RCA MANUFACTURING COMPANY, INC.
A RADIO CORPORATION OF AMERICA SUBSIDIARY
Harrison, New Jersey

RCA RADIOTRON
DIVISION

APPLICATION NOTE No. 86
January 26, 1938

APPLICATION NOTE ON OPERATION OF THE 6Y6-G

The problem of producing a low-cost a-c operated receiver can be solved satisfactorily by employing a power output tube designed for operation at low voltages. The use of such an output tube effects substantial savings in receiver cost because a low-voltage power transformer, low-voltage filter condensers, and a low-cost rectifier tube are used.

The 6Y6-G, a 6.3-volt, 1.25-ampere beam power amplifier, is intended for use in such an a-c operated receiver. Its characteristic features are high power sensitivity and high plate-circuit efficiency. Under ideal conditions of zero power-supply regulation, a single 6Y6-G can furnish 3.6 watts with reasonable distortion; under practical operating conditions, approximately 3.3 watts can be obtained at the grid-current point. Two type 6Y6-G's connected in push-pull can furnish nearly 6 watts at the grid-current point in a receiver of average design.

This Note describes operation of the 6Y6-G in single-ended and in push-pull circuits. All the data reported in this Note were taken in a radio receiver of average design in order that the information would be of practical value. The rms rectifier current and rms rectifier voltage are also given to facilitate the design of the power transformer. The type 5Y3-G was used as a rectifier in both single-ended and push-pull tests. (The 5Y3-G is similar electrically to the type 80.)

Single-Tube Tests

Single-tube tests were conducted in a receiver using a 6A8, 6K7, 6Q7, 6Y6-G, and 5Y3-G. An a-f signal was fed to the input of the triode section of the 6Q7 and the power furnished by the 6Y6-G to the primary of the output transformer was measured. The circuit of the power supply and of the a-f portion of the receiver is shown in Fig. 1. In these tests, bias on the 6Y6-G was adjusted to -13.5 volts and the screen voltage was adjusted to 135 volts with no signal.

Curves of power output, distortion, and screen dissipation vs load resistance are shown in Fig. 2. The recommended load of 2000 ohms

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was selected on the basis of good power output, reasonable distortion, and reasonable screen dissipation at the grid-current point. It should be noted that screen dissipation rises rapidly with load impedance. Hence, a high value of load may contribute to poor tube life because of excessive screen dissipation. The value of load shown in these tests is the parallel combination of the output transformer's primary impedance at 420 cycles and a fixed resistor. Bias for the 6Y6-G was obtained from the voltage drop across the speaker field. This arrangement is preferred by some engineers because the voltage output of the filter (Fig.1) is less than that required for self-biased 6Y6-G's by an amount equal to the bias voltage.

Curves of distortion and peak input signal vs power output for a load of 2000 ohms are shown in Fig.3. The grid-current point of the 6Y6-G was reached at 3.3 watts output; the grid-current point of the 6Q7 was reached at 4.75 watts output. The power delivered from the secondary of the output transformer to the speaker is obtained by multiplying the power delivered to the primary by the efficiency of the output transformer. The efficiency of the usual single-tube output transformer is about 70 per cent.

The cathode current of the 6Y6-G remained substantially constant at 65 milliamperes and the total rectifier current remained substantially constant at 85 milliamperes. The total rectifier current included the current drain of the 6A8 and 6K7; the avc system was not acting on these tubes during the tests. When the converter and i-f tubes are under the control of the avc system, the values of total rectifier current and 6Y6-G cathode current are somewhat different from the values given.

When the rectifier is furnishing maximum current, the voltage per plate of the 5Y3-G is 230 volts (rms) and the rectifier current per plate is 84 milliamperes (rms). Under these conditions, the screen voltage is approximately 130 volts. The decrease from 135 volts is due to the internal resistance of the power-supply unit.

Push-Pull Operation

The receiver used in the previous tests was redesigned to accommodate two 6Y6-G's connected in push-pull and a two-tube phase inverter. The circuit of this arrangement is shown in Fig.4. Two 6Q7's were used in the phase inverter circuit in order that a single cathode resistor and by-pass condenser could serve for both tubes. The diode plates in the second 6Q7 were connected to cathode, as shown, but may be grounded.

