RCA-6417 is a general-purpose transmitting beam power tube of the heater-cathode type intended for use in compact, low-power mobile and portable transmitters and in emergency communications equipment operating directly from 12-volt storage batteries. It can also be used in the low-power stages of larger fixed station transmitters. The 6417 can be operated with full input up to 50 megacycles per second and with reduced input up to 175 megacycles per second.

Because of its high transconductance, and a plate characteristic favorable to the generation of a high harmonic output, the 6417 is particularly useful in the doubler and tripler stages of transmitters. Because of its high permeance, this tube can supply high power output at relatively low supply voltages. These features in addition to its high power sensitivity make the 6417 especially useful as an rf power amplifier, frequency multiplier, oscillator (VFO or crystal), and as a vhf driver tube for larger tube types.

Featured in the design of the 6417 are heavy control-grid support rods and two control-grid base-pin connections which provide for cooler grid operation; a cathode with a large area to supply the high peak currents required for multiplier service; and a 12.6-volt heater which can be conveniently operated from a storage battery.

**GENERAL DATA**

**Electrical:**
- Heater, for unipotential cathode:
  - Voltage (AC or DC) ........... 12.6 ± 10% volts
  - Current ................ 0.375 amp
- Transconductance for dc plate current of 45 ma, dc plate voltage of 250 volts, and dc grid-No.2 voltage of 250 volts: 7000 μhos

**Plate-Multiplying RF Power Amp. - Class C Telephony**

Carrier conditions per tube for use with a maximum modulation factor of 1.0

<table>
<thead>
<tr>
<th>DC Plate Voltage</th>
<th>250 max.</th>
<th>300 max. volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Grid-No.3 (Suppressor) Voltage</td>
<td>0 max.</td>
<td>0 max. volts</td>
</tr>
<tr>
<td>DC Grid-No.2 (Screen) Voltage</td>
<td>250 max.</td>
<td>250 max. volts</td>
</tr>
<tr>
<td>DC Grid-No.1 (Control-Grid) Voltage</td>
<td>-125 max.</td>
<td>-125 max. volts</td>
</tr>
<tr>
<td>DC Plate Current</td>
<td>40 max.</td>
<td>50 max. ma</td>
</tr>
<tr>
<td>DC Grid-No.2 Current</td>
<td>15 max.</td>
<td>15 max. ma</td>
</tr>
<tr>
<td>DC Grid-No.1 Current</td>
<td>5 max.</td>
<td>5 max. ma</td>
</tr>
<tr>
<td>Plate Input</td>
<td>10 max.</td>
<td>15 max. watts</td>
</tr>
<tr>
<td>Grid-No.2 Input</td>
<td>1.5 max.</td>
<td>1.5 max. watts</td>
</tr>
<tr>
<td>Plate Dissipation</td>
<td>8 max.</td>
<td>12 max. watts</td>
</tr>
</tbody>
</table>

Peak Heater-Cathode Voltage:
- Heater negative with respect to cathode: 100 max. 100 max. volts
- Heater positive with respect to cathode: 100 max. 100 max. volts

Bulb Temperature (At hottest point on bulb surface): 200 max. 250 max. °C

Typical Operation up to 30 Mc:
- DC Plate Voltage ........... 250 300 volts
- Grid No.3 .................. Connected to cathode at socket
- DC Grid-No.2 Voltage# .... 250 250 volts
- DC Grid-No.1 Voltage# .... 250 250 volts
- DC Grid-No.1 Current# .... 250 250 volts
- DC Grid-No.1 Current (Approx.) .... 39000 18000 ohms
- Peak RF Grid-No.1 Voltage ................ 46.5 53.5 volts
- DC Plate Current ........... 40 50 ma
- DC Grid-No.2 Current .... 6 ma
- DC Grid-No.1 Current (Approx.) .... 1 2.4 ma
- Driving Power (Approx.) .... 0.05 0.15 watt
- Useful Power Output (Approx.) .... 6.4 10 watts

