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DATE 1 August 1944

FR 2212

SUBJECT

The 884 Gas Tube as a Noise Source

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NAVAL RESEARCH LABORATORY

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1 August 1944

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Problem S195R-S

SEARCH RADAR SECTION

Radio Division, U.S. Naval Research Laboratory

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Navy Department

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Naval Research Laboratory

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1. ABSTRACT.

This noise source was developed for use in the modulator of a radar jammer. The circuit is built around two 884's and a 6L6. It produces noise with a bandwidth of about 4 Mc. The peak-to-peak output is in the vicinity of 35 volts but varies as much as 20% with tubes. The oscillations which most 884 noise sources exhibit are attenuated by drawing considerable current through the gas tubes. The bandwidth is obtained by feeding back some of the noise output to the input.

2. INTRODUCTION.

The 884's outstanding advantage over the 931 as a noise source is the magnitude of its output. The output of a 884 is about 15 volts peak to peak while that of a 931 is only a fraction of a volt. The 884 was chosen because the large output might make possible a modulator which would be light in weight, use few tubes and, by minimizing video gain, give no trouble from feedback and oscillations. It was desired that the spectrum of the noise output voltage be down by no more than 3 db at 4 Mc.

The disadvantages usually encountered in using 884's are poor noise spectrum and susceptibility to oscillations. The difficulties produced by oscillations were partially surmounted by running the 884's with about 50 ma cathode current. The tendency to oscillate increases as the current decreases. Any residual oscillation was suppressed by putting a second 884 in series with the first. The spectrum was also improved by the addition of the second 884. To further improve the spectrum, feedback from the output of the noise source to the grid of one 884 and to the grid of the 6L6 was used.

3. DESCRIPTION OF MEASURING EQUIPMENT.

The measurements which were made on these various noise sources were of three different types. A scope was used for peak-to-peak voltage measurement. For quick measurements of the spectrum an analyzer was arranged with a communication receiver, a cathode ray oscilloscope and an oscillator, the tuning condenser of which was rotated by a motor. A block diagram of the analyzer is in Figure 2A. The signal is put on the control grid of the mixer section of a 6AS. The frequency of the oscillator section of the 6AS is controlled by the motor driven tuning condenser. The output of this mixer is then fed into a communication receiver tuned to 10 megacycles. The bandwidth of the receiver is about 6 kc. The output of the receiver goes to the vertical plates of an oscilloscope and the horizontal deflection is synchronized with the rotation of the motor driven condenser. The horizontal scale of the scope can be calibrated with a signal generator. A 0-6 Mc spectrum is spread out on the oscilloscope and can be seen at a glance. This presentation makes it possible to see immediately the results of a change in the noise generator.

The third type of measurement involved the comparison of the noise to the output of a 400 cycle modulated signal generator. The noise was put on the grid of a 6AG mixer and the oscillator section was tuned by hand. A communication receiver with about a 6 kc bandwidth amplified the output which was measured with a copper oxide rectifier meter. The modulated signal generator was then substituted for the noise and the output adjusted to give the same reading on the meter as the noise gave. Figure 2B is a block diagram of this apparatus. When more accurate measurements than could be made with the motor-driven analyzer were desired the comparison between the signal generator and noise was used.

4. DESCRIPTION OF NOISE CIRCUIT.

The curves shown in Figure 3 are for five different pairs of noise tubes selected at random. The peak-to-peak output of the 6L6 with the five pairs of 884's was between 25 and 35 volts, and was substantially free from oscillations when the gas tubes ran at cathode currents of 50 ma. The d-c current which passed through the 884's also passed through the 6L6 so that the total power supply drain was 50 ma. The curves shown in Figure 4 are given to show the results of changing the feedback coil, L₂, in the generator. The components referred to are indicated in the diagram in Figure 1.

The curves given in Figures 5 and 6 show the spectra for 884's in various circuits. These diagrams show how the final circuit was developed from a single 884. The curve 1 in Figure 5 is the spectrum of the circuit 1 in Figure 7. This curve follows the usual pattern of drooping response above one megacycle and shows signs of oscillation just below one megacycle. No effort was made to record accurately the amplitude of the oscillations because the problem at this stage of the investigation was the increase in output above 1 mc. Peaking coils were then tried in series with the load resistor.

