311.60
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PEB RHBE PBM RHB PBM

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DATA FOLDER No. 72164

Title Oscillographic Method of Measuring Positive Grid Characteristics

By

Electronic Tube Engineering Div.

Information prepared for Electronic Tube Engineering Division

Tests made by

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Countersigned by

Date Sept. 1, 1943

OSCILLOGRAPHIC METHOD OF MEASURING POSITIVE GRID CHARACTERISTICS

Electronic Tube
Engineering Division

September 1, 1943

Introduction

This Data Folder supersedes #64587, with the same title, prepared by O. W. Livingston. For this reason, much of the theory and discussion are taken directly from the above-mentioned data folder. Some of the original information, which is no longer necessary, has been eliminated and new information added to cover operation of the rebuilt set.

Considerable difficulty has been experienced in the past in obtaining positive grid characteristics of high-vacuum triodes since tube dissipation while taking these points is so high that the destruction of the tube is likely to take place if the power is left on sufficiently long to read a standard meter.

To obviate this difficulty, tests have been made in which the power is applied for only a short time and oscillograms taken on all the essential data. This method, however, requires considerable calculation from the oscillograms obtained and in many cases errors or peculiar results in the tests are not noticed until the calculations are made which may be sometime after the tests and the test setup may be no longer available. The method used in these tests, we believe, overcomes many of the difficulties involved in these former methods. It is essentially a point-to-point method in which each point on the desired characteristic is obtained separately and can be read directly and plotted as the test progresses. In this way any errors may be checked immediately when the work is completed. No further calculation is necessary since the curves are immediately available.

Theory and Method of Test

Fig. 2 (T-988567) shows the schematic diagram of the test setup. Fundamentally, the operation is as follows. The plate supply condenser C_1 and the grid supply condenser C_2 are charged to a predetermined voltage through their respective rectifier tubes, VT_1 and VT_2 and transformers, T_3 and T_4. When the switch S_1 is thrown to the discharge position, an impulse generated in the grid transformers T_7 and T_8 "trips" the thyratrons VT_3 and VT_4 simultaneously applying potential to both the grid and anode. The wave shape of this voltage is similar to that shown in Fig. (a), being essentially the wave shape of a condenser discharge. Since both the grid and anode potentials have this same shape, the instantaneous grid and plate currents at the start of the phenomenon correspond to the values normally obtained with the peak values of grid and plate voltage. The plate current in general has the shape shown in Fig. (a) and the peak value of this

current is normally read by observing the drop across R_{13} and/or R_{11} with a cathode-ray oscillograph. Under some conditions, the grid current has the shape of Fig. (a), but under certain other conditions may assume the shape of Fig. (b); in which case, the current at the beginning of the phenomenon is the desired peak current. Again, the grid current may go negative, in which case the negative peak is observed and recorded. It is important in this method that the decay of both grid and plate voltages be sufficiently slow that small errors in firing time of VT_3 and VT_4 do not cause appreciable error. For this reason, the capacities C_1 and C_2 are adjustable in steps.

Calibration curves of the output voltages across the potentiometers R_7-R_9 and R_8-R_{10} against voltages on the primaries of the supply transformers are included in this report. It is advisable actually taking test data to check this calibration by substituting a known resistance for the tube load and checking a few points on the curves. By means of the calibration curves it is possible to set the grid voltage at some predetermined value, say plus 300 volts, and then vary the plate voltage over the operating range to secure the desired characteristic data.

In some cases, it is further desirable to add additional "bleeder" resistance across the voltage potentiometers, particularly in the case of low or negative currents, which sometimes occur in the grid circuit, in order to insure reliable firing of the thyratrons. Oscillations sometimes occur and are readily observed on the oscillograph when the entire wave shape is being scanned by means of the conventional sweep. In general, oscillations are caused by excessive length or improper placement of the leads connecting the tube under test to the test setup. Small condensers (small compared to C_1 and C_2) connected between grid and cathode and plate and cathode may be helpful. In taking readings, it is sometimes convenient to turn off the sweep circuit and simply read the peak, but whenever this is done the sweep should be used from time to time to determine whether or not oscillations are present and, in the case of the grid current, whether or not the peak value is the correct point to read.

Operation of the Revised Setup (Fig. 1 T-988567)

1. Set up proper ratios on voltage dividers R_7-R_9 and R_8-R_{10}, and set suitable series resistors in plate and grid leads R_{11}-R_{13} and R_{12}-R_{14}.