Maximum Circuit Values (For maximum rated conditions):
- Grid-No.1-Circuit Resistance 0.1 max. 0.1 max. megohm
RF POWER AMP. & OSC. - Class C Telegraphy

and

RF POWER AMPLIFIER - Class C FM Telephony

Typical Operation:

<table>
<thead>
<tr>
<th>Voltage/Parameter</th>
<th>Doubler to 175 Kc</th>
<th>Tripler to 175 Kc</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Plate Voltage</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Grid No.3</td>
<td>Connected to cathode at socket</td>
<td></td>
</tr>
<tr>
<td>DC Grid No.2 Voltage</td>
<td>10</td>
<td>** 20</td>
</tr>
<tr>
<td>Grid No.1 Voltage#</td>
<td>-75</td>
<td>-100</td>
</tr>
<tr>
<td>From a grid resistor of</td>
<td>75000</td>
<td>100000</td>
</tr>
<tr>
<td>Peak RF Grid No.1 Voltage</td>
<td>95</td>
<td>120</td>
</tr>
<tr>
<td>DC Plate Current</td>
<td>40</td>
<td>35</td>
</tr>
<tr>
<td>Grid No.2 Current</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Grid No.1 Current</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Driving Power (Approx.)</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Useful Power Output (Approx.)</td>
<td>2.1</td>
<td>1.3</td>
</tr>
</tbody>
</table>

Maximum Circuit Values (For maximum rated conditions):

- Grid No.1 Circuit Resistance 0.1 max. 0.1 max. megohm

MAXIMUM RATINGS vs OPERATING FREQUENCY

<table>
<thead>
<tr>
<th>FREQUENCY</th>
<th>50 Kc</th>
<th>175 Kc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Input</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class C Telephony, Plate Modulated</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Class C Telegraphy</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Class C FM Telephony</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Frequency Multiplier</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

- Heater Current . . . . . 1 0.345 0.405 Amp
- Grid No.1-to-Plate Capacitance | 2 | -0.8 | 0.3 µf
- Output Capacitance | 2 | 8 | 11 µf
- Transconductance | 2 | 3.8 | 5.2 µs
- Plate Current | 1.3 | 33 | 57 mA
- Grid No.2 Current | 1.3 | -10 | 10 µa
- Reverse Grid No.1 Current | 1.4 | -2 | 2 µa

NOTE 1: with 12.6 volts ac or dc on heater.
NOTE 2: with no external shield.
NOTE 3: with dc plate voltage of 250 volts, dc grid-no.2 voltage of 250 volts, and dc grid-no.1 voltage of -7.5 volts.
NOTE 4: with dc plate voltage of 250 volts, dc grid-no.2 voltage of 250 volts, dc grid-no.1 voltage of -7.5 volts, and grid-no.1 circuit resistance of 0.1 megohm.

FREQUENCY MULTIPLIER

Maximum CCS Ratings, Absolute Values:

- DC Plate Voltage . . . . . 300 max. volt
- DC Grid No.3 (Suppressor) Voltage | 0 max. |
- DC Grid No.2 (Screen) Voltage | 250 max. |
- DC Grid No.1 (Control-Grid) Voltage | -125 max. |
- DC Plate Current | 50 max. |
- DC Grid No.2 Current | 15 max. |
- DC Grid No.1 Current | 5 max. |
- Plate Input | 15 max. |
- Grid No.2 Input | 2 max. |
- Plate Dissipation | 12 max. |

PEAK HEATER-CATHODE VOLTAGE:

- Heater negative with respect to cathode | 100 max. |
- Heater positive with respect to cathode | 100 max. |

BULB TEMPERATURE (At hottest point on bulb surface) | 250 max. 0°C
INSTALLATION AND APPLICATION

The maximum ratings are limiting values above which the serviceability of the 6417 may be impaired from the viewpoint of life and satisfactory performance. Therefore, in order not to exceed these absolute ratings, the equipment designer has the responsibility of determining an average design value for each rating below the absolute value of that rating by an amount such that the absolute values will never be exceeded under any usual conditions of supply-voltage variation, load variation, or manufacturing variation in the equipment itself.