The output tubes were self-biased by a cathode resistor. When the bias is obtained from the voltage drop across the speaker field in a manner similar to that shown in Fig.1, a large amount of hum is introduced into the grid circuit of 6Q7 (II). This hum voltage can be reduced to a satisfactory level by employing a suitable resistance-capacitance filter in the grid circuit of this tube. When such a filter is used, the plate-supply voltage of both 6Q7's is the zero-signal output voltage of the rectifier, or 135 volts. With 135 volts available from the filter, the output voltage of the 6Q7's at their grid-current point is not enough to drive the output tubes to full output (grid-current point of

6Y6-G's) when the output tubes are biased for class A_1 operation. Moreover, with class A_1 operation of the output tubes, the total rectifier current is high. However, when the output tubes are biased by a self-bias resistor, the output voltage of the filter is approximately 150 volts, which is the plate-supply voltage of the 6Q7's. With this value of supply voltage, the output of the 6Q7's is more than sufficient to drive the 6Y6-G's to full output. Hence, the 6Y6'G's can be overbiased to reduce the total rectifier current to approximately 125 milliamperes.

Curves of power output, distortion, and screen dissipation vs plate-to-plate load are shown in Fig.5. A recommended plate-to-plate load of 2500 ohms was selected from these data. Curves of distortion, total rectifier current, and output-stage cathode current vs power output are shown in Fig.6. A power output of nearly 6 watts with 5 per cent distortion is obtained at the grid-current point of the 6Q7's.

When the rectifier is furnishing maximum current, the voltage per plate of the 5Y3-G is 247 volts (rms) and the rectifier current per plate is 120 milliamperes (rms). Under these conditions, the screen voltage of the 6Y6-G's is 117 volts. The internal resistance of the power-supply unit, as calculated from zero-signal and full signal data, is approximately 1600 ohms.