2. Close 220 volt AC main switch. (20)

3. Close non-interlocked 110 v. supply. (21)
   Allow five minutes for FG-41 filaments to heat.

4. Close 125 volt DC main supply. (22)

5. Close 110 volt AC interlocked supply. (23)

6. Adjust the filament voltage of the tube under test.

7. After the interlock has been closed, grid and plate voltages, grid and plate currents, may be read by placing the oscilloscope switch in the proper position.

8. Press the charging button and hold in long enough for the capacitors to charge.

9. Release the button and record the deflection on the scope.

10. Calibrate the oscilloscope by adjusting the calibration variac to obtain the same peak deflection as in 9.

11. Record peak volts and calculate tube voltage or current.

Fig. 3 (T-988567) shows the arrangement of the oscillograph calibrating and switching equipment number "7" and the "off" position may be used to connect the oscillograph to other circuits.

Fig. 4 (T-988567) shows the non-interlocked 110 volt AC supply.

Fig. 5 (T-988567) shows the circuit used to control the voltage regulator.

Fig. 6 (T-988567) shows the interlocked 110 volt AC supply to variacs in the anode, grid, and calibration circuits.

Also included in this folder are the calibration curves for anode and grid supplies, correction curves for the ABLO panel instruments, and some typical tube characteristic curves taken from Livingston's folder.

C. W. Bleichner
ELECTRONIC TUBE ENGINEERING DIVISION

S. G. Ringland
ELECTRONIC TUBE ENGINEERING DIVISION

CONNECTION BLOCKS IN REVISED TEST SET

(Can be identified by the number of terminals in each block).

Block 1

1, 2 — Secondary of transformer for CRO calibration

3, 4 — One side of 110 volt interlocked supply

5, 6 — 110 volt 60 cps. interlock supply

7 — Common for calibration, grid, and anode transformers.

8 — Calibration variac secondary
Primary of calibration transformer
Calibration voltmeter

Block 2

1, 2 — Primary of 1100 volt transformer
Secondary of variac for same

3, 4 — Primary of 6600 volt transformer
Secondary of variac for same

5 — Spare

6 — Spare

7 — Spare

8 — DC from control push button

9 — Spare

10, 11 — Primary of grid transformers T_5-T_6

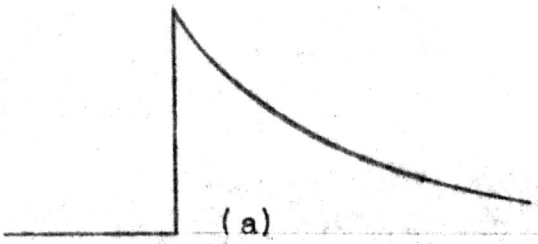
12 — Primary of grid transformers T_7-T_8

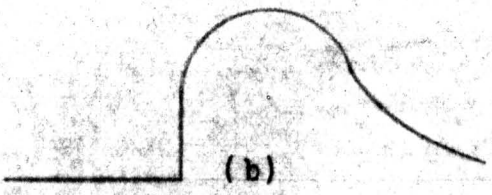
Block 3

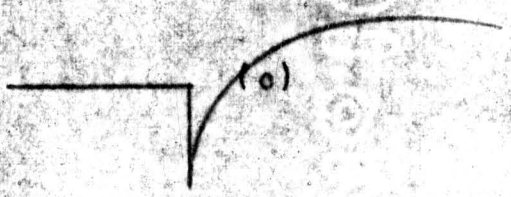
1, 2 — 110 volt AC non-interlocked supply for peeker

3 — 110 volt DC (#8 on block 2)

4 — Primary of grid transformers T_7-T_8







K-5108348

REVISIONS	MADE BY C.W. Bleichner Mayfield	INSPECTED BY	PRINTS TO
	GENERAL ELECTRIC WORKS Schoy	K-5108348 SHEET NO. CONT. ON SHEET	

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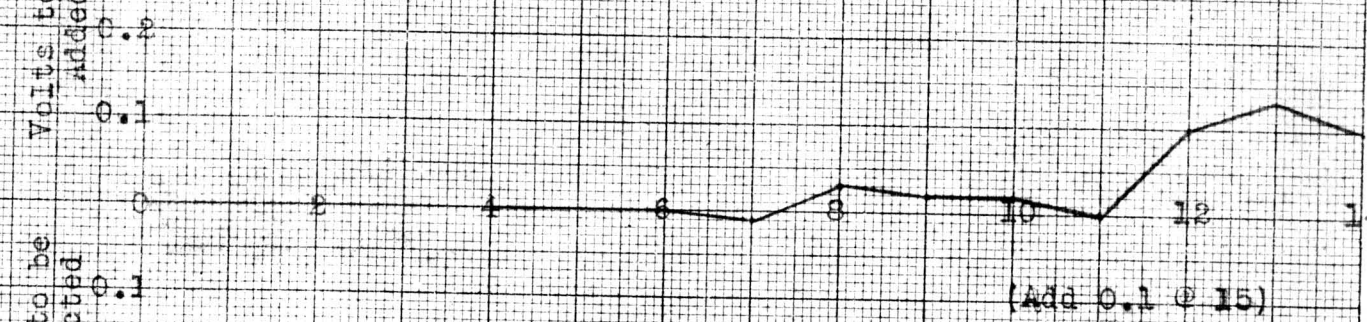
INSPECTED BY- SEPT 4-43
JJ-7858

