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AECD-4077

CLINTON ENGINEER WORKS
Tennessee Eastment Corporation
A DIRECT CURRENT EMISSION REGULATOR

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August 4, 1946

Introduction

In the course of some experimental work in which the collector plate of a Nier mass spectrometer tube was coupled through a 100% voltage feedback DC amplifier and high voltage gain AC amplifier to the vertical deflection plates of an oscilloscope, it was observed that the ion beam was modulated with phase distorted sixty cycle alternating current. This experiment was performed on an instrument using a standard alternating filament current emission regulator unit, the magnet supply unit described in report CD-Chem-S-572, and the high current voltage supply unit described in report S-5-460.1. The modulation, which appears to be wholly amplitude in character and not the result of ion beam position shift, represents 10% to 25% of the total beam intensity. The contour of the wave form may be varied by varying the emission current setting. Examination of the magnetic field, accelerating voltage potentials, and case and trap potentials revealed no alternating current variance that would explain the beam modulation. When the emission regulator unit was replaced with a battery filament current supply all traces of beam modulation disappeared.

The direct current emission regulator unit described is designed to replace the standard alternating current unit. It embodies all the essential features of the standard unit and enables the filament to be operated on direct current containing not more than 3% AC ripple. No beam modulation is apparent when using this regulator as a replacement for the standard unit.

Initially it was felt that an ion beam modulation of high amplitude intensity might be accompanied by slight beam position variation with consequent loss of ion peak resolving power. Subsequent experiments in which alternating and direct current regulators have been interchanged without affecting instrument resolution now indicate that no resolution improvement may be expected in replacing the alternating current filament supply with the direct current supply. The direct current supply is essential for oscilloscope examination of beam contour.

The Direct Current Regulator

Figure 1 contains a schematic circuit diagram of the direct current regulator units. The essential regulation circuit of the standard unit has been preserved. It is necessary to supply a higher filament

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voltage than provided in the 5-volt winding of Thordarson transformer T15R13 in order to compensate for the voltage drop in the rectifier and filter choke. This is accomplished by introducing a 7.5 volt filament transformer with primary winding in series with the primary load resistance R_1R_2 . The dropout relay circuit, standard in this laboratory, which prevents re-energizing of the filament before the regulator tubes have warmed after a line current interruption, has been incorporated in the 115 volt circuits. The selenium rectifier unit is a Fansteel PG30M. The high current filter section consists in a choke input L section using a Gardner 10 mh. 10 ampere choke and two 4000 mfd. 12 volt condensers. The 6SJ7 regulator has been replaced with a 6AC7 with appropriate increase in plate current and reduction in plate resistance.

The introduction of the long time constant choke condenser network resulted in the familiar "hunting" phenomenon. Oscillations appeared at about five cycles per second. This tendency has been suppressed by introducing a measure of low frequency degeneration. Case and trap potential surges are made to appear directly on the grid of the regulator through the 40 mfd. by pass condensers C_1 and C_2 . The 0.05 mfd. condenser C_3 prevents 60 cycle supply ripple from appearing in the regulated current. Increasing C_3 obviously results in a return of the "hunting" phenomenon. When properly adjusted the regulator will stabilize the filament current through a 30-volt range of AC line voltage variation. At the extremes of this regulating range the "hunting" phenomenon appears. The regulation of filament current is sufficient for precise assay work.

Summary

1. Alternating current beam modulation has been traced to the standard emission regulator units. This modulation appears as a result of alternating current energization of the spectrometer tube filament.
2. The modulation appears to be amplitude in character and not the result of beam position shift. Removal of the modulation does not result in improved ion peak resolving power.
3. A direct current emission regulator unit is described. This unit is designed to replace the standard regulator and to achieve an ion beam free from amplitude modulation.

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