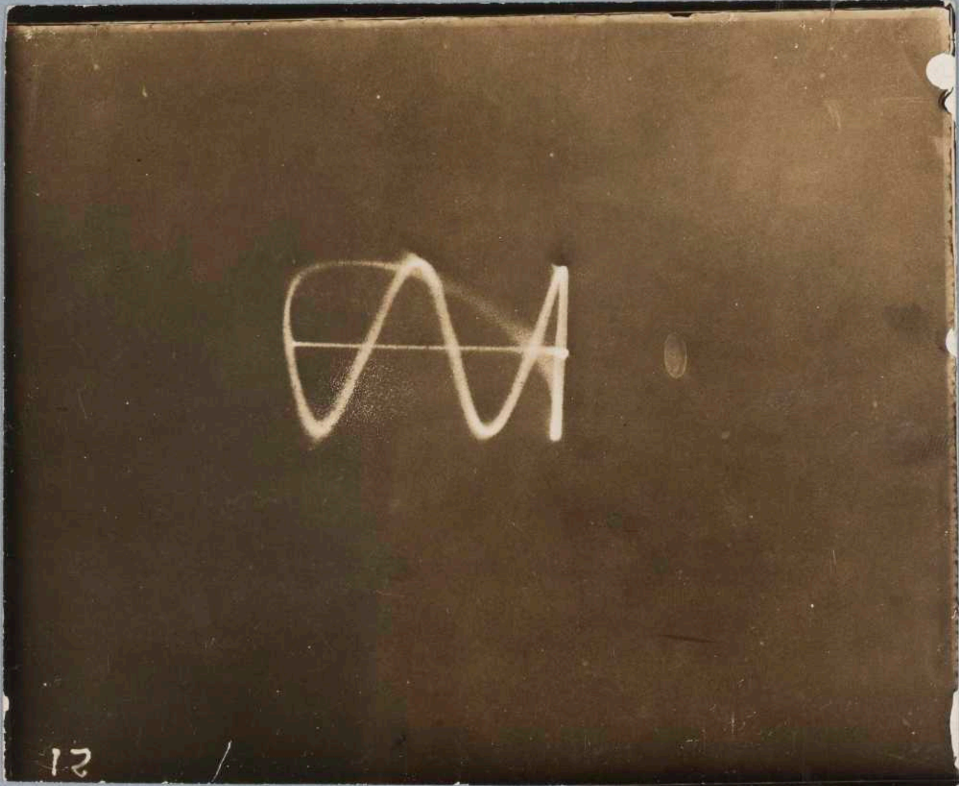
Publications, 1931 - 1940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Ask about oscilator and amplifier.?

See Westham + Horton Nov 6 1931

1. Study of cathode ray oscillograph in order to use it for quantitative measurement.

Application to study of thyratron cut-off for inverter and for studies of deionization time.

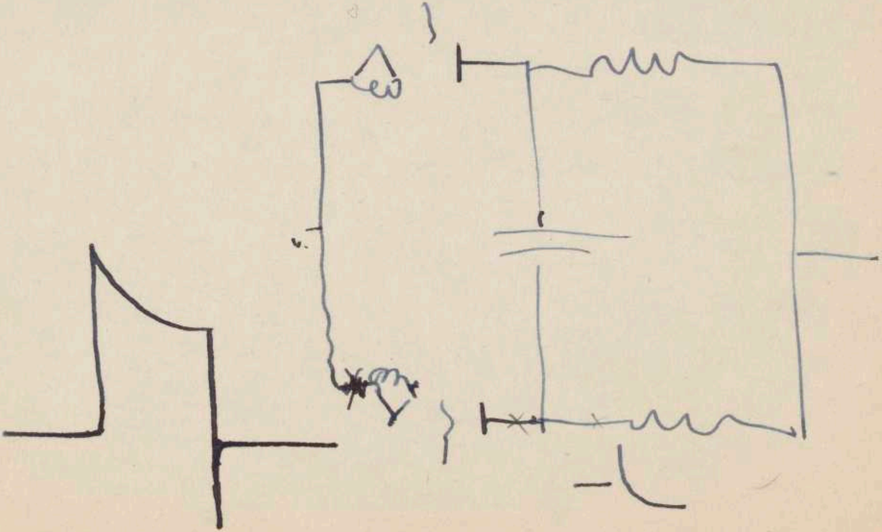
Study interference from power supply in case of G.E. and G.R.

Study of response curves of deflection vs. pot. at various electron velocities.

1. Can beam be focused at lower speeds at with sacrifice of light?

2. Determine quantitative variation of size with speed.

3. Study methods of applying potential to plates and study distortion produced in various methods.



A NOTE ON THE TIME REQUIRED TO SET UP CONDUCTION IN AN FG-17 THYRATRON AS DETERMINED BY A STUDY OF A LINEAR TIME AXIS CIRCUIT FOR AN OSCILLOGRAPH

by

W. B. NOTTINGHAM, E.E., Ph.D.

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A NOTE ON THE TIME REQUIRED TO SET UP CONDUCTION IN AN FG-17 THYRATRON AS DETERMINED BY A STUDY OF A LINEAR TIME AXIS CIRCUIT FOR AN OSCILLOGRAPH.