Calibration For Anode Voltage Instruments

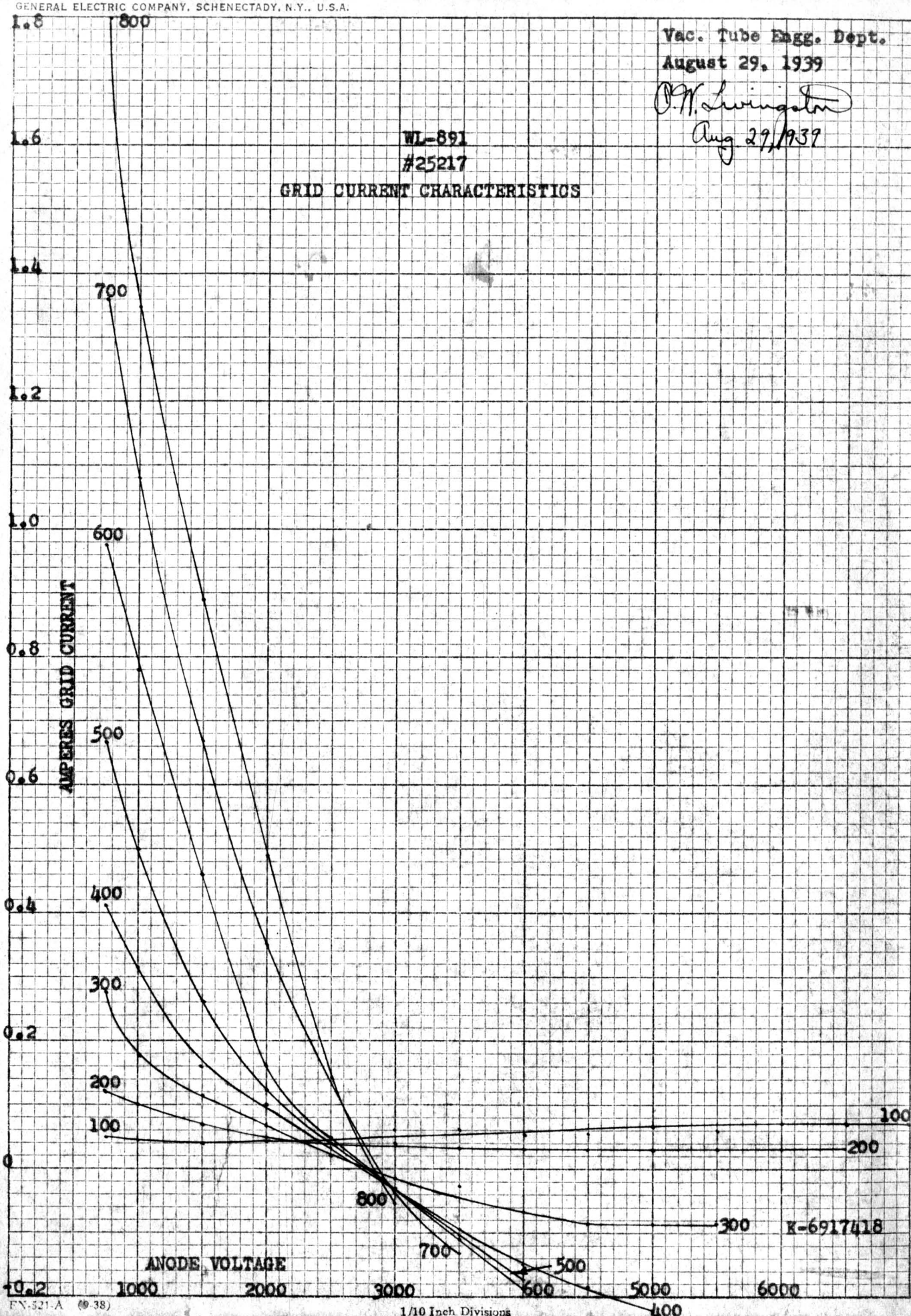


0-15 Volts
No. 1306127

0-150 Volts
No. 1158702

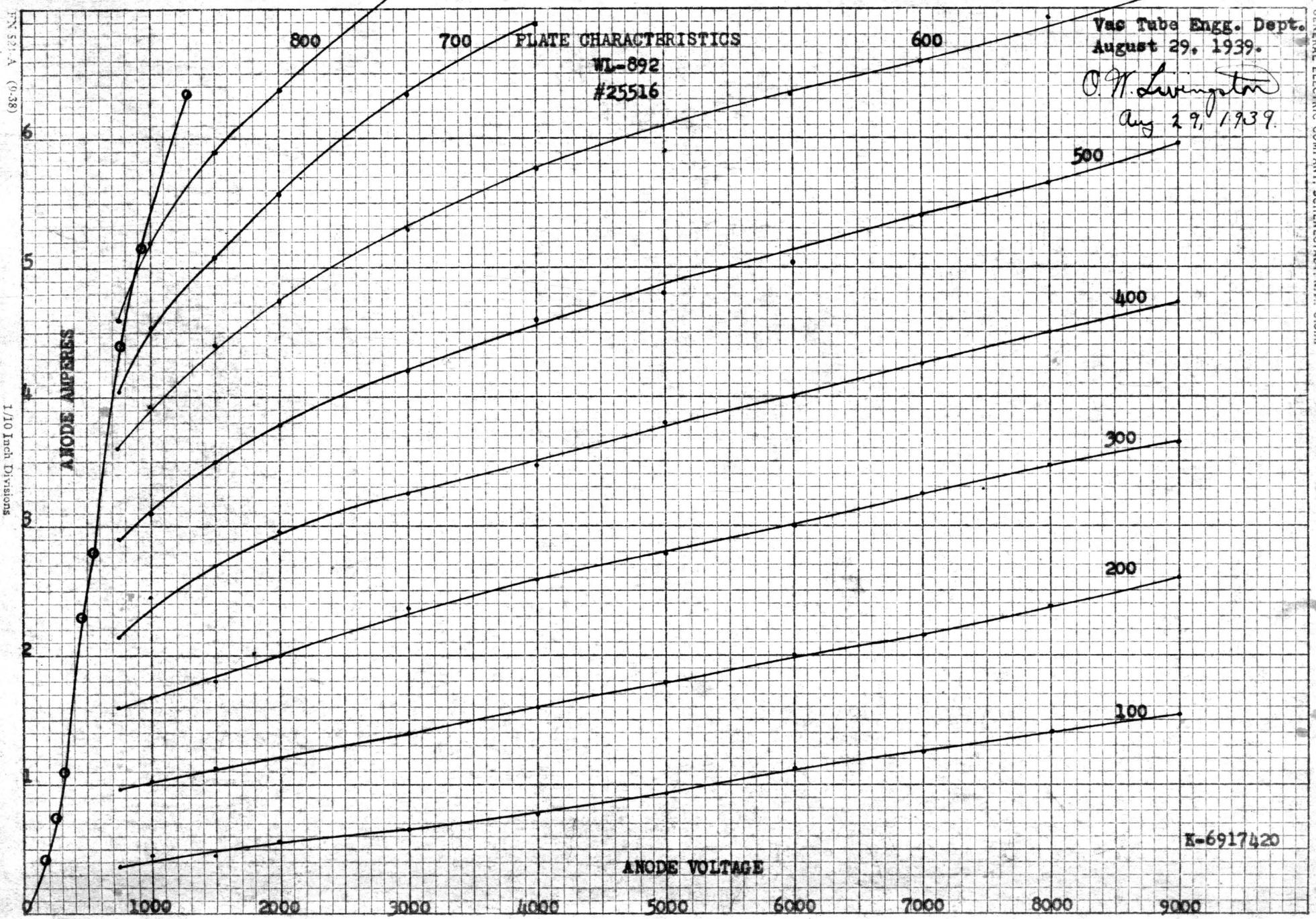
VT 7
F

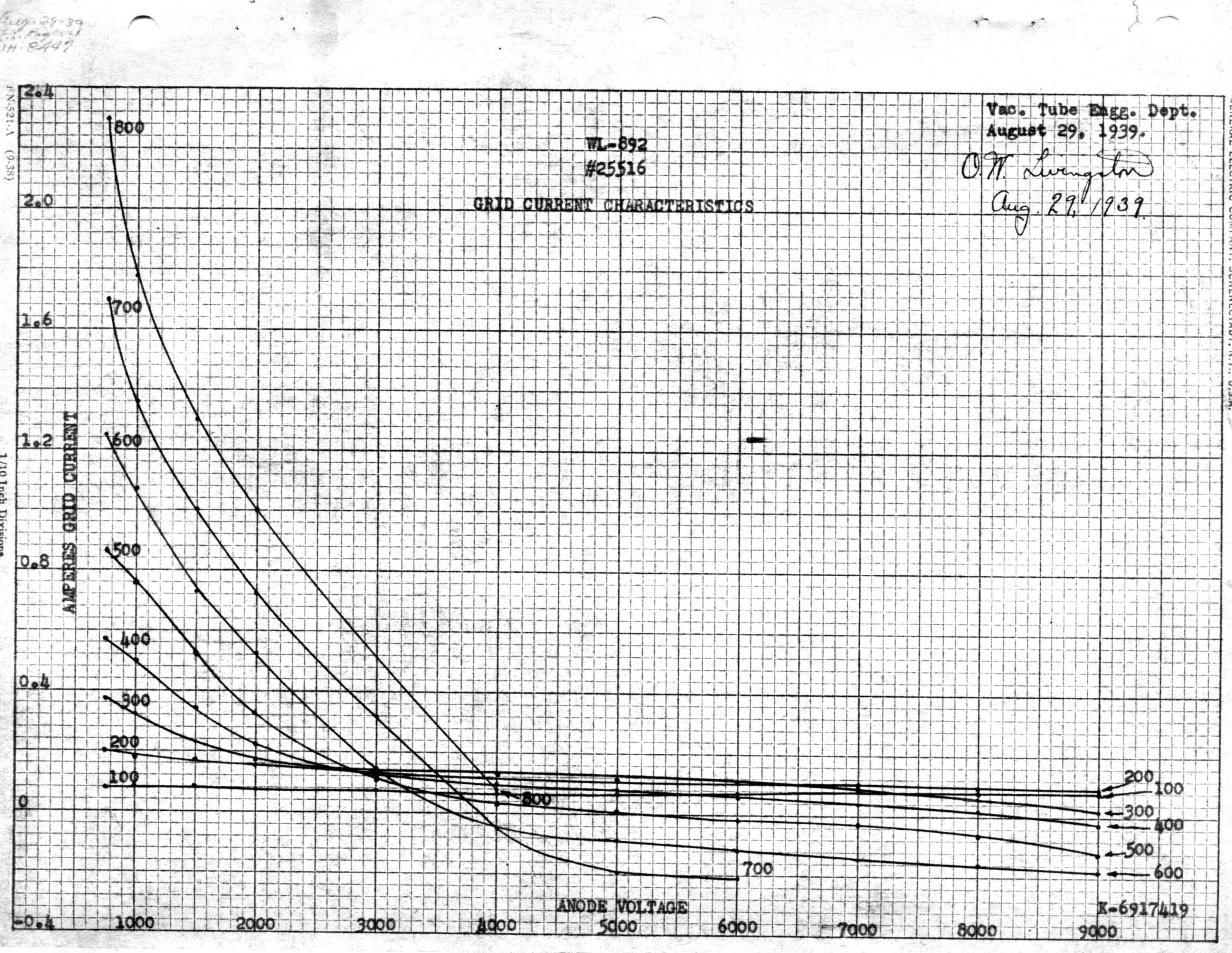
