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Brief 70-10499

NASA TECH BRIEF

Thermionic Triode Generates AC Power

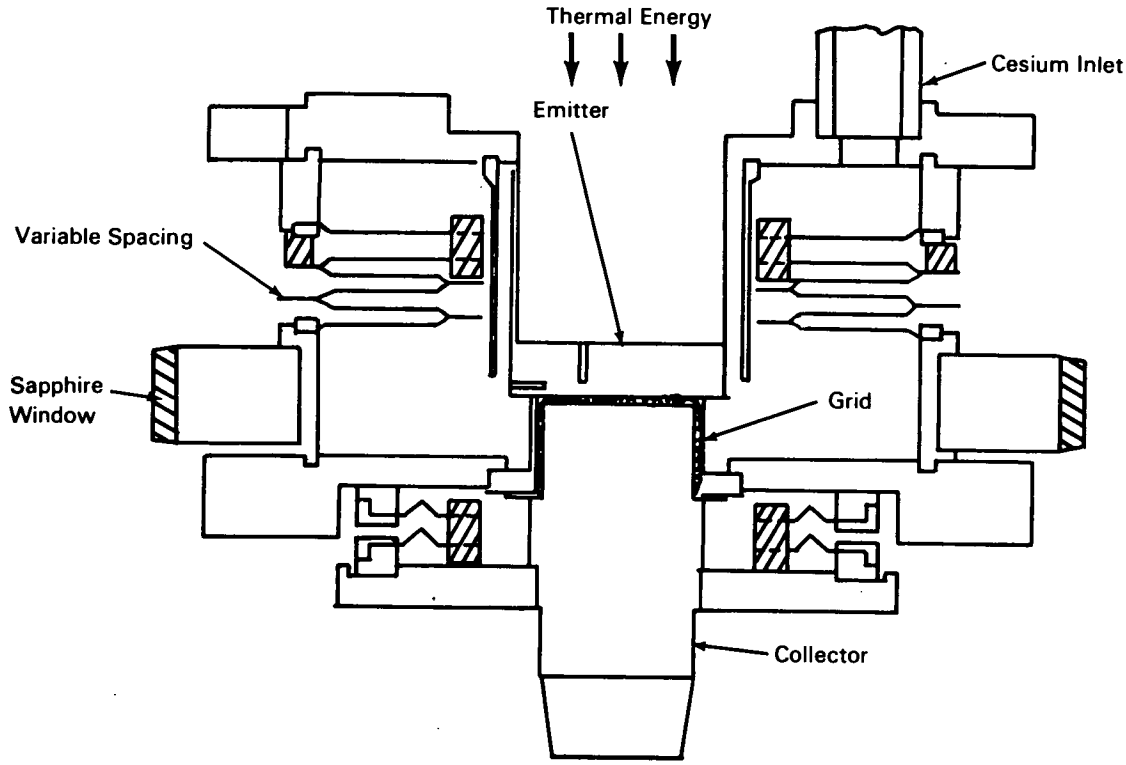

Figure 1. Experimental Cesium Thermionic Triode

The problem:

Thermionic diodes are used to convert the energy from solar and nuclear sources to electrical power. However, low dc output voltages generated by the diodes (0.3 to 0.6 volts) need to be increased and converted to ac voltages for many practical applications. The eletronic circuit which converts low dc power to high ac power reduces the overall efficiency of the energy conversion process.

The solution:

Perform the dc-to-ac conversion within the thermionic device by means of an electrostatic grid that controls the conduction cycle of the diode.

How it's done:

The thermionic diode operates by emitting electrons from a cathode surface, which is heated by the external energy source, and then condensing them on a collector. The net result is the generation of electrical

(continued overleaf)

power at an output voltage of 0.3 to 0.6 volts dc. Cesium vapor, introduced into the cathode region, decreases the internal resistance and forms a thin film on the cathode which readily emits electrons. The control grid of the new thermionic triode shown in Figure 1

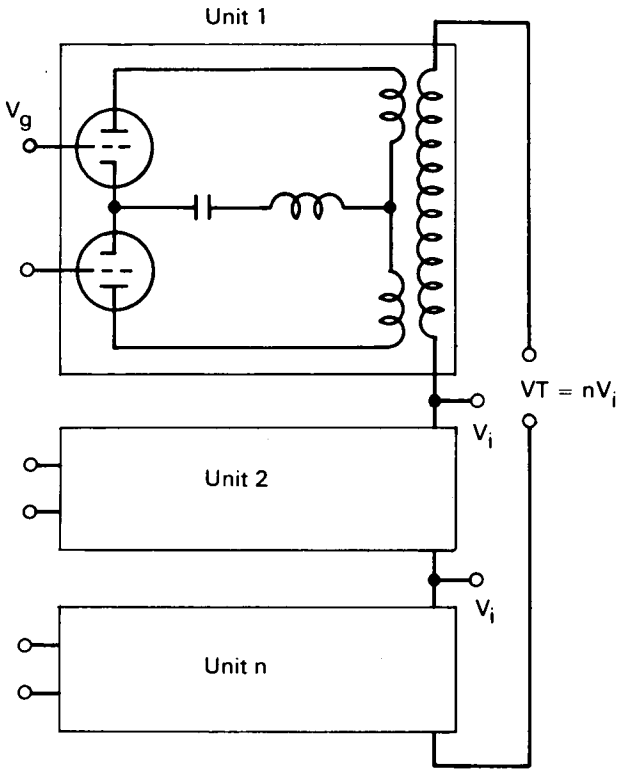

Figure 2. Frequency Modulated Series Inverted Circuit

is mounted between the cathode and collector. The grid is maintained at a relatively low temperature by means of a ceramic layer which has high thermal conductance and high electrical insulation properties. An ac voltage (V_g) applied to the grid controls the conduction cycle between the cathode and collector, to produce an ac output.

A high power thermionic system can be constructed from individual units by series-connecting the secondary circuits of each triode in the manner shown in Figure 2. The proper phase relationship can be maintained in the secondary by synchronizing the grid ignition voltage of each unit. The total output voltage (power) in the secondary is the sum of the voltages in each unit.

In summary: The thermionic triode ac generator directly converts heat into high voltage electrical power. The entire energy conversion system has no moving parts which can wear out. There are no switching elements, other than the thermionic elements in the primary circuit. The problems of low output voltage inherent in thermionic conversion devices and the undesirable power losses in the solid state converters have been eliminated.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
Headquarters
National Aeronautics
and Space Administration
Washington, D.C. 20546
Reference: TSP70-10499

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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