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BARTOL RESEARCH FOUNDATION.
Communication No. 54.

ABSTRACT.

In connection with a study of small thyratrons recently published, certain results seemed to indicate that 1,000 micro-seconds were required to set up conduction, but an investigation using a cathode-ray oscillograph definitely shows that good conduction can be set up in 10 to 20 micro-seconds. A satisfactory explanation of the earlier result, not requiring a time lag, has been suggested by O. W. Livingston of the General Electric Company.

INTRODUCTION.

Cathode-ray oscillograph measurements using an FG-17 General Electric thyratron show conclusively that the time required to set up conduction in a thyratron is of the order of 10 to 20 micro-seconds even under unfavorable conditions, instead of 1,000 micro-seconds as previously suggested.[1] The earlier result came out as an incidental to a rather complete study of small thyratrons and depended upon the fact that the apparent maximum phase difference between the grid and plate potentials for which conduction could be set up in the thyratron was about 152° instead of 176° using 60 cycles A.C. The suggestion was made that this discrepancy of 24° between the observed and the calculated maximum phase difference could be explained by assuming that 1,000 micro-seconds were required to set up conduction, but in a personal communication, Mr. O. W. Livingston of the General Electric Company offered the alternative explanation that the condenser used in the "phase shifting" circuit charged up with grid current during the half cycle in which the plate potential was negative

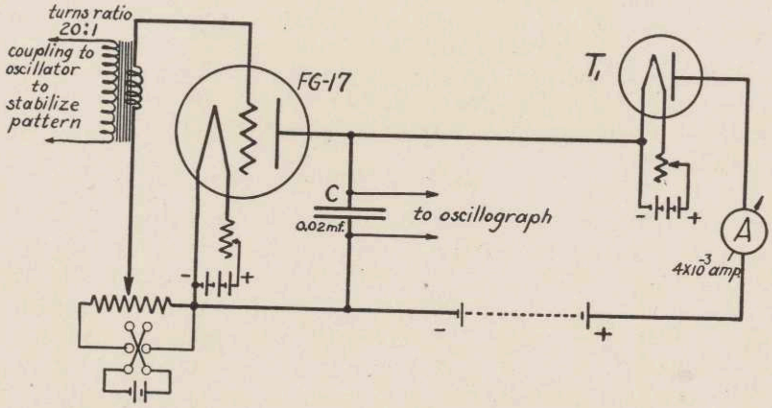
[1] W. B. Nottingham, JOURNAL OF FRANK. INST., 211, 271 (1931).

and the grid potential was positive with respect to the cathode. Although, this charge partly leaked off through the resistance of the "phase shifting" circuit, the grid was more negative than it should have been during the negative half of the grid potential cycle. Thus for a given *calculated* phase difference between the plate and grid potentials, the *effective* phase difference was probably greater by as much as the 24° observed.

NEW EXPERIMENTS USING A CATHODE-RAY OSCILLOGRAPH.

The thyratron circuit shown in Fig. 1 was set up to produce a linear time-axis for use with a cathode-ray oscillograph.

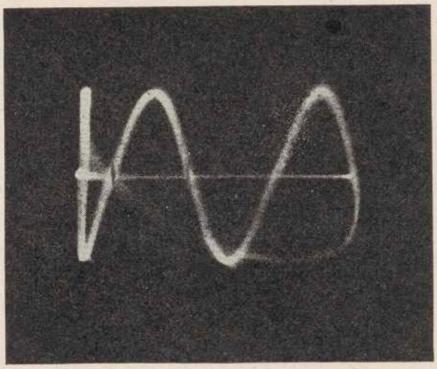
FIG. 1.



Thyratron circuit for linear time axis on cathode-ray oscillograph.

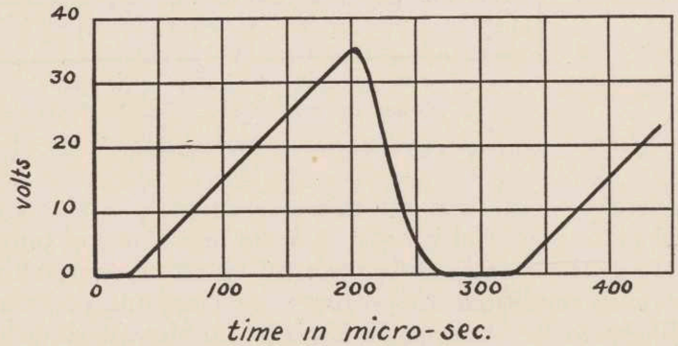
The operation of this circuit may be described briefly as follows: The electron current flowing across the vacuum tube T_1 is the saturation current and is therefore practically independent of the potential across T_1. This constant current charges the condenser C at a uniform rate and therefore causes its potential to increase linearly with the time until the potential is reached at which the thyratron is set to operate as determined by the grid potential. The thyratron then suddenly discharges the condenser, returning its potential to zero after which the cycle is repeated. Fig. 2 shows the pattern produced with a 10,000 cycle wave impressed on one pair of plates while the time axis was operating at one-third that frequency. It is not only possible to study the wave form of the 10,000 cycle wave in this picture but it is also possible to obtain fairly accurate information concerning the

FIG. 2.