The 6417 can be operated at full input up to 50 megacycles. It is recommended that it be used as a frequency multiplier rather than as a straight-through amplifier at frequencies above 135 megacycles, in order to avoid excessive drive power due to high-frequency input loading.

Heavy leads and conductors together with suitable insulation should be used in all parts of the rf plate tank circuit so that losses due to rf voltages and currents may be kept at a minimum. At the higher frequencies, it is essential that short, heavy leads be used for circuit connections in order to minimize lead inductance and losses.

Average Characteristics of Type 6417 with $E_{c1}$ as Variable.

The base pins of the 6417 fit the noval socket. The socket may be mounted to hold the tube in any position.

If the 6417 is to be used in aircraft transmitters at high altitudes, it is recommended that the socket clip corresponding to pin No. 2 be removed. Removal of this clip will help to insulate the plate (pin No. 1) from grid No. 3 (pin No. 3) and thus prevent any flashover.

The bulb becomes hot during continuous operation and, therefore, free circulation of air around the
tube should be provided. If a tube shield is used, it is advisable to paint the inside and outside surface of the shield a mat black, and to provide ventilation slots in order to prevent the temperature at the hottest point of the bulb surface from exceeding 250° centigrade.

Grid No. 1 of the 6417 is designed with heavy support rods, and has 2 pin connections (pins 8 and 9) to permit cooler grid operation. In operating the 6417, it is essential that both grid-No.1 pins be connected into the circuit.

In plate-modulated class C RF power amplifier service, the 6417 should be supplied with bias from a grid-No.1 resistor or from a suitable combination of grid-No.1 resistor and fixed supply grid-No.1 resistor and cathode resistor. The cathode resistor should be bypassed for both audio and radio frequencies. The combination method of grid-resistor and fixed supply has the advantage of not only protecting the tube from damage through loss of excitation but also of minimizing distortion by bias-supply compensation.

In class C RF telephony and class C F.M. telephony service, the 6417 should be operated with grid-No.1 bias obtained from a fixed supply or from a grid-No.1 bias resistor. The use of a grid-No.1 resistor is preferred because the bias is automatically adjusted as the load on the circuit varies. Because of the high amplification factor of the 6417, a small cathode resistor of 68 ohms can furnish sufficient voltage to protect the tube in the event of excitation failure and resultant loss in developed bias. The cathode bias of 3 volts required for protection is sufficiently small to make the dc plate power loss an unimportant factor.

The driver stage for the 6417 in either class C telephony or telegraphy service should have considerably more output capability than the typical tube driving power shown in the tabulated data in order to permit considerable range of adjustment and also to provide for losses in the grid-No.1 circuit and the coupling circuits. This recommendation is particularly important near the maximum rated frequency where there are other losses of driving power, such as circuit losses, radiation losses, and transit-time losses.

Highest operating efficiency in high-frequency service, and therefore maximum power output, will be obtained when the 6417 is operated under load conditions such that the maximum rated plate current flows at the plate voltage which will give maximum rated input.

Push-pull or parallel circuit arrangements can be used when more radio-frequency power is required than can be obtained from a single 6417. Two 6417's in parallel or push-pull will give approximately twice the power output of one tube. The parallel connection requires no increase in exciting voltage necessary to drive a single tube.

With either connection, the driving power required is approximately twice that for a single tube. The push-pull arrangement has the advantage of simplifying the balancing of high-frequency circuits. When two or more tubes are used in the circuit, precautions should be taken to insure that each tube draws the same plate current.

Devices and arrangements shown or described herein may use patents of RCA or others. Information contained herein is furnished without responsibility by RCA for its use and without prejudice to RCA's patent rights.