The curve 2 in Figure 5 shows the increase in higher frequency noise components brought about by the addition of the peaking coil, L₁. Although the noise spectrum was extended to about two and one-half megacycles this did not alter the effect of the oscillations at a lower frequency.

Curve 3 in Figure 6 shows a complete spectrum with careful measurement made both above and below 1 mc in order to show the presence of gas tube oscillations. This curve was taken using circuit 3 in Figure 8. The 6L6 was added as an amplifier and as a dropping resistance for the 884. It also introduced the normal grid capacitance to the 884 circuit.

A second 884 was added in series with the one already used as shown in circuit 4 of Figure 8. This addition was made with the hope that two gas tubes would give greater output than just one. This expectation was not realized as shown in curve 4 until the circuit was changed to that of circuit 5. The use of a .01 condenser from the output

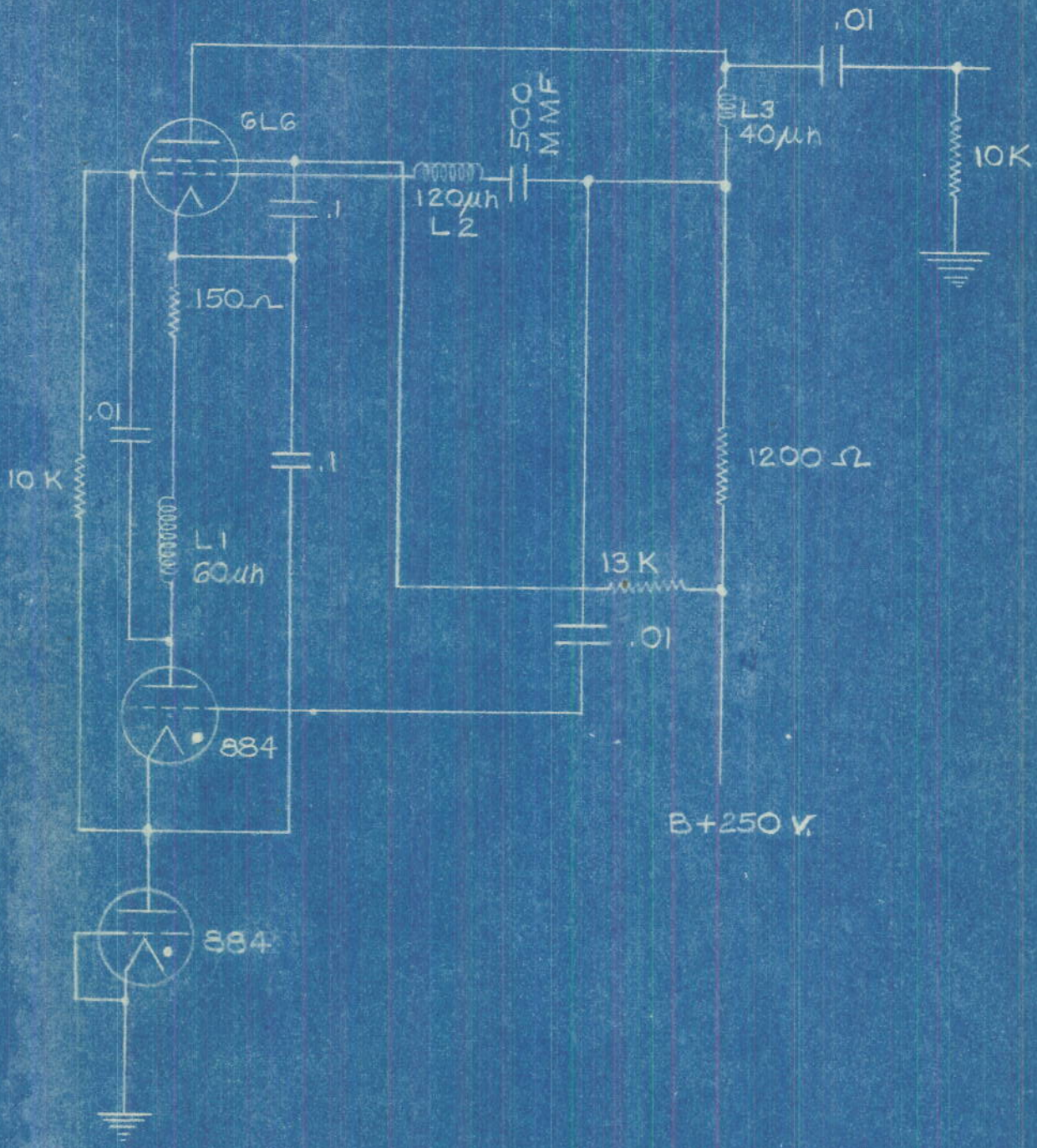
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back to the grid of one 884 suppressed the oscillations completely as shown in curve 5. However the spectral curve does not have the desired shape and it was decided that frequency selective feedback might be used to flatten out the spectrum. A series coil and condenser were added between the grid of the 6L6 and the junction of the peaking coil and load resistor in the plate circuit of the 6L6. This brought about the result shown in curve 6 in Figure 6. Figure 1 shows the final circuit. While the value of L_2 is not critical, it is recommended that it be made adjustable with an iron core in order to compensate for differences in layout.

