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Linear Time Base Using OA4G Tube

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Citation: Review of Scientific Instruments **19**, 821 (1948); doi: 10.1063/1.1741174
View online: http://dx.doi.org/10.1063/1.1741174
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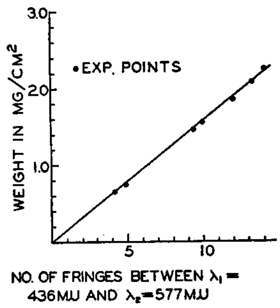

FIG. 2.

continuous spectrum is crossed by interference fringes and the number of these, between the yellow line (577mμ) and the blue line (436mμ) of mercury is counted. This comparison mercury spectrum is obtained from an ordinary white fluorescent light. Figure 1 is a photograph taken through the direct vision spectroscope showing the interference fringes of 1.56 mg/cm² mica together with the comparison spectrum. Figure 2 is a plot of the number of interference fringes *versus* the weight of the mica in mg/cm². The curve is calculated from the formula

$$W=\left[\frac{\rho\lambda_1\lambda_2 10^{-4}}{2\mu\cos r(\lambda_1-\lambda_2)}\right]n\frac{\text{mg}}{\text{cm}^2}=0.163n\frac{\text{mg}}{\text{cm}^2},$$

where W is the weight in mg/cm², ρ is the measured density of mica—2.85 grams/cm³, μ is the index of refraction—1.58, r is the angle of incidence, λ_1 and λ_2 are 577 and 436 millimicrons, respectively, and n is the number of fringes. The experimental points were obtained by weighing the mica, measuring the area, and computing the weight in mg/cm².

This is the only method we know by which one can measure the thickness of windows on tubes already assembled. It is quick, easy, and accurate enough to serve the needs for Geiger tube work.

[1] R. W. Wood, *Physical Optics*, 3rd ed., p. 192.

A Simple Recording System for Small Currents*

G. W. MONK**
Carbide and Carbon Chemicals Corporation, Oak Ridge, Tennessee
September 1, 1948

MOST commercially available recorders do not lend themselves readily to the recording of small ion currents of the order of 10^{-13} ampere because of their low input impedance. Several circuits have been given in the literature which combine high impedance d.c. amplifiers, or vibrating reed electrometers, with such low impedance recorders, but the circuit described here is much simpler and perfectly reliable for recording small currents where a slight zero drift in a few hours is not important. It is especially suitable for recording receiver current in mass spectrometers, and it has been used successfully with a 9-cm trochoidal mass spectrometer and with a Nier-type mass spectrometer.

A Brown "Electronik" strip recording potentiometer, giving full-scale reading for 10-mv input, will work successfully from an impedance of 10,000 ohms if the damping condenser and resistor are removed. In recent models it is also necessary to remove a 0.1-megohm resistor between ground and grid of the first amplifier tube. The circuit shown in Fig. 1 has been used with recorders having both 2.5 and 5 inches per second pen travel rates. The voltage gain of the circuit is about 0.25, so that the recorder deflects full scale (10 mv) when a current of 4×10^{-12} ampere flows through the 10^{10}-ohm input resistor. The zero drift is entirely negligible for a period of an hour or more if the temperature remains fairly constant. Measurements have shown the output to be proportional to the input throughout the scale, and it should be linear over a much wider range. The VX41 electrometer tube should, of course, be shielded and placed as close as possible to the current source to decrease the input capacitance. The speed of response in most applications has been limited by the writing speed of the recorder.

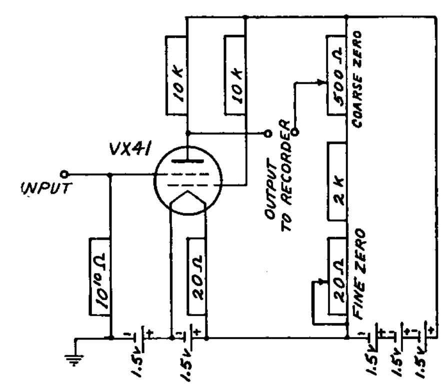

FIG. 1. Circuit diagram of the recorder for use with the Brown Instrument Company's "Electronik" recorder.

The balancing voltage from the slide wire of the "Electronik" recorder can be put back into the grid circuit to provide a true null-type recorder, but oscillations may be objectionable if the time constant of the collector system and resistor is large, unless satisfactory antihunt devices can be used. Such a null system has been used successfully where the collector capacity was low, and it improved the linearity but not the zero drift or speed of response.

* This document is based on work performed during 1947 under Contract W-7405-Eng-26 for the Atomic Energy Commission by Carbide and Carbon Chemicals Corporation, at Oak Ridge, Tennessee, and approved for release August 16, 1948.
** Now at Camp Detrick, Frederick, Maryland.