August 25, 1943



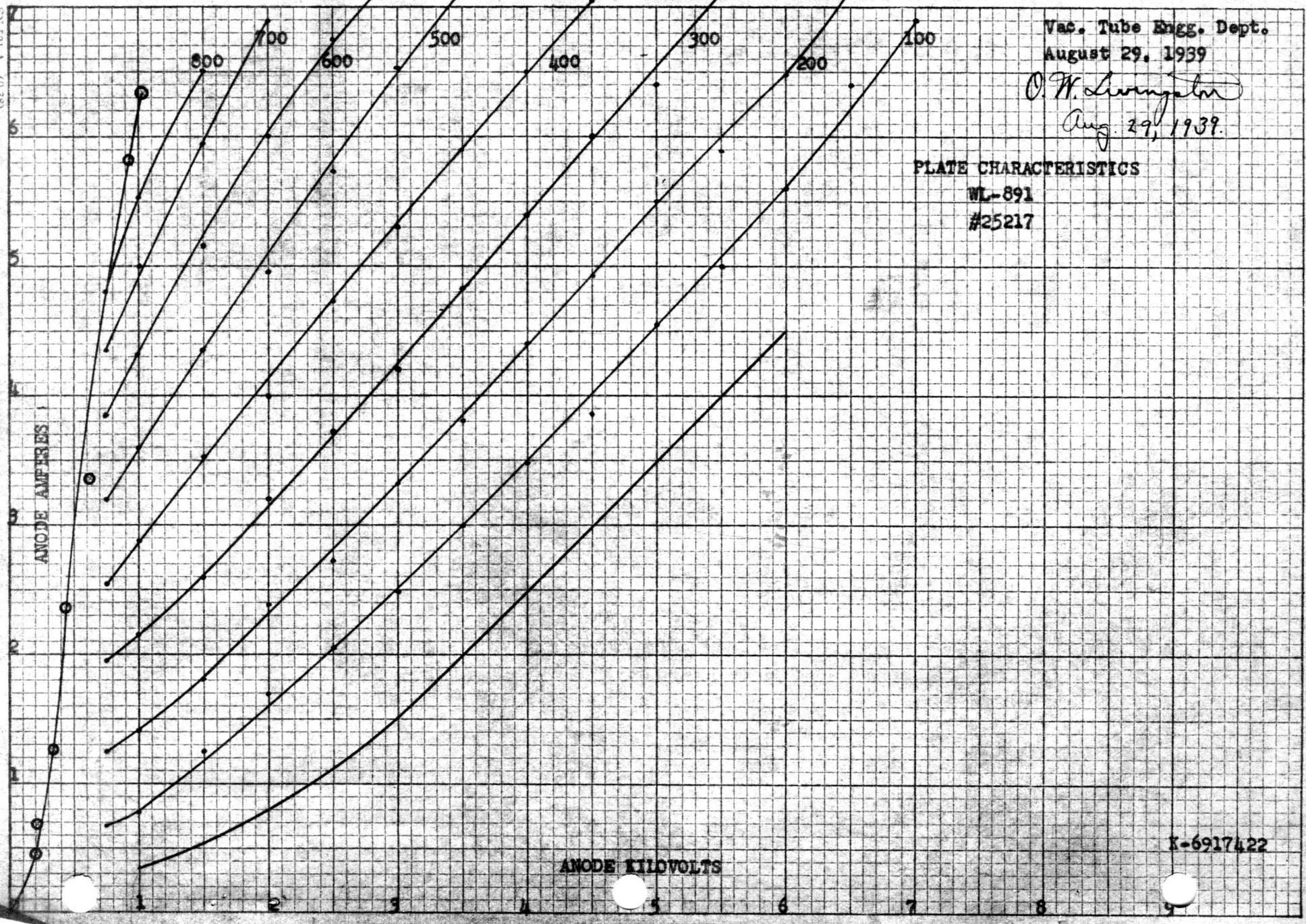
Aug 29-39
Rogers
6447

Aug 27-39
E.T. Rogers
J4-E447




WL-892
#25516
GRID CURRENT CHARACTERISTICS
Vac. Tube Engg. Dept.
August 29, 1939.
O.W. Livingston
Aug. 29, 1939.
AMPERES GRID CURRENT
ANODE VOLTAGE
2.4
2.0
1.6
1.2
0.8
0.4
0
-0.4
1000
2000
3000
4000
5000
6000
7000
8000
9000
800
700
600
500
400
300
200
100
K-6917419
GENERAL ELECTRIC COMPANY, SCHENECTADY, N.Y., U.S.A.
1/10 Inch Divisions

Aug 29-39
E. Kogan
114-5447



Vac. Tube Engg. Dept.
August 29. 1939
O. W. Livingston
Aug. 29, 1939.

PLATE CHARACTERISTICS
WL-891
#25217

K-6917422

FN-521-A (9-38)

1/10 Inch Divisions

GENERAL ELECTRIC COMPANY, SCHENECTADY, N.Y., U.S.A.

