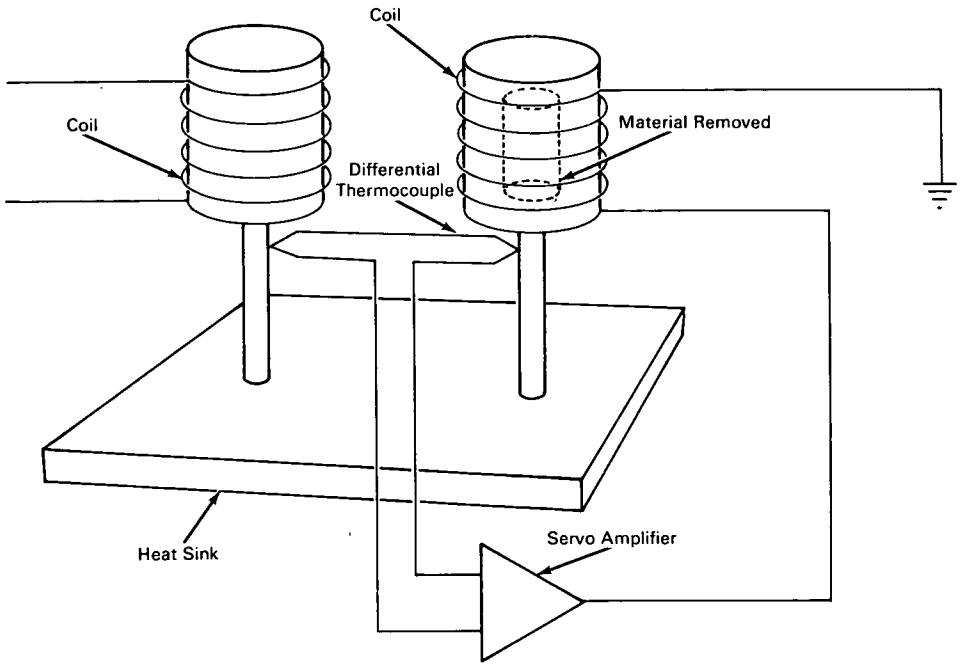
NASA TECH BRIEF

Servo Calorimeter Measures Material Heating Rate



The problem: To measure the heating rate of a material when exposed to nuclear radiation. Accurate measurements are complicated by the nonlinear behavior of the specific heat and thermal conductivity of metals with changing temperature.

The solution: A servo calorimeter in which the electrical power used is a direct measure of the nuclear heating rate.

How it's done: The material to be tested is made up into two rods of identical external dimensions mounted to a heat sink. The rod at the right of the illustration has a finite amount of material removed from it. Identical electrical resistive heating coils are wound around each rod. The coil on the left rod is not electrically connected, but is used to equalize the temperature rise of the right-hand rod due to the mass of its coil.

Upon irradiation, the right-hand rod because of its lower mass, undergoes a smaller temperature rise than the left-hand rod. A differential thermocouple senses the temperature difference between the rods and, through a servo amplifier drives the heating coil on the right-hand rod until the temperatures of the two rods are equal. The nuclear heating range of the material is equal to the servo power delivered to the coil, divided by the rod weight difference.

(continued overleaf)

Notes:

1. The measured heating rate is independent of the specific heat and thermal conductivity of the material.
2. While this method is conceptual and has not been reduced to use, it is theoretically sound.
3. Inquiries concerning this innovation may be directed to:

   Technology Utilization Officer
   AEC–NASA Space Nuclear Propulsion Office
   U.S. Atomic Energy Commission
   Washington, D.C., 20545
   Reference: B65-10247

Patent status: NASA encourages commercial use of this innovation. No patent action is contemplated.

Source: G. Gilmour and J.H. Wilson of
Westinghouse Astronuclear Laboratories
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