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Instrumentation
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A COUNT RATE CIRCUIT WITH A GROUNDED OUTPUT

by

L. Cathey
Instrument Development Division

August 1954

E. I. du Pont de Nemours & Co.
Explosives Department — Atomic Energy Division
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ABSTRACT

A count rate meter is described with full scale ranges of 10, 100, and 1,000 counts per second. The output of the count rate circuit has one side grounded so that it can be used with a servo-recorder. Response times of 10 milliseconds to 100 seconds are possible.

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A COUNT RATE CIRCUIT WITH A GROUNDED OUTPUT

INTRODUCTION

In commercially available count rate meters, the voltage or current that is proportional to the count rate is commonly presented to the output terminals of the instrument about 100 volts above ground potential. Since the signal is usually small, leakage to ground in the measurement apparatus used with the count rate circuit gives a large error signal. One method to eliminate the trouble is to use components that have very low leakage, such as a panel meter, for the measuring apparatus.

It is necessary at times to operate a servo computer on the currents from count rate meters. In servo work, the current is usually converted to A.C. by means of a chopper and transformer. These two components of a servo amplifier are not usually available in low leakage forms. In particular, the servo systems in commercial electronic recorders show significant leakage when the input is 100 volts above ground.

The present work was undertaken to develop a count rate meter that would put out small current or voltage signals with one output side grounded so that it could operate a servo mechanism.

SUMMARY

A count rate circuit with one side grounded was developed. It has three ranges: 10 counts per second, 100 counts per second, and 1000 counts per second full scale. The time constant is variable from 10 milliseconds to 100 seconds. The output signal may be a current up to 100 microamperes or a voltage up to 100 millivolts for full scale on any of the three ranges. About 80 of the count rate circuits were built and operated satisfactorily for many months.

DISCUSSION

For use in a count rate circuit, the input pulses to be counted must be reshaped and made uniform in size and shape. The uniform pulses are then added in an integration circuit. The state of the integration circuit is sampled by a detector which gives a measure of the total number of pulses currently added in the integration circuit. The sampled current or voltage is thus proportional to the count rate averaged over the integration time of the integrator.(1)

The count rate circuit is shown on page 9. It contains two dual triodes--a 6J6 and a 12AU7. The 6J6 is connected as a univibrator which serves as a pulse shaper and discriminator. The length of the univibrator pulse is determined by the RC time constants selected by the "Coarse Count Rate" control switch and the "Fine Count Rate" control potentiometer.

The first half of the 12AU7 is a limiting amplifier. In this amplifier, the height of the univibrator pulse is made uniform since the tube is driven to cut-off by the output pulse of the univibrator.

The second half of the 12AU7 is a limiting cathode follower that drives the two integration condensers. For a set count rate input, the charge "pumped" into the integration condensers is proportional to the length of the univibrator pulse which is, in turn, proportional to the settings of the "Coarse Count Rate" and "Fine Count Rate" controls. The integration time constant of the count rate meter is determined by the value of the integration condensers and the resistance of the measuring resistors. With the 250-ohm load resistance shown in the circuit diagram, the time constant for "Response Time" #1 is 1.5 seconds; for "Response Time" #2, it is 3 seconds.

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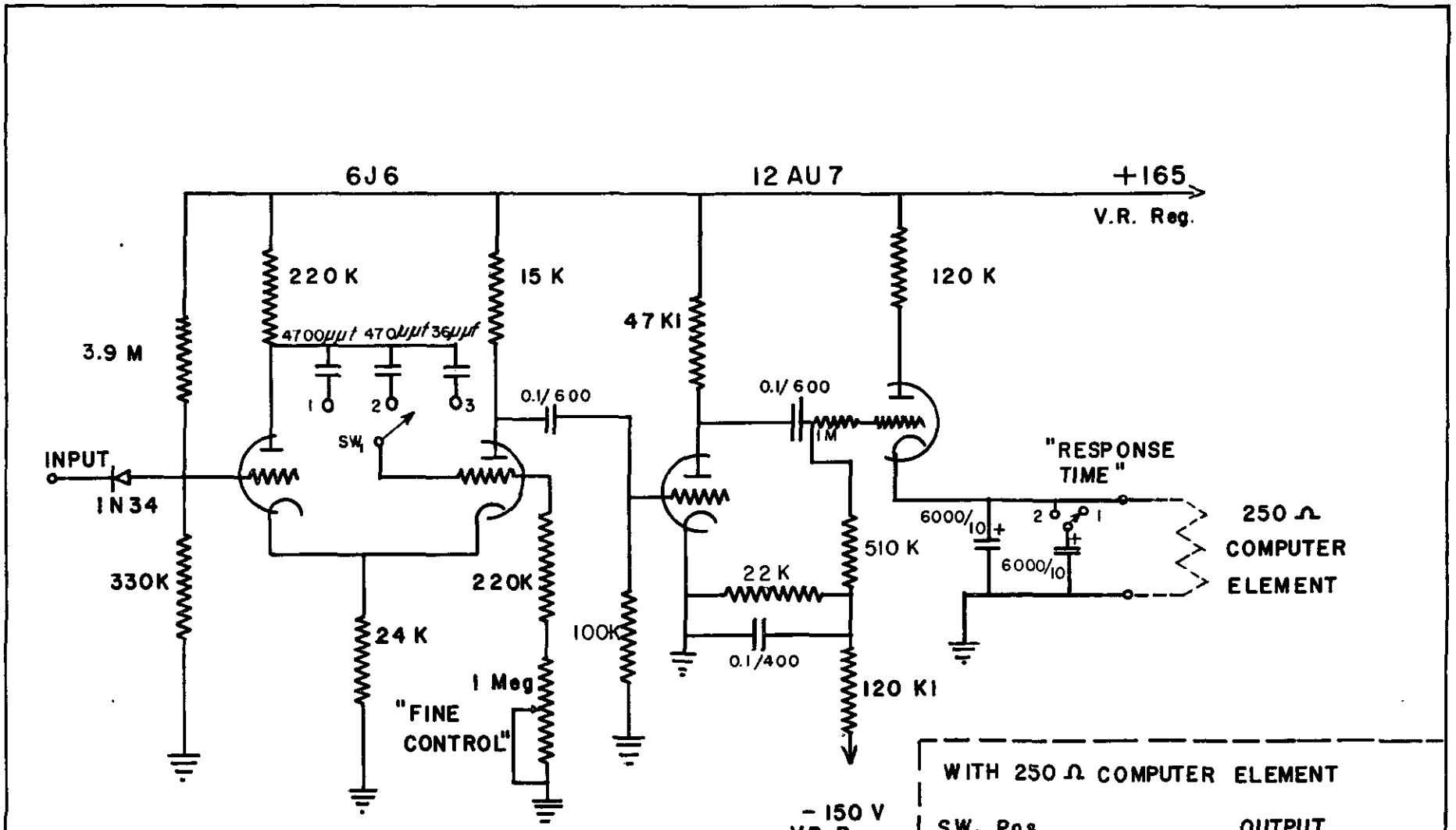
1. Elmore, W. C., and Sands, M. Electronics. First Edition. New York: McGraw-Hill Book Company (1949), P. 249.



COUNT RATE CIRCUIT WITH ONE OUTPUT SIDE GROUNDED