Application of Transformer RCA-225T1 in Deflection System for Wide-Angle Large-Screen Kinescopes

A deflection system using the new ferrite-core transformer, RCA-225T1, has been developed to supply adequate horizontal deflection and anode voltage of 15 kilovolts for kinescopes such as the RCA-17CP4 and RCA-20CP4, having horizontal-deflection angles of about 66 degrees. The tubes required for the horizontal-deflection-and-high-voltage circuit are one 6BQ6-GT or 6AU5-GT beam power amplifier, one 6W4-GT damper diode, and one 1B3-GT high-voltage rectifier. Transformer RCA-225T1 is so designed that the power for the vertical-deflection circuit may be obtained from the boosted B-voltage supply. The power input required for the horizontal-deflection-and-high-voltage and vertical-deflection circuits totals approximately 29 watts from a 280-volt B-supply when a 6BQ6-GT is used, or 31 watts from a 300-volt B-supply when a 6AU5-GT is used.

General circuit design considerations for the use of the RCA-225T1 are the same as those for the RCA-224T1 and are described at some length in RCA Application Note AN 148. The deflecting yoke, RCA-209D1; the linearity control, RCA-209R1; and the vertical-deflection circuits for the RCA-225T1 are the same as those used with the RCA-224T1. The recommended horizontal-deflection circuit for the 225T1 shown in Fig.1 is essentially the same as the circuit for the 224T1. Special considerations in the use of the 225T1 are discussed below.

Width Control

An inductive width control may be used, connected to terminals 1 and 3 of the 225T1. When this control has the recommended inductance range (1.5 to 13 millihenries), the maximum width reduction is approximately 12 per cent and the corresponding high-voltage reduction is approximately 400 volts.

The deflection circuit is well suited to methods of width control in which power input to the circuit is varied. One such method is to insert an unbypassed variable resistor in series with the B-supply lead.
to the deflection circuits. Another is to add a variable resistor in
series with the screen-grid resistor, \( R_{15} \). A disadvantage of these
methods is that the high-voltage is reduced; an advantage is that
appreciably less current is required by the deflection circuits. For
example, with any of the power-control methods the no-load kinescope
anode voltage at normal width setting is approximately 14.5 kilovolts
and the cathode current of the horizontal-output tube is approximately
80 milliamperes (the corresponding figures with an inductive width control
are 16 kilovolts and 95 milliamperes). By adjustment of the power control,
variations in line voltage and components can be compensated for, so that
for normal picture width the no-load high voltage and the cathode current
of the horizontal-output tube are maintained substantially constant at
the above figures.

Lead Dress

The step-up ratio of the 225T1 transformer is such that a kinescope
anode voltage of 15 kilovolts may be obtained. Because of this step-up
ratio any capacitance between the 133-0T plate and the chassis has a 30
times greater effective value at the yoke. If this effective capacitance is excessive, horizontal-retrace time is increased and the high
voltage is decreased. Consequently, it is important to keep the 1B3-0T
plate lead short and to mount the 1B3-0T in such a manner that stray
capacitance from plate to chassis is minimized.

Drive Requirements

To obtain adequate deflection and high-voltage output from any hori-
Zontal-deflection circuit without excessive power input and excessive
dissipation in the horizontal-output tube, a sawtooth voltage of proper
amplitude and waveform must be applied to the grid of the horizontal-
output tube. The proper amplitude is that which results in near class B
operation. Insufficient sawtooth voltage yields more nearly class A
operation, and therefore results in reduced efficiency and a consequent
reduction in the deflection voltage and high-voltage output. Excessive
sawtooth voltage produces class C operation, which causes a localized
cramping and a resultant white line near the center of the raster. The
desired sawtooth amplitude may be determined by adjusting the drive
control to increase the amplitude until a white line appears near the
center of the raster and then reducing the drive until the white line
just disappears.

The waveform of the driving sawtooth voltage is determined in the
design of the horizontal-oscillator circuit and no service adjustment
is needed. The criterion for proper sawtooth waveform is circuit
efficiency. If the designer uses a horizontal-oscillator circuit other
than that shown in Fig.1, he should try various component values in the
horizontal-oscillator circuit until the combination is found which produces
the most high-voltage output with the least cathode current in the
horizontal-output tube. The data in Table I indicate the efficiency
which can be obtained. The shape of the sawtooth voltage waveform on an
oscilloscope is not a satisfactory criterion for waveform adjustment.
Significant changes in circuit efficiency can be obtained with such
subtle changes in sawtooth waveform that the effects on the oscilloscope
 waveform are not readily perceptible.
Vertial Deflection

The vertical-deflection circuits may be operated from the boosted B-supply, provided the current drain is not more than 12 milliamperes. Any larger current drain reduces the scanning amplitude and the high-voltage output. The relatively high boosted voltage permits the design of a vertical-deflection circuit of good efficiency. When a 6SH vertical-output tube, a 209DL yoke, and a vertical-output transformer having an 18:1 turns ratio are used, adequate vertical deflection is obtained with a 6SH plate current of approximately 11 milliamperes.
Typical Operation

Table I shows typical operating conditions for the circuit of Fig.1 with an average 6BQ6-GT, a line voltage of 117 volts, and with maximum width adjustment. For purposes of evaluating circuit performance, the following values should be measured: the B-voltage, the 6BQ6-GT cathode current, the 6BQ6-GT screen current, the 6BQ6-GT screen voltage, the current drawn from the boosted-voltage supply, and the voltage of the high-voltage supply.

Table I - Typical Operation of Circuit in Fig.1

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>B-Voltage</td>
<td>280 volts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Voltage:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At Zero Beam Current</td>
<td>16 kilovolts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At 140 μA Beam Current</td>
<td>14.8 kilovolts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boosted Voltage</td>
<td>520 volts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current from Boosted Voltage Supply</td>
<td>11 milliamperes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retrace Time</td>
<td>8.9 microseconds</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6BQ6-GT

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode Current</td>
<td>93.7 milliamperes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plate Current</td>
<td>80.0 milliamperes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grid-No.2 Current</td>
<td>13.7 milliamperes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>146 volts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grid-No.2 Input</td>
<td>2.0 watts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grid-No.1 Voltage</td>
<td>-32 volts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak Plate Voltage</td>
<td>4350 volts</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6W4-GT

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Current</td>
<td>91 milliamperes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak Inverse Plate Voltage</td>
<td>2400 volts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak Heater-to-Cathode Voltage</td>
<td>1600 volts</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1B3-GT

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Inverse Plate Voltage</td>
<td>18.7 kilovolts</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* At a line voltage of 117 volts with maximum width adjustment. All values are at zero kinescope beam current unless otherwise noted.

● Measured at terminal 3 of RCA-225T1.

▲ Composed of 14 volts cathode bias and 18 volts grid-resistor bias.

When a 6AU5-GT is used, the no-load value of the high voltage is 16 kilovolts for the following 6AU5-GT operating conditions: B-voltage, 300 volts; screen voltage, 195 volts; screen current, 10.5 milliamperes; and cathode current, 91 milliamperes.
ERRATUM NOTICE

for

Application Note AN-149 ‘Application of Transformer RCA-225T1 in Deflection System for Wide-Angle Large-Screen Kinescopes.’

Page 3, Fig. 1 - Horizontal-Deflection and High-Voltage Circuit. The value shown in the parts list for resistor R20 is incorrectly given as 10000 ohms, 0.5 watt; the correct value of R20 is 1000 ohms, 0.5 watt.