The distribution of noise was made essentially flat to four megacycles and the peak-to-peak output of the 6L6 was 35 volts.

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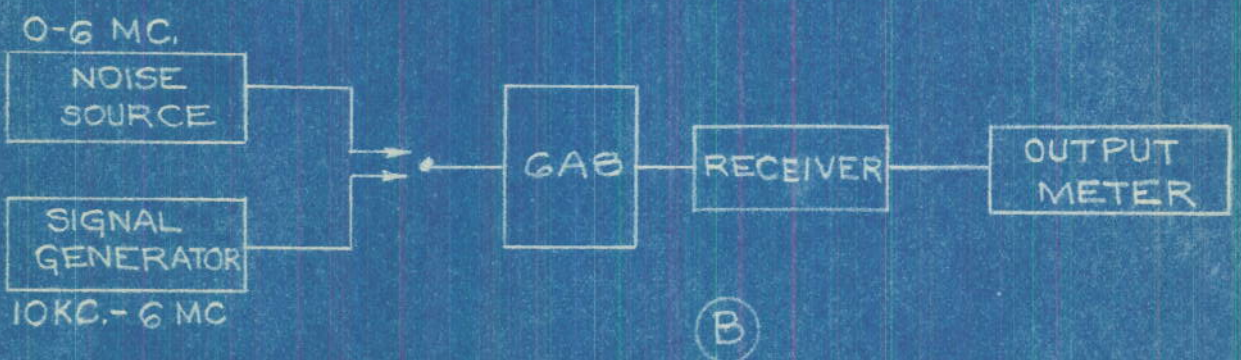
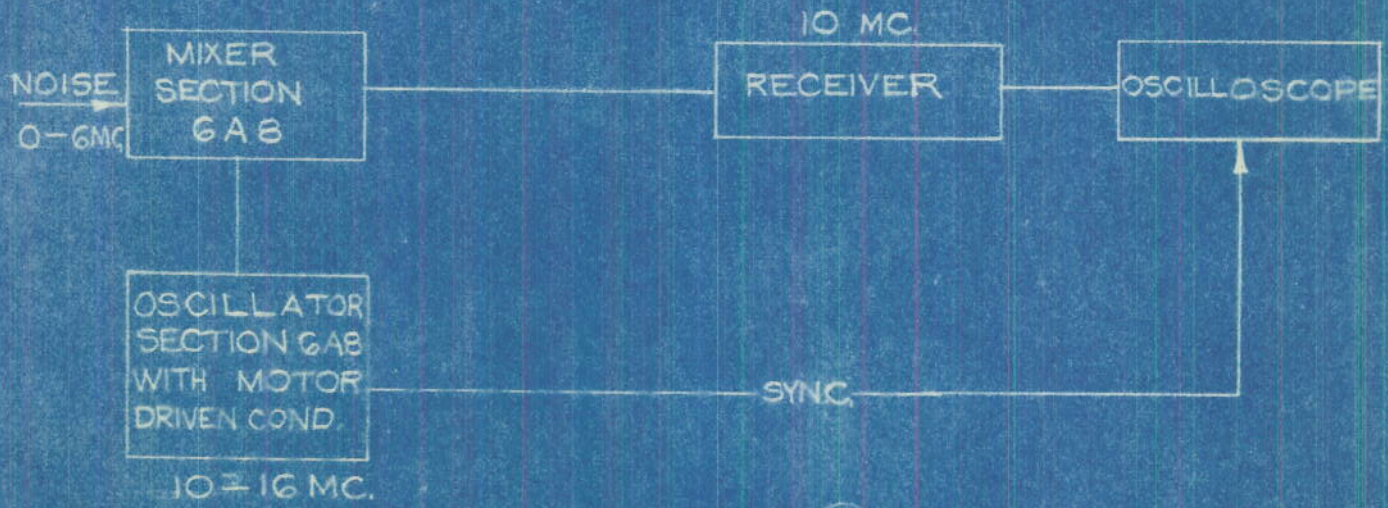
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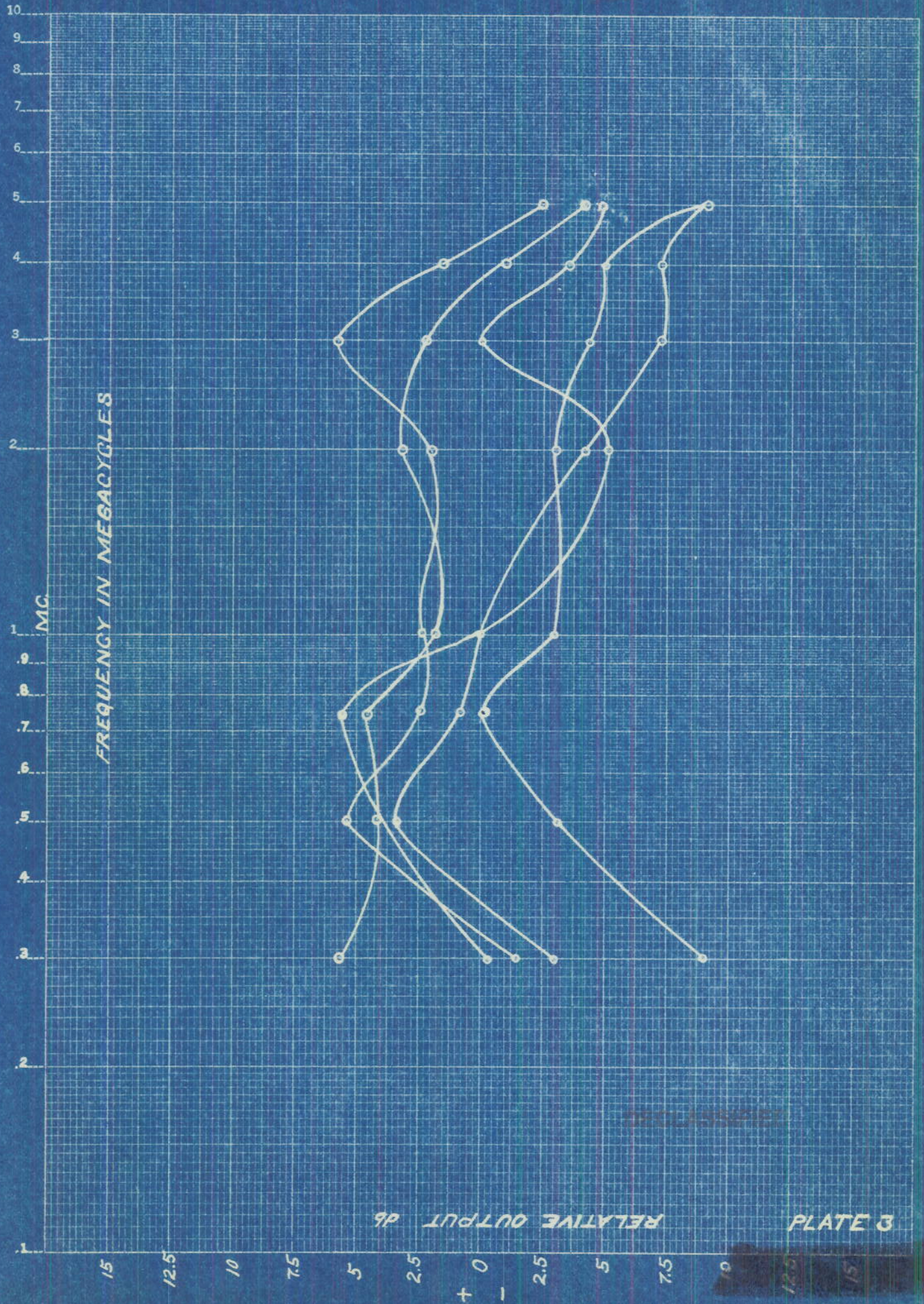
PLATE 1

