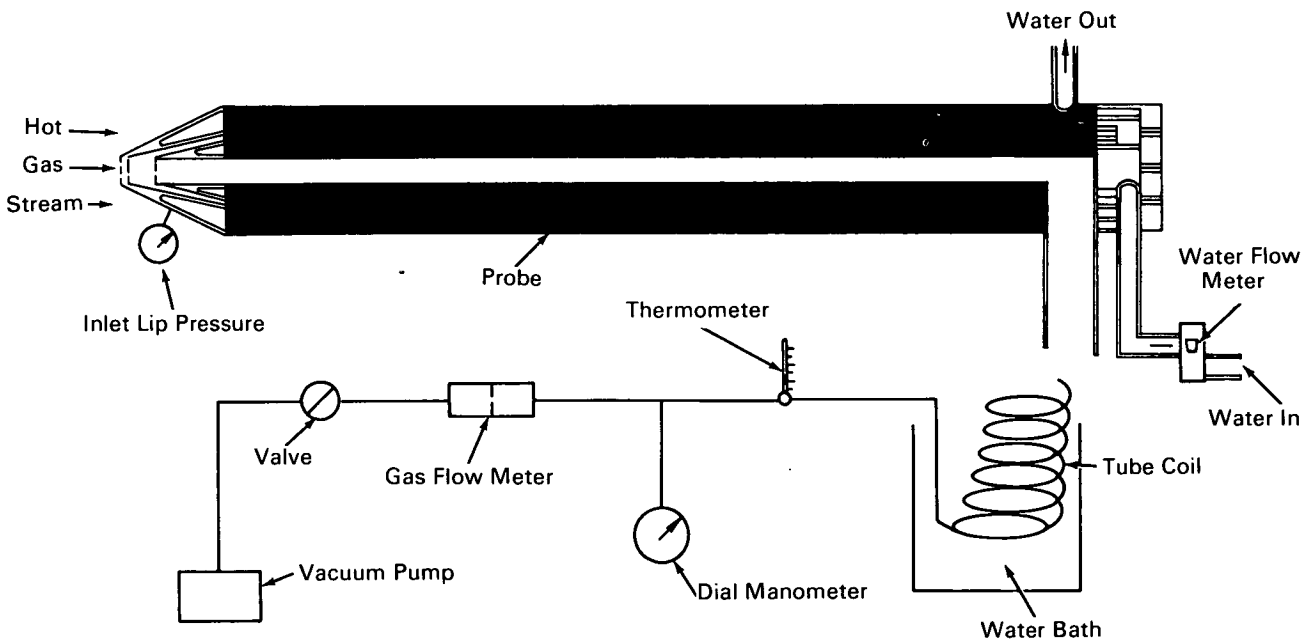
NASA TECH BRIEF

Probe Measures Characteristics of Hot Gas Stream



The problem: Measurement of the characteristics of a very hot gas stream of unknown composition. An instrument is needed that will measure mass flow density and total heat content per unit mass, total heat content per unit mass only, and pitot pressure.

The solution: A shielded, tubular flow calorimeter that is simply operated by valve position to selectively measure the desired gas stream properties.

How it's done: The probe consists of a calorimeter tube encased in a water-cooled shield. Flow of water through the device is controlled to minimize effects of external heat transfer. Water in the calorimeter tube passes along the inner face of the shield, thus reducing the temperature differential and resultant heat transfer between tube and shield. It then passes along the outer wall of the shield, cooling the surface in contact with the hot stream. Accurate measurement of the gas temperature at the probe outlet is not required as long as it is close to the water temperature because residual heat content per unit mass is usually negligible. However, gas temperature must be known accurately at the gas flowmeter, therefore the gas is passed through a coil in a water bath to bring it to a constant temperature. Pressure is measured at the flowmeter entrance by a dial manometer. A throttling valve is placed in the line following the flowmeter.

(continued overleaf)

To measure total heat content per unit mass, the probe is inserted at the desired point in the stream and the throttle valve adjusted until a suitable gas outlet temperature is reached. To measure total heat content per unit mass and local mass flow density, the probe inlet faces the stream directly and the throttle is adjusted to capture the entire mass flow ahead of the inlet. For this measurement, pressure at the inlet lip must be held equal to the free-stream pressure. To measure pitot pressure, the probe faces the stream directly and the throttling valve is fully closed.

Notes:

1. The probe should find application wherever it is desired to measure the properties of a hot process stream, such as furnace and reactor exhausts or engine exhausts.
2. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama, 35812
   Reference: B65-10133

Patent status: NASA encourages the immediate commercial use of this invention. Inquiries about obtaining rights for its commercial use may be made to NASA, Code AGP, Washington, D.C., 20546.

Source: Plasmadyne Corporation under Contract to Marshall Space Flight Center (M-FS-240)