CIRCUIT OF POWER SUPPLY AND A-F PORTION OF TYPICAL RECEIVER

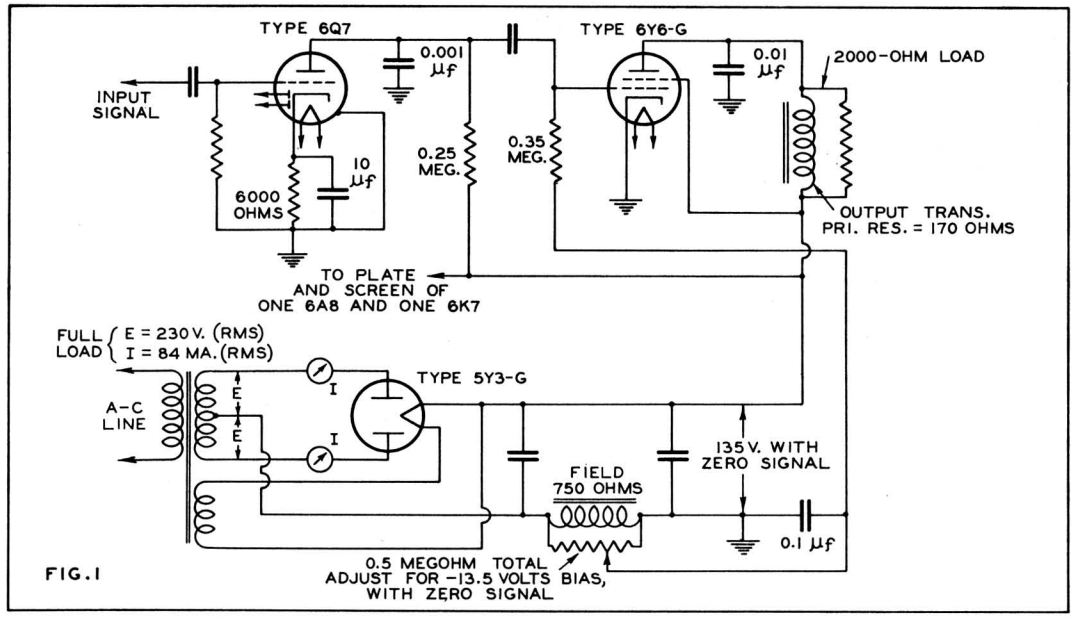

FIG. 1

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OPERATION CHARACTERISTICS OF A SINGLE 6Y6-G IN A TYPICAL RECEIVER

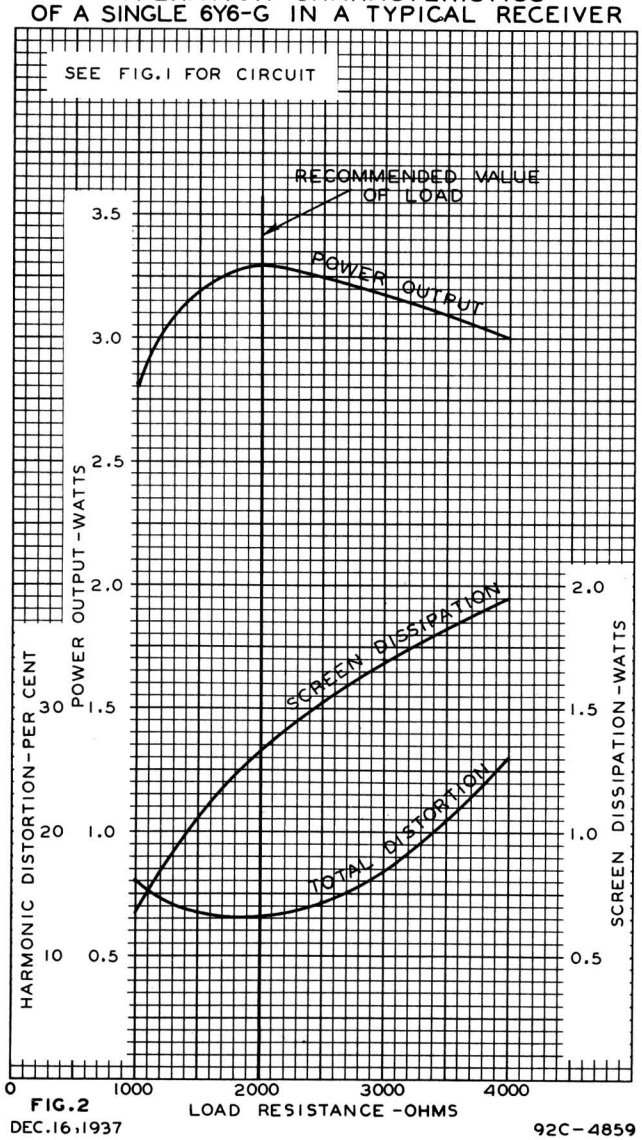

FIG. 2

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OPERATION CHARACTERISTICS OF A SINGLE 6Y6-G IN A TYPICAL RECEIVER