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PLATE 2



KEUFFEL & ESSER CO., N. Y. NO. 359-63
Semi-Logarithmic, 2 Cycles x 10 to 100
MADE IN U. S. A.

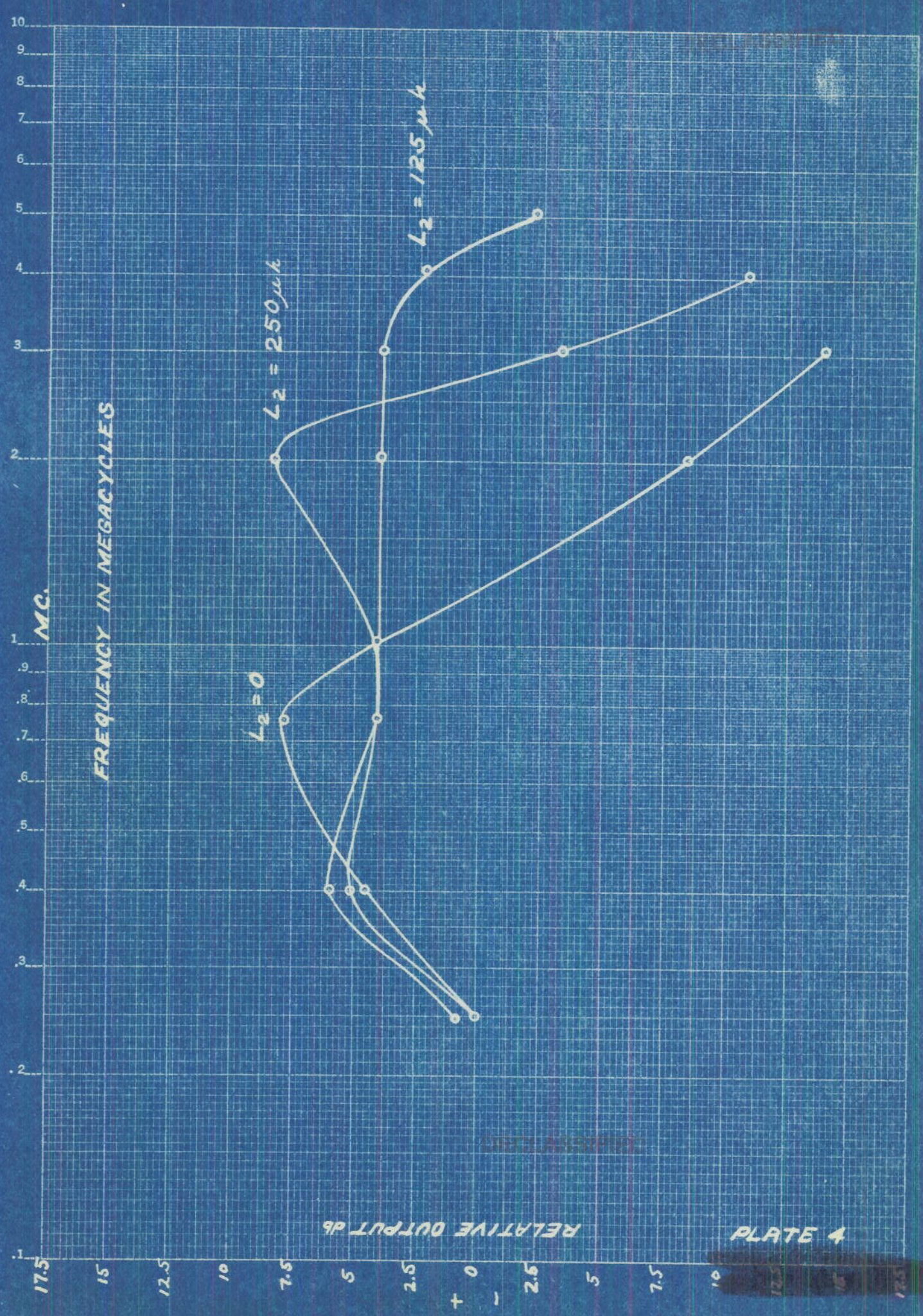


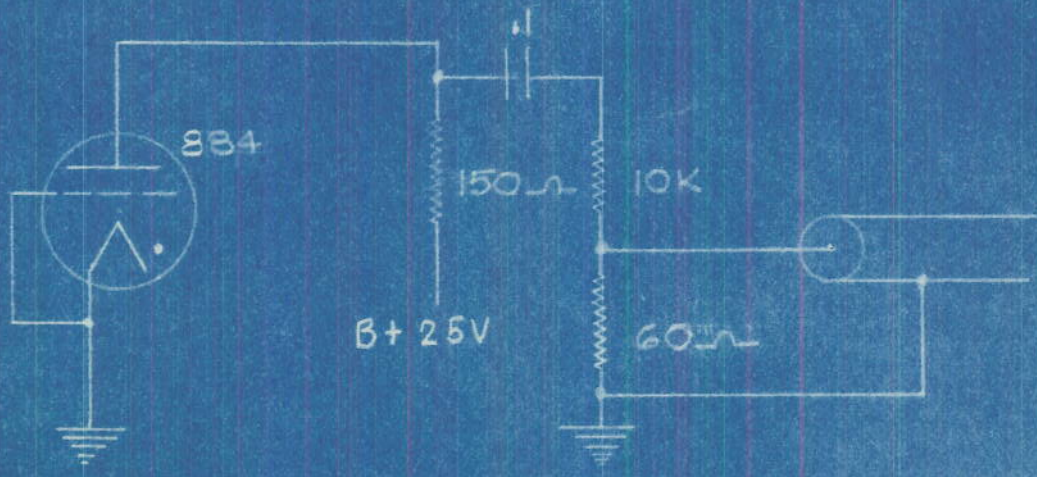
PLATE 4

REUFFEL & EBBERT CO. NO. 35065
Semi-Logarithmic, 5 Cycles to 100 Inch.
MADE IN U.S.A.

