EXPERIMENTAL TELEVISION CIRCUITS

By The Engineering Department, Kenyon Transformer Co., Inc.

SINCE sweep circuits are the foundation on which a television receiver must be built, it is logical to consider what their function is, how they work, and how they may be built, before going into the other details of the receiver.

A characteristic of the human eye termed as the persistence of vision is such that if an image is flashed intermittently before it more than a certain minimum times per second the image appears without perceptible flicker. Around this peculiar characteristic is built up the principle of television and also motion pictures.

Now let us suppose it is possible to move the beam of cathode ray tube back and forth in a horizontal direction fast enough, and at the same time move it up and down on the screen sixty times per second, making a series of horizontal lines about a fourth of an inch apart. This is as though we had laid out a rectangle on a piece of paper and had moved our pencil once across the page for every time we moved it down the page a fourth of an inch. A series of parallel lines very close together would be the result. Now, if we were to bear down lightly on the pencil every time across until we reached the middle, then heavily for the rest of the lines, a picture would be formed of two rectangles side by side, one light, and the other dark. By varying the pressure of our pencil on the way across the

Fig. 1

The complete sweep circuit assemblies and cathode ray tube as set up for experimental use.

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Experimental Television Circuits

Vertical Low Frequency Sweep Circuit

List of Parts

- R1: 1 Meg. Pot.
- R2: 4,000 ohms—1 watt
- R3: 100,000 ohms—1 watt
- R4: 250,000 ohms—Pot. Freq. Control
- R5: 25,000 ohms—Pot. Sine Control
- R6: 2,000 ohms—5 watt
- R7: 50,000 ohms—Pot. Bias
- R8: 500,000 ohms—1 watt
- R9: 100,000 ohms—Pot. Linearity Control
- R10: 500,000 ohms—1/2 watt
- R11: 10,000 ohms—Pot. Bias

- C1: 1 mfd—400 v. Paper
- C2: .002 mfd—400 v. Mica
- C3: .1 mfd—400 v. Paper
- C4: 10 mfd—50 v. Elect.
- C5: .5 mfd—400 v. Paper
- C6: .1 mfd—400 v. Paper
- C7: 20 mfd—50 v. Elect.
- C8: 8 mfd—40 v. Elect.
- V1, V2, V3—76
- V4—6CS

T1—Kenyon Type T112

Suggested Centering Control

To T1

De-leafing of Coil

5 ohms

Horizontal High Frequency Sweep Circuit

List of Parts

- R1: 1 Meg. Potentiometer
- R2: 4,000—1 watt
- R3: 100,000—1 watt
- R4: 100,000—Pot. Freq. Control
- R5: 10,000—Pot. Sine Control
- R6: 2,000—1 watt
- R7: 10,000—Bias Pot.
- R8: 250,000—1 watt
- R9: 50,000—1/2 watt
- R10: 1,000—Pot. Bias
- R11: 8,000—1/2 watt
- R12: 35,000 ohms—1 watt

- C1: .005 mfd—400 v. Paper
- C2: .002 mfd—400 v. Mica
- C3: .3 mfd—400 v. Paper
- C4: .01 mfd—50 v. Elect.
- C5: .06 mfd—50 v. Elect.
- C6: .005 mfd—400 v. Paper
- C7: .05 mfd—50 v. Elect.
- C8: .05 mfd—600 v. Paper
- V1, V2, V3—76
- V4—6C6
- V5—1V (Filament Insulated from Ground)
- T1—Kenyon Type T111

In order to make our picture plane, we went back and put an extra line between each of those we had already drawn. In order to do this, we would go back to the top of the picture, if this is where we started, and draw another set of horizontal lines, shading them by pencil pressure, to conform with those previously drawn. The picture is now finished, and we go on to another picture to be made in exactly the same manner.

The sweep circuits to be described are for standard 441 line scanning, 50 frames per second. This means that there are 220 parallel lines on each tracing of the picture (or half frame) and that it takes 1,100th of a second to trace a half frame. From this we see that the frequency of the vertical sweep is 56 per second and the horizontal sweep is 220 times this or 13,200 per second.

Thus one sweep must generate sixty uniform pulses per second, and the other 13,200 per second. Since these pulses must be uniform in time, the wave form will be a saw tooth with one side a straight slanted line, and the other side almost vertical, indicating a quick return.

The saw tooth generators to be described are designed to meet these requirements by two Englishmen, Bedord and Puckle. They were recommended and described to us by Mr. M. E. Wilder of the National Union Radio Co. Their advantage over some other types is in the stability of oscillation, ease of adjustment, and in the low value of voltage necessary to synchronize them.

Vertical Low Frequency Sweep

The saw tooth generator in this circuit as shown in Fig. 2 consists of V1, V2, and V3. Note the connections on these tubes. It is

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voltage drop in $R_6$. Since $R_6$ is coupled to the grid of $V_1$, it swings the grid negative and $V_1$ draws no current. At the same time a voltage has been building up across the $R_4$, $R_5$, $C_3$ network. This happens almost instantaneously and the plate current of $V_2$ reaches a steady value. When the steady state is reached there is no longer a negative voltage applied to the grid of $V_1$. As soon as the charge leaks off its grid through $R_7$, $V_1$ starts to draw plate current. This causes a voltage drop in $R_6$, swinging the grid of $V_2$ further negative. This reduces the plate current of $V_2$ decreasing the voltage drop in $R_6$ and applying a positive surge to the grid of $V_1$ through the coupling network $R_8$, $C_3$. This causes additional plate current to flow through $R_8$, biasing $V_2$ further toward cut-off.

Now when plate current no longer flows in $V_2$, the charge starts to leak-off $C_3$ through $R_4$, $R_5$. The time necessary for this to occur is determined by the time constant of the RC combination. The voltage drop is then following the exponential discharge curve of a condenser-resistor combination. When this charge has leaked off, the grid of $V_2$ is again at a positive potential with respect to its cathode so $V_2$ starts to draw plate current. So the cycle is ready to repeat itself. During this cycle the voltage across $R_6$, $R_5$ increases very sharply and decreases at a rate as determined by the values of resistance and capacity chosen. A portion of this voltage is taken off $R_5$ and fed to the grid of $V_2$ to be amplified.

Since the voltage fed to the grid of $V_2$ is that of a condenser discharging through a resistor it is of an exponential curve and not truly linear. In order to correct for this, and also distortion which occurs in the deflecting coils on the cathode ray tube, $R_7$ and $R_6$ are made variable. This makes it possible to operate $V_3$ and $V_4$ on the portion of the plate characteristic which is curved in the proper manner to compensate for the nonlinearity. The resistor-condenser combination $R_6$, $C_3$ form an additional control for the purpose of linearity correction.

T-112, the output transformer, is specially designed to match the impedance of the vertical coils