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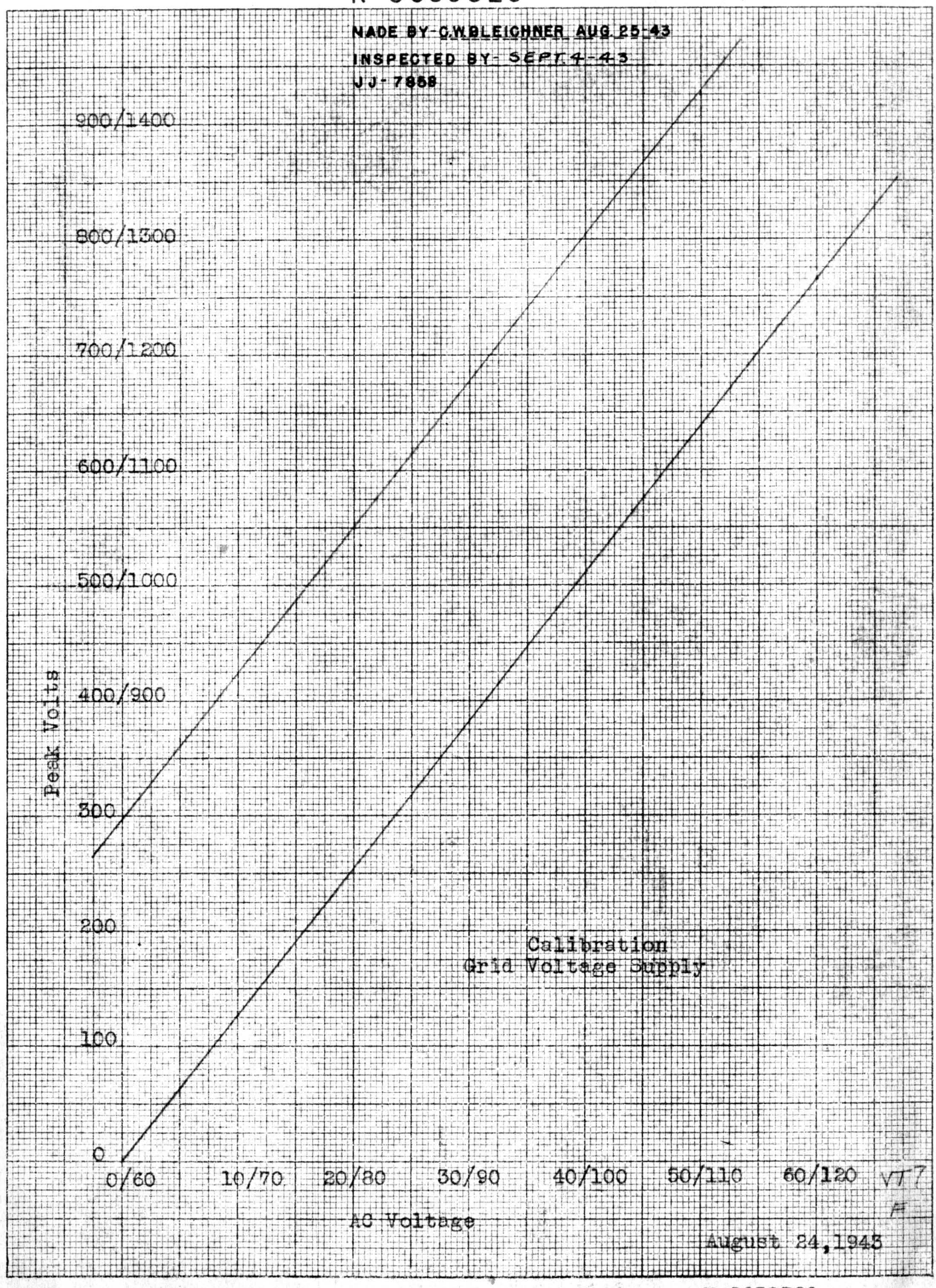
JJ-7858