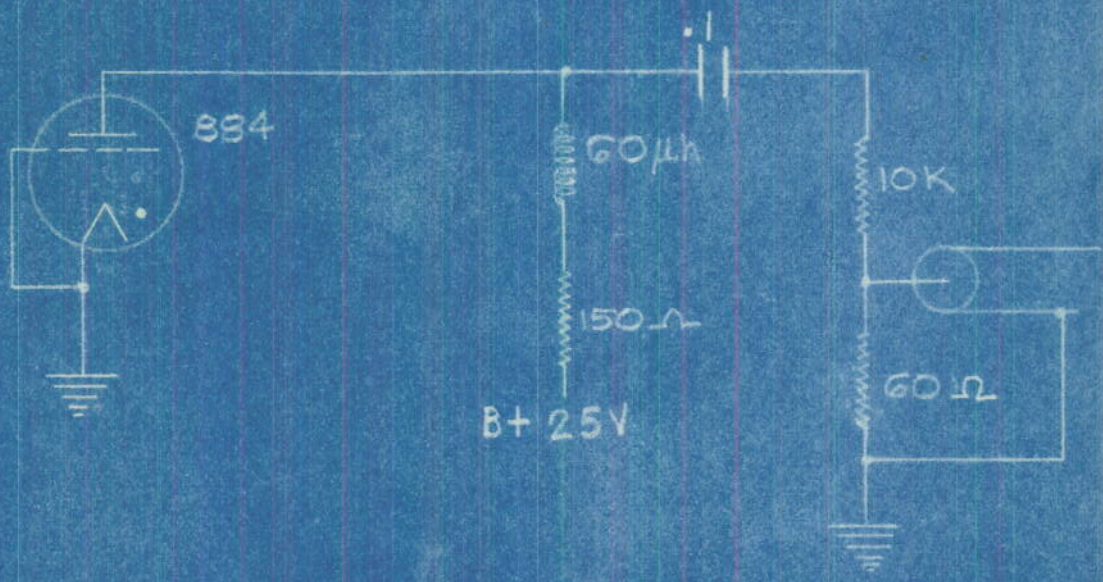


PLATE 5

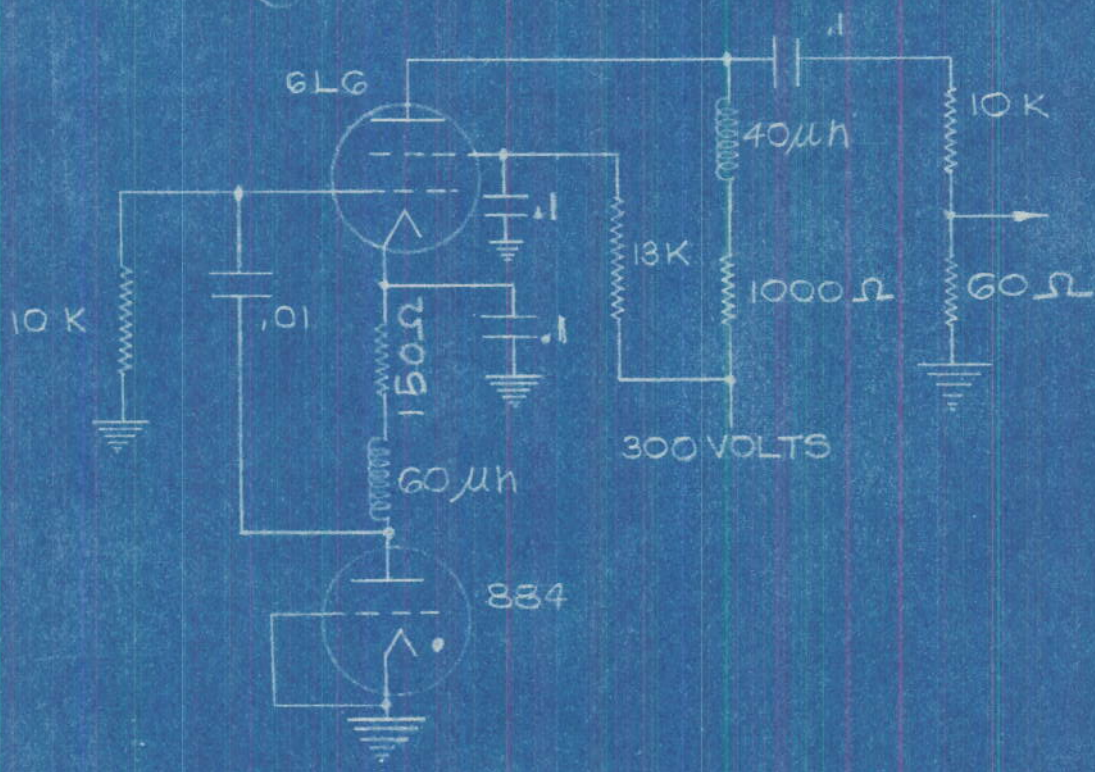
(1)



(2)



3



4

