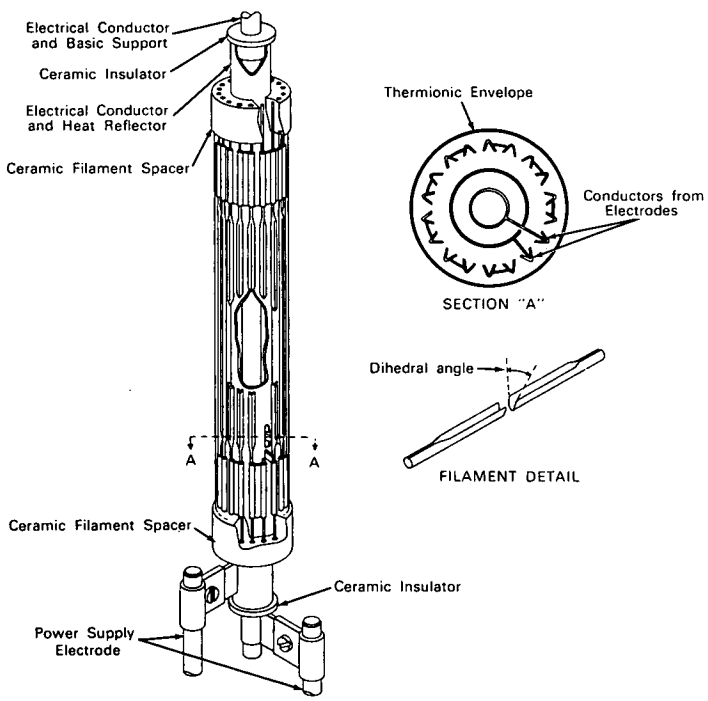
NASA TECH BRIEF

Radiant Heater for Vacuum Furnaces Offers High Structural Rigidity, Low Heat Loss



The problem: Electrical radiant furnaces are extensively used in such processes as zone refining, metal melting and purification, vapor deposition, and heat treatment. Most of the high-temperature heaters for these processes use water-cooled or insulated vacuum chambers with radiant heating elements suspended in them. The heating elements are typically formed into cylinders from sheets of refractory metals and generally operate at high currents and low voltages, use three-phase a-c power, and require water-cooled electrodes. In some instances the heating elements are arranged to provide rectangular-section heating zones. Wire-wound ceramic tubes are used for heating at lower temperatures. Problems associated with the high-temperature heaters include heat losses through the electrodes and insulation, movement and buckling of the heating elements, inadequate water cooling, undesirable thermal gradients in the water-cooled electrodes, and difficulties in supporting the heating elements and the material to be heated.

(continued overleaf)

The solution: A high-temperature heater having specially formed filaments, and several other features described below, all of which reduce the severity of the problems arising with conventional heaters.

How it's done: As shown in the illustration, the heater consists of an even number of shaped filaments of refractory metal, such as tantalum, tungsten, or molybdenum, which are supported in a cylindrical array by spacing members of a ceramic material at each end. The filaments are thin strips of the refractory metal bent to a dihedral angle for structural rigidity. To eliminate the need for stepdown transformers and large bus bars, the filaments are designed to operate with high-voltage, low-current a-c or d-c power. Other advantages of the heater are as follows: 1) The filaments are supported on ceramic spacers outside the hot zone of the heater to minimize the formation of volatile products. 2) Water cooling of the electrodes is not required. 3) Electrical insulation is required only in the cool zones of the heater. 4) The filaments are electrically connected so that the current in adjacent filaments flows in opposite directions to cancel the magnetic flux. 5) The heater structure is free to expand longitudinally as a unit, thus avoiding the development of mechanical stresses during operation.

Note:

For further information about this innovation inquiries may be directed to:

Technology Utilization Officer
Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio 44135
Reference: B63-10342

Patent status: NASA encourages the immediate commercial use of this invention. It is owned by NASA, and a patent application has been filed. When patented, royalty-free non-exclusive license for its commercial use will be available. Inquiries concerning license rights should be made to NASA Headquarters, Washington, D.C. 20546.

Source: Alex Vary
(Lewis-39)