10,000 cycle wave with linear time-axis.

FIG. 3.

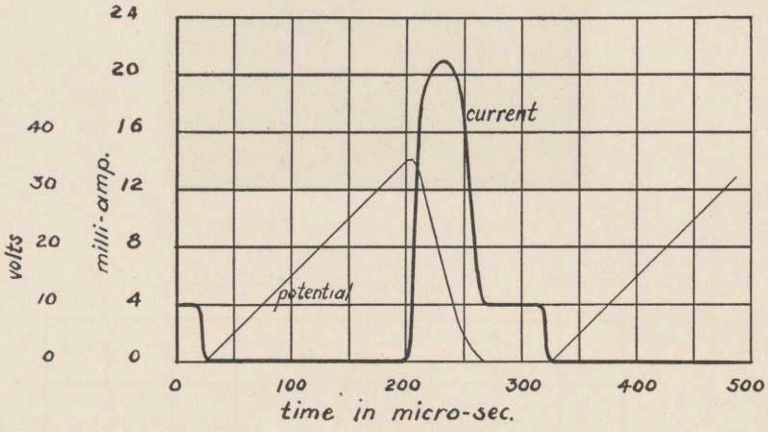


Thyratron (or condenser) potential as a function of the time.

current-potential relationship in the thyratron as a function of the time during the discharge.

The curve of Fig. 3, shows the potential across the plates of the condenser as a function of the time that was obtained from an analysis of the pattern shown in Fig. 2. Since the current flowing into, or out of, a condenser is equal to the time rate of change in the potential multiplied by the capacity, it is possible to calculate the current flowing at any time from the slope of the potential curve at the time in question. The current flowing through the thyratron is obviously the algebraic sum of the condenser current and the constant thermionic current flowing through tube T_1. This current is shown by the heavy line of Fig. 4 while the potential is shown lightly for reference. It is evident from these curves, that the time required to set up good conduction in a thyratron is

FIG. 4.



Thyratron plate current as a function of the time.

considerably less than 30 micro-seconds even though the initial plate potential is only 35 volts and the grid potential exactly at the corresponding critical value. For quick operation, such conditions are probably the most unfavorable that are likely to be imposed in almost any thyratron problem. It is quite probable that under more favorable conditions good conduction could be set up in ten micro-seconds or less.

It is also of interest to note that the thyratron continues to be a fairly good conductor for about 75 micro-seconds after the plate potential has fallen below that at which appreciable further ionization can take place. The rated "deionization" time of 1,000 micro-seconds for this type of thyratron, is thus seen to be very conservative in this particular application. The deionization time probably would have been much longer if the tube had been carrying its full load current of 0.5 amp. instead of a maximum of only 0.021 amp. as in this case.

In conclusion I wish to acknowledge my indebtedness to Mr. I. Melville Stein, Director of Research of Leeds & Northrup Company, for kindly loaning me the cathode-ray oscillograph and FG-17 thyratron used in this study.

The Preparation of Mirrors by Sputtering Metals on to Glass Surfaces. A. CHRISTOPHER G. BEACH. (*Jour. Sci. Instr.*, June, 1930.) Though the process of sputtering the metal of a cathode on to the cathode side of a sheet of glass interposed between the anode and the cathode in a vacuum tube through which an electric current passes has long been known and used, yet satisfactory results are not always attained. This paper describes in detail the method of getting excellent mirrors of silver and of nickel.

"The most usual source of trouble appears to be the use of too high an exhaust. The author's experience is that the cathode space should not touch the glass or the deposit is not so good and, if thick, may peel off." The glass surface to be coated rests face downwards about 2 cm. above the silver cathode. The vessel is exhausted by a "Hyvac" oil pump and no special gas is required. The current comes from the secondary of a transformer in which is included a Lodge valve tube. About 20 milliamperes pass through the sputtering tube, the potential difference between the electrodes being from 1000 to 2000 volts R.M.S.

Devices are used to remove the sputtered plate without jar or scratch, to exclude dust upon the admission of air, to facilitate the change of cathodes and to insure a clean surface for the deposit of the metal. "About 5 minutes with 10 M.A. gives a good deposit for interferometer plates," in the case of silver. Nickel requires a longer time.

G. F. S.

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