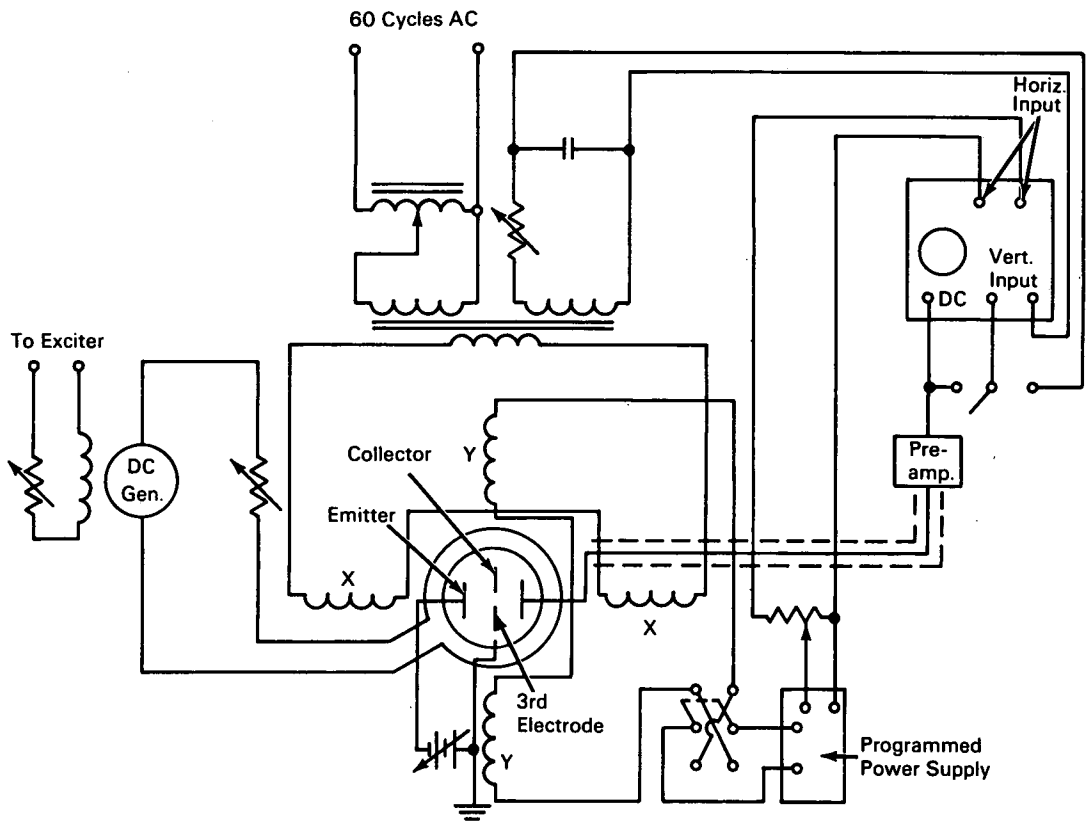
October 1966

Brief 66-10444

NASA TECH BRIEF

Thermionic Scanner Pinpoints Work Function of Emitter Surfaces



The problem:

In the testing of electron tubes such as phototubes, the metallic surface work functions of emitters are normally measured by mean values over relatively large surfaces. It would be advantageous to manufacturers to be able to make accurate spatial resolution measurements to determine local departures from the mean value.

The solution:

A thermionic scanner that uses variable magnetic fields, to sample thermionic emission in a selective manner, to determine the work function of emitter surfaces on a point-by-point basis for display on an oscilloscope.

How it's done:

The thermionic scanning system uses a set of field

(continued overleaf)

coils for collimation and controlled deflection of the magnetic field in the emitter-collector interspace. The collimating field coil surrounds the entire thermionic scanner casing while two pairs of coils are arranged in the X- and Y-axes to obtain the scanning. The X-axis coils are series connected to provide the X-deflection of the electrons and the Y-coils are series connected to obtain the Y-deflection. The Y-coils are operated at a low frequency (1 or 2 cycles per minute) while the X-coils are operated at 60 cps. Combination of the two motions generates a two-dimensional scan of the emitter surface past the aperture in the collector. Constant current for the collimating coil is supplied by a dc generator while the X-deflection coils are powered by a stepdown transformer off the 60 cps ac main. The Y-deflection current is obtained from a low-voltage, high-current regulated dc supply programmed by a sawtooth voltage from the display oscilloscope. Because this is a dc supply, only 1/2 of the emitter surface may be scanned before reversing the deflection coil connections. A field of intensity of about 200 gauss can be obtained from the deflection coils. Vertical deflection is obtained through a phase shifting circuit from an extra winding on the X-scanning transformer, while horizontal deflection is obtained directly from the time base. A negative-going sawtooth from the horizontal output terminal is used to drive the Y-deflection power supply. At this low scanning frequency, no phase problem exists.

Notes:

1. At the low scanning frequencies used, direct visual observation is very difficult and photographic techniques must be used. A film with a good range of grays must be employed to make apparent the variations in the output waveform.
2. Inquiries concerning this innovation may be directed to:

   Technology Utilization Officer
   Jet Propulsion Laboratory
   4800 Oak Grove Drive
   Pasadena, California 91103
   Reference: B66-10444

Patent status:

No patent action is contemplated by NASA.

Source: Ned S. Rasor
of Thermo Electron Engineering Corp.
under contract to
Jet Propulsion Laboratory
(JPL-SC-177)