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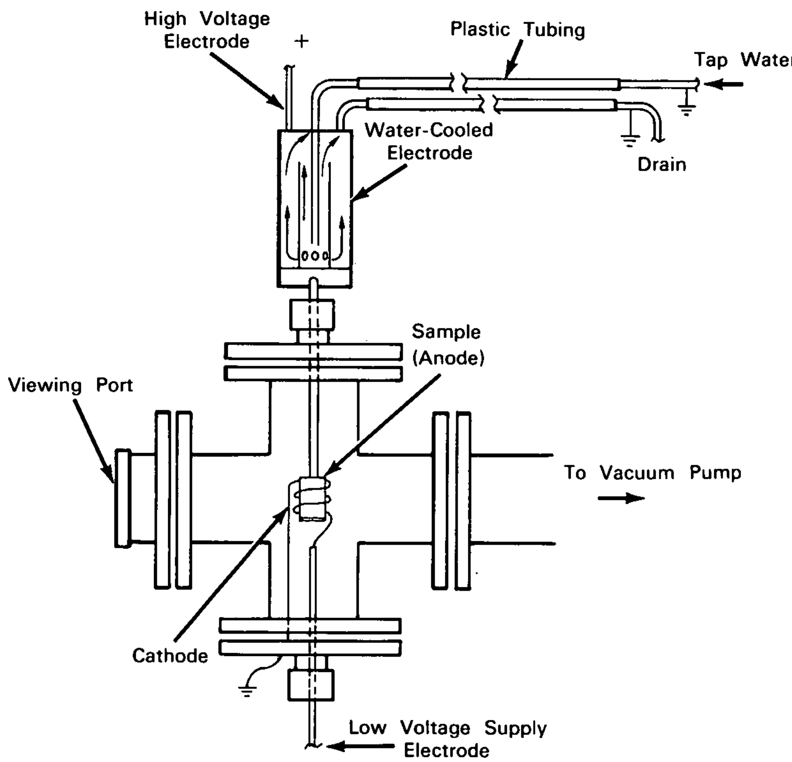
NASA TECH BRIEF

Inverted Grounding Technique for Electron Beam Heating



Conventionally, in the production of high temperatures by electron bombardment the anode is held at ground potential while the hot cathode is raised to a high negative potential. This practice is employed primarily to eliminate cold cathode discharge around grounded surfaces inside the vacuum chamber. It also provides a convenient means of heat-sinking the anode supporting structure through conduction directly to the normally massive chamber walls.

There is a distinct advantage to be realized, however, if the cathode can instead be grounded. In an all-metal chamber, the electron beam from a grounded cathode is effectively focused electrostatically by the chamber walls. In the conventional arrangement, an additional element is required to contain the beam. This element ordinarily encloses both the cathode and anode, and is electrically connected to the highly negative cathode. The elimination of this shielding allows a substantial reduction in the size of the vacuum chamber, since the allowance of sufficient space between the chamber walls and internal members at cathode potential to prevent electrical breakdown is

(continued overleaf)

no longer a factor. In addition, its elimination removes a potential source of contamination in the vacuum system. This is particularly important in the annealing of high purity refractory metals near their melting points in vacua in excess of 10^{-8} torr. The high vacua required in these applications to attain acceptable impurity levels within the chamber makes possible the operation of a grounded cathode system without an attendant cold cathode discharge.

Shown in the accompanying figure is an annealing chamber using the inverted grounding. It is constructed around a commercially available stainless steel "cross." Single insulated-electrode high-temperature flanges provide the necessary electrical feed-throughs: one to the sample holder anode, the other to one side of the wire cathode. The cathode return is made by connection directly to the grounded flange. Heat conducted along the sample holder is satisfactorily removed at the flange by a water cooled electrode attachment. The length of the plastic lines carrying the cooling water is dictated by the conductivity of the locally available water and by the cross-sectional area of the tubing so as to keep the leakage currents through the water within tolerable limits.

Such a system is successfully being employed in the annealing of high purity single crystals of niobium and similar metals.

Notes:

1. No additional documentation is available for this invention.
2. Technical questions concerning this invention may be directed to:

   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B68-10411

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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