VT 7
F

August 24,1945

K-8639326

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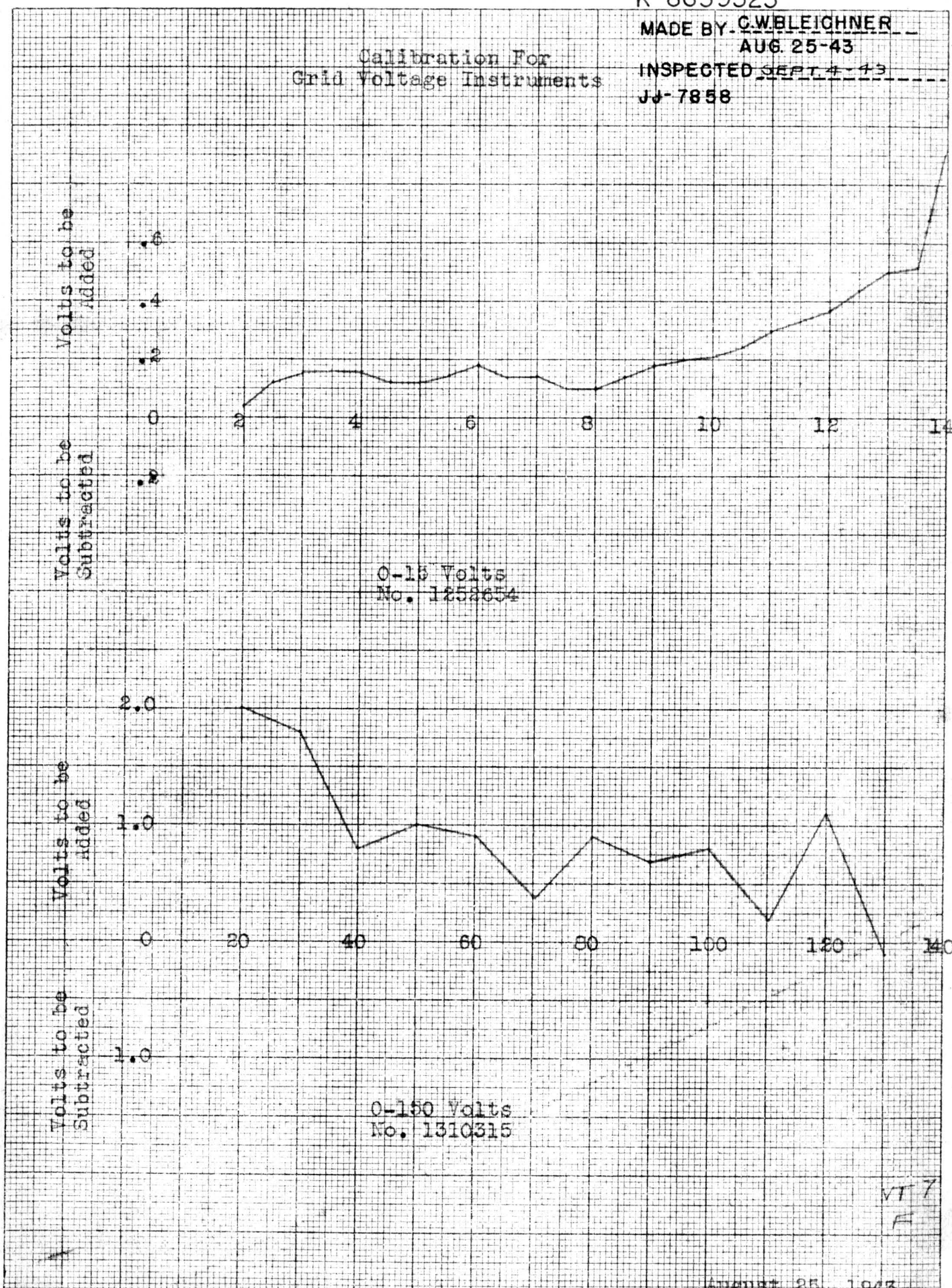
Calibration For Grid Voltage Instruments



August 25, 1943

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JJ-7858

5000/9500
4500/9000
4000/8500
3500/8000
3000/7500
2500/7000
2000/6500
1500/6000
1000/5500
500/5000
0

Peak Volts

Calibration
Anode Supply Voltage

0/70 10/80 20/90 30/100 40/110 50/120 60/130

AC Voltage

VT 7
F

August 24, 19

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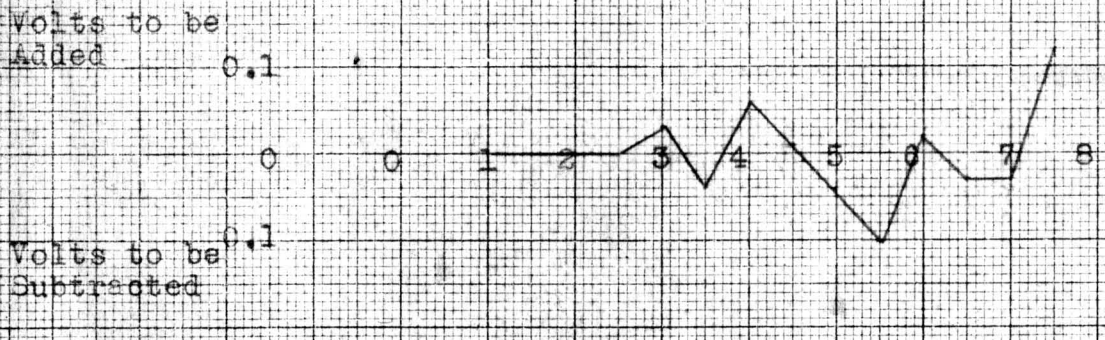
Calibrations For Peak Reading Instruments



0-7.5 Peak Volts
No. 1255550

VT 1
F

August 25, 1943