Linear Time Base Using OA4G Tube

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August 2, 1948

THIS note describes a linear time base which utilizes an OA4G cold cathode control tube in place of the

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usual thyratron (884 or 885). The OA4G offers practically all the advantages of a thyratron. It does not require the shielded and insulated heater transformer which a thyratron would require in the same circuit. The diagram and the wave form of voltage generated by the circuit is given in Figs. 1 and 2.

The pentode T draws a constant current, and thereby produces a constant rate of change of voltage, of the point K across the condenser C. This is taken out through the condenser C' for deflection of the light spot of the cathode-

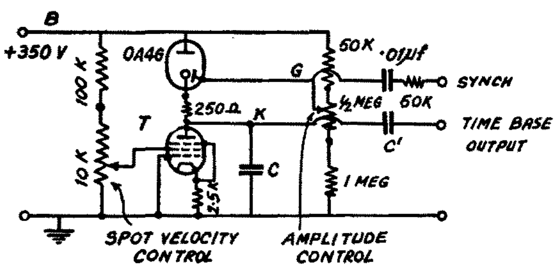

FIG. 1.

ray tube. The rate of change of voltage being constant, the spot velocity is constant, and this produces a uniform time axis. The magnitude of current taken by the tube, T, may be controlled by the 10,000-Ω-potentiometer varying the screen voltage. This, therefore, forms the spot velocity control.

When, because of the continued drain of electricity from the condenser C, the voltage at the cathode (point K) of the OA4G tube falls below the grid voltage G by about 80 volts, the OA4G tube fires and brings back the voltage at the point K to 60–80 volts below the anode supply voltage. Thereafter the cycle repeats.

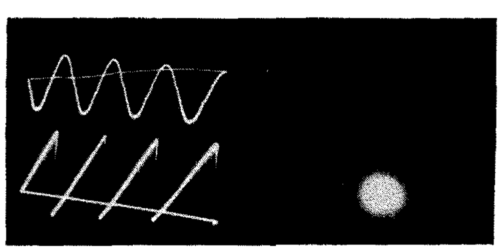

FIG. 2.

The voltage at the point K therefore fluctuates from (B-60) volts to (G-80) volts linearly. The amplitude of this may be controlled by the $\frac{1}{2}$-meg. potentiometer, as this sets the value of G.

The synchronizing voltage is impressed on the grid of the OA4G tube and produces forced synchronization by fixing the firing time of the OA4G tube with the synchronizing signal.

The condensers C, C' are of equal value—0.05μf for the range of 20–100 c.p.s. The tube T may be a 6AC7, 6SJ7, or 6SK7. The 2500-Ω-cathode resistor minimizes the warming up drift of the repetition frequency.

A time base output of 150 volts is easy to obtain.

Because of the rather larger de-ionization time of the OA4G tube, the system is not suitable for repetition frequencies greater than 1000 c.p.s. Further, the OA4G tube requires a considerably stronger synchronizing signal. The OA4G tube produces a shorter flyback time compared to 885 thyratron, as it is capable of a much higher peak current.

The system does not require a well filtered B supply.

It is hoped that the device will be useful in a nuclear physics laboratory for visual monitoring of counter pulses in a cathode-ray tube.

A Process for the Electroforming of Nozzles*

JOHN W. ANDERSEN
Naval Research Laboratory, University of Wisconsin, Madison, Wisconsin
September 24, 1948

A RAPID and accurate method for producing nozzles with specialized inside contours is herein described. The process was developed in response to a need for the production of a constant velocity profile nozzle[1] for use in Bunsen flame speed measurements and other research purposes. In order to circumvent the difficulties of machining a complex internal surface and to improve the flow conditions of secondary air external to the nozzle, an electroforming technique has been developed. The essential steps in the method are:

1. Design of forming tool and contour.
2. Formation of beeswax core.
3. Turning the beeswax core down with the forming tool and application of graphite.
4. Electroplating and cutting lose the finished nozzle.

The accompanying photograph illustrates three stages of the process. This nozzle has a 2.000-inch inlet diameter and a 0.500-inch exit diameter.

1. *Design of forming tool and contour.* The forming tool may be conveniently made by a photographic engraving technique. The form of the desired cutting edge is laid out to an enlarged scale on Bristol board and carefully inked in. A copper etching of the proper size reduction is made by a commercial photo-engraver and the cutting edge dressed. A mount for the tool to fit in the tool post of a lathe is attached.

2. *Formation of the beeswax core.* A wood form somewhat undersized is forced onto a rod with centers at each end and beeswax (U.S.P. No. 1, bleached) is applied by dipping. The beeswax deposit must be built up slowly, care being taken so that adherence between successive layers is obtained and also that heat is removed to reduce the danger of cracking upon cooling.

3. *Turning the beeswax core down with the forming tool and application of graphite.* The beeswax core is turned down in just a few minutes on a lathe. Application of graphite must be done very carefully to make certain that electrical contact with the central rod is made and that corners are well covered.

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