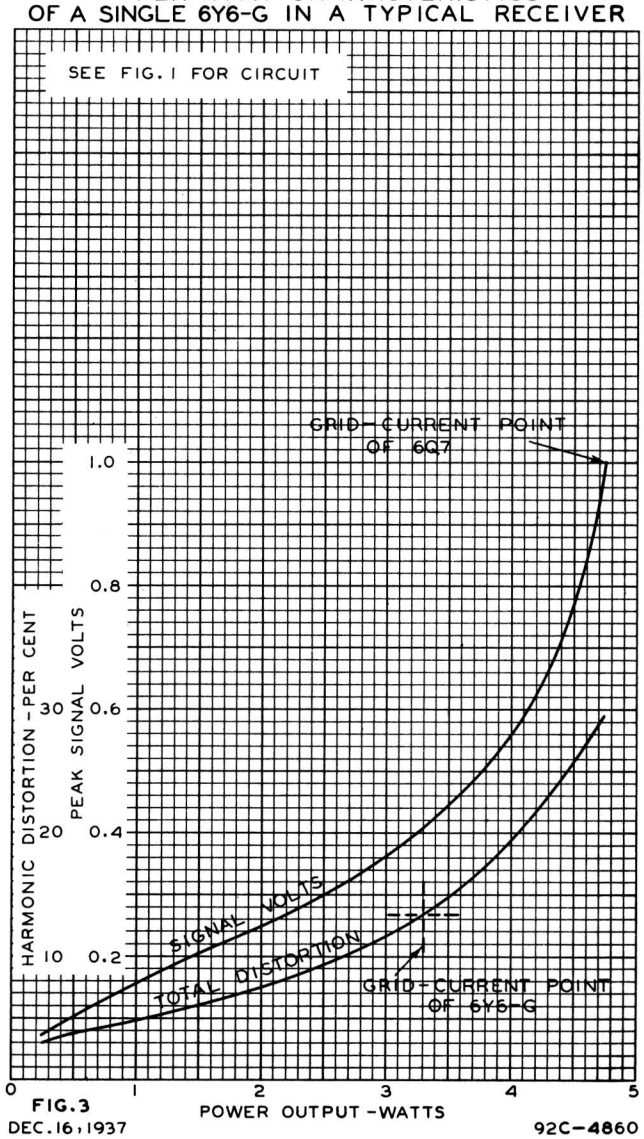

FIG. 3

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CIRCUIT OF POWER SUPPLY AND A-F PORTION (WITH TWO-TUBE PHASE INVERTER) OF TYPICAL RECEIVER

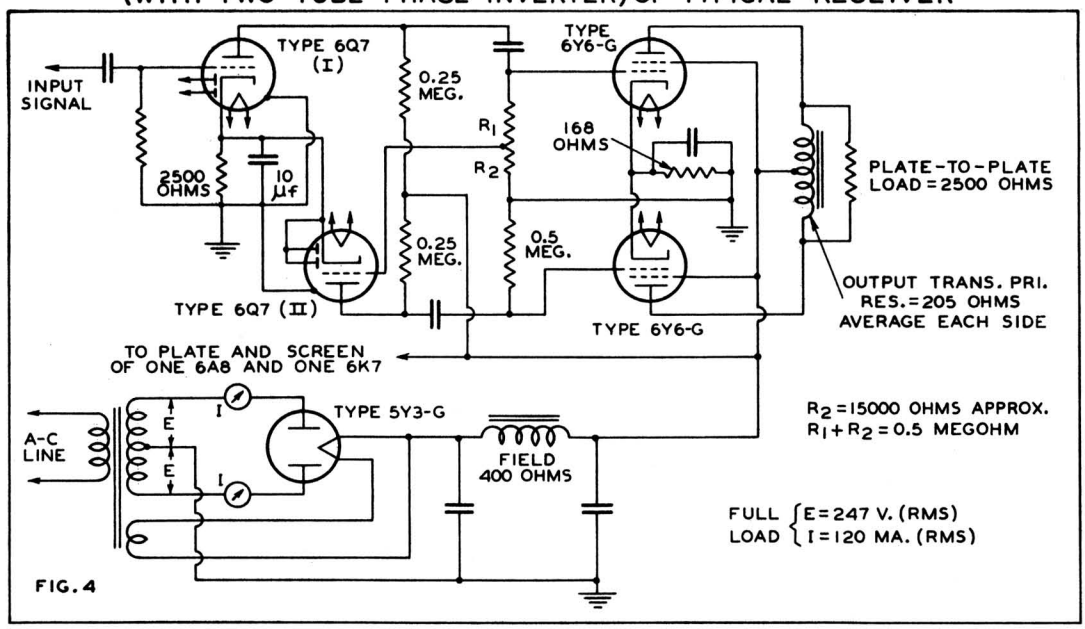

FIG. 4

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OPERATION CHARACTERISTICS OF PUSH-PULL 6Y6-G'S IN A TYPICAL RECEIVER

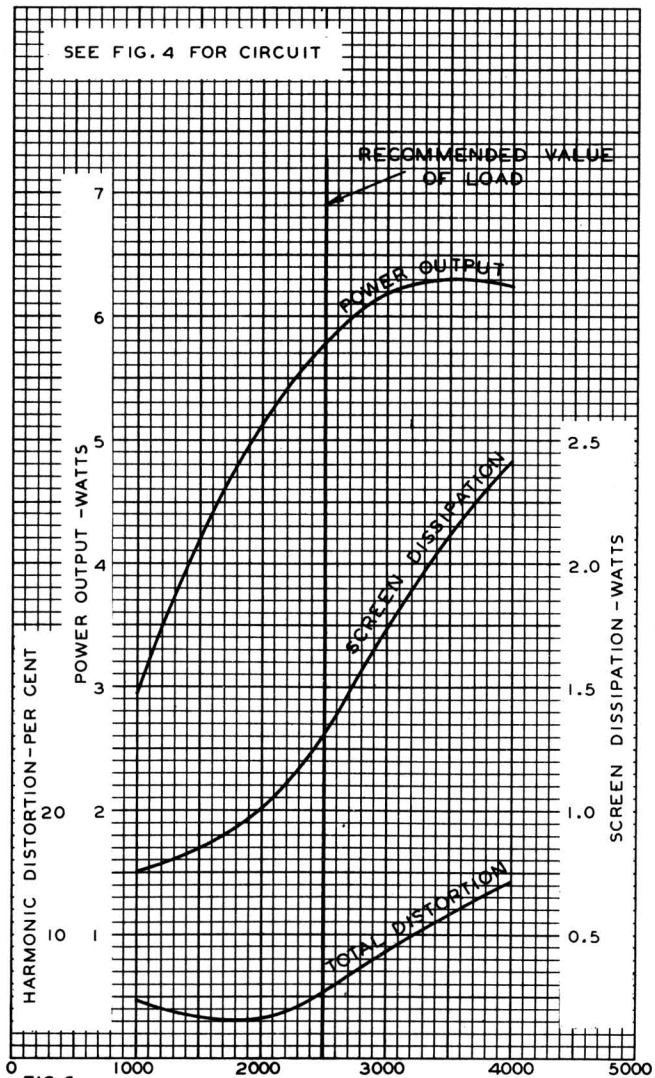

FIG. 5

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OPERATION CHARACTERISTICS OF PUSH-PULL 6Y6-G'S IN A TYPICAL RECEIVER

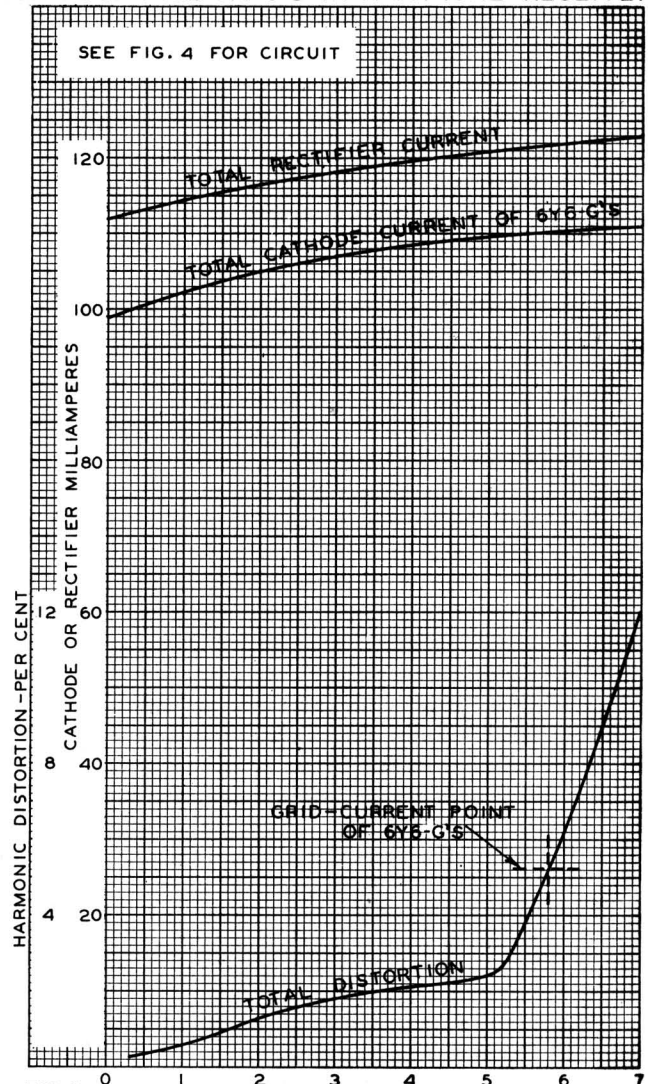

FIG. 6

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