DIRECT CURRENT POWER SUPPLY FOR AH-6 MERCURY ARCS*

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In the photochemical determination of absolute radical reaction rates by the rotating sector method (1), it is sometimes necessary to use an ultraviolet source of high intensity. The source must be capable of producing a beam small enough to be cleanly chopped. In addition, it should operate on direct current, so that the only time intermittency is that produced by the sector.

The General Electric AH-6 mercury arc, designed to operate on alternating current, combines the desired features of small source size and high intensity (1000 w. output). This note describes a direct current supply and controls which enable us to operate the AH-6 on direct current (Fig. 1).

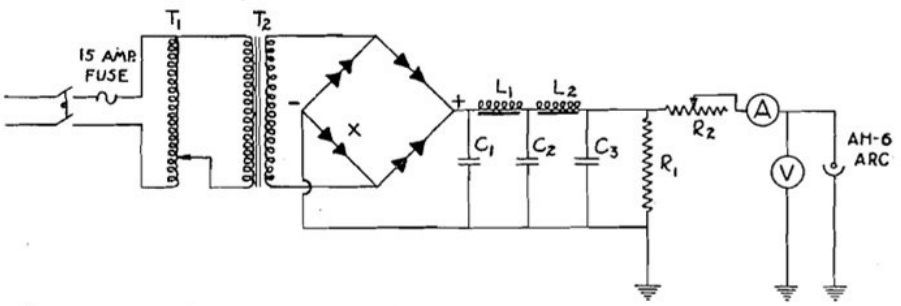

FIG. 1. Wiring diagram of power supply.
T_1—10 amp. Variac
T_2—59 G37 General Electric transformer
L_1, L_2—7 h., 1.5 amp. d-c.
C_1, C_2, C_3—8 μf., 1500 DCWV.
X—Selenium rectifiers, Federal Telephone and Radio Corp. 131H24AX1.
R_1—50000 Ω, 150 w.
R_2—500 Ω, 100 w. rheostat.

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The 110 v. alternating mains current, controlled by a 10 amp. Variac, is transformed by a General Electric 1200 v. ballast transformer. Rectification is accomplished by eight selenium rectifiers in a bridge circuit, with two stacks in series in each arm of the bridge. The direct current is filtered by three condensers, two choke coils, and a bleeder resistance. The lamp circuit contains a current limiting rheostat and ammeter in series, and an electrostatic voltmeter in parallel with the lamp.

The lamp is mounted in a quartz envelope, through which precooled distilled water is circulated. The envelope in turn is surrounded by a water-cooled brass jacket containing a 3 cm. by 0.5 cm. slit. The distilled water supply, brass jacket, negative electrode of the lamp, and power supply chassis are all grounded.

In operation, with R_2 full in, the Variac is turned up to give a static voltage of about 750 v. across the lamp. The arc is then struck by holding a Tesla coil to the brass jacket, after which the Variac is turned up to deliver full mains voltage and R_2 adjusted to give about 1.5 amp. through the lamp. A new lamp will heat up after about thirty seconds. As the intensity suddenly increases, R_2 must be rapidly taken out of the circuit and the Variac set so as to deliver about 100 v. Under these conditions the voltage drop across the lamp is 600 v., the current 1.0 to 1.2 amp.

The light intensity has been measured only with respect to the photolysis of di-*n*-propyl ketone. In this case it is great enough to fulfill the requirements of the rotating sector method. Individual lamps vary markedly in their aging characteristics, although in general the intensity decreases somewhat with operating time, as measured by the rates of production of carbon monoxide and ethylene (2). Although not visible to the eye, a film becomes deposited on the lamp and quartz envelope after several hours. This is thought to be iron oxide which probably originates from a ferrous component in the assembly used for mounting the lamp. Wiping the lamp with lens tissue moistened with dilute acetic acid removes the deposit and raises the output intensity.

With some lamps the current required for the initial heating increased with operating time. With the present power supply, this effectively determined the useful lifetime of this type of lamp (10 hr. was the maximum) since 1.6 amp. is about the largest current that can be drawn. On the other hand, the lamp now in use has run for a total of 16 hr., with about thirty starts and stops, and shows no sign of deterioration.

1. KISTIAKOWSKY, G. B. and ROBERTS, E. K. J. Chem. Phys. 21: 1637. 1953.
2. MASSON, C. R. J. Am. Chem. Soc. 74: 4731. 1952.

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