

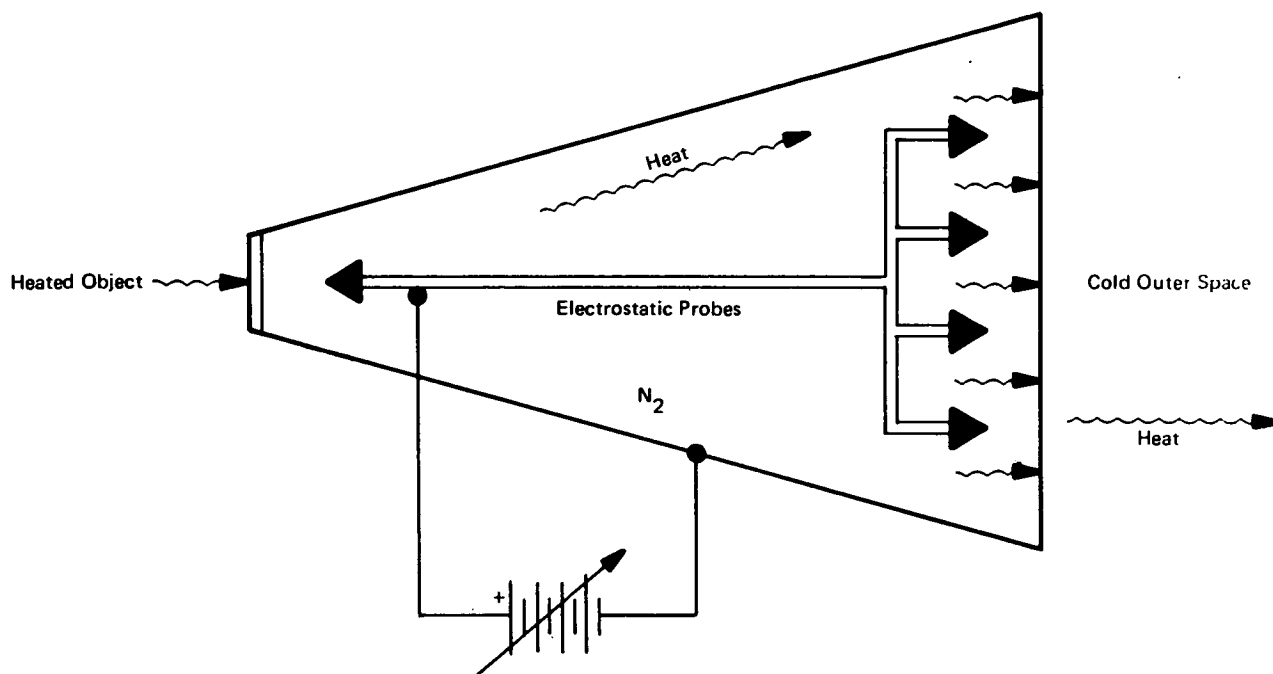
# NASA TECH BRIEF

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## Electrostatically Controlled Heat Shutter



Electrostatically Controlled Heat Shutter

### The problem:

A number of components used in spacecraft generate heat and require some form of cooling. The only cooling methods available, however, are by conduction and radiation. Unfortunately conduction and radiation cooling are relatively inefficient: conduction is impaired by the thermal resistance of the materials used, and the low radiating temperatures generated by these components are inadequate for effective cooling by radiation.

### The solution:

An electrically controlled chamber filled with inert gas efficiently removes heat from the heat-generating components.

### How it's done:

The cooling device, as shown in the figure, consists of a chamber filled to a pressure of 1 atmosphere with  $N_2$ , Ar, or other ionizable gas. The device encloses electrostatic probes which are electrically connected and face the opposite ends of the chamber. The chamber ends are made of a good thermal conductor such as copper; the walls are made of a poorer thermal conductor such as stainless steel. One chamber end, the hot plate, is in direct contact with the heat-generating component, and the other, the cold plate, is in direct contact with the cold environment.

When high voltage is applied between the chamber case and the electrostatic probes, the neutral gas

(continued overleaf)

molecules ionize around the probe near the hot plate and form an ionic wind. All of the ions near the hot plate are electrostatically attracted to it, to become neutral and absorb heat energy from the plate. These hot neutral gas atoms are then moved to the vicinity of the cold plate by the ionic wind. There the atoms are ionized again and attracted to the cold plate where they release the heat energy they carry from the hot plate. The ionic wind then moves the cooled atoms back toward the hot plate.

Since the ionic wind intensity is directly proportional to the voltage applied to the electrostatic probes, the rate of heat removal is controlled by varying this voltage. The system can be reversed to bring heat from an external source to a component.

**Note:**

Requests for further information may be directed to:  
Technology Utilization Officer  
NASA Pasadena Office  
4800 Oak Grove Drive  
Pasadena, California 91103  
Reference: B74-10161

**Patent status:**

This invention has been patented by NASA (U.S. Patent No. 3,763,928). Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to:

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