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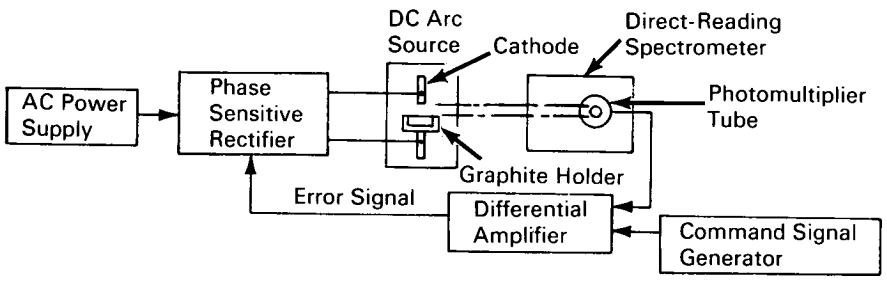
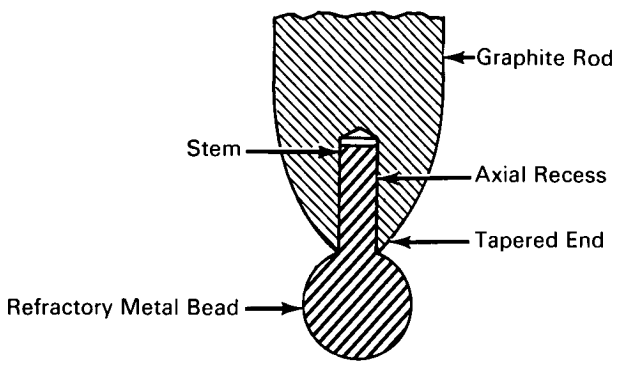
Brief 67-10404

NASA TECH BRIEF

Control Apparatus for Spectral Energy Source



CONTROL SYSTEM



CATHODE ELECTRODE

The problem:

To devise a method for controlling the energy source of an emission spectrograph or spectrometer, particularly the dc arc source which excites the sample material. A dc arc source is extremely sensitive, but no satisfactory method has been found to precisely control its output energy. Uncontrolled arcs are subject to large relative errors which severely restrict the precision with which trace analyses can be made. Analytical spectroscopists use other sources to achieve high precision and thereby sacrifice sensitivity.

The solution:

An automatic, light-controlling system for dc arc emission spectrographs, which controls the vaporization rate of the sample, and also stabilizes the dc arc. The output energy is regulated such that advantage can be taken of the highly sensitive dc arc source, without sacrificing the desired precision.

(continued overleaf)

The vaporization rate of the sample, and therefore, the output energy of the dc arc source, are controlled in accordance with a programmed signal—either a constant or a time-dependent command signal. The output energy of the dc arc source is compared with a programmed command signal and the difference between them produces an error signal. This signal regulates the dc current supply to the arc source, such that the output energy is in accordance with the programmed command signal.

The system also stabilizes the arc of the dc arc source by means of a cathode structure having a refractory metal tip. This produces a steady, rather than flickering, source of light.

How it's done:

The control system consists of a dc arc source associated with a direct reading spectrometer. The arc source includes a cathode and an anode having a graphite holder which contains the sample material. To produce an arc between the anode and cathode, these electrodes are connected to a phase sensitive rectifier, energized from an ac power supply.

A photomultiplier tube senses the light output of a selected spectral line of the arc source and supplies an electrical signal through a line to a differential amplifier. The signal is proportional to the light energy of the arc. The photomultiplier tube signal is compared by the differential amplifier with the output from a command signal generator. The difference produces an error signal which is fed to the phase sensitive rectifier to control the rectifier's output magnitude. The error signal increases or decreases the rectifier output to control the vaporization rate of the sample material.

The cathode electrode is a graphite rod having a tapered end. An axial recess, drilled into the tapered end of the rod, receives the stem of a refractory metal bead. This bead enables a stable arc discharge to be maintained.

Notes:

1. Although this apparatus was designed for analysis of trace constituents in a sample by emission spectroscopy, it also can be used for determining major constituents of a sample.
2. This apparatus can be used in mass spectrometry and atomic absorption spectroscopy and in any application in which a constant or time-dependent energy output is required.
3. Inquiries concerning this innovation may be directed to:

   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B67-10404

Patent status:

This invention is owned by NASA and a patent application has been filed. Royalty-free, nonexclusive licenses for its commercial use will be granted by NASA. Inquiries concerning license rights should be made to NASA, Code GP, Washington, D.C. 20546.

Source: William A. Gordon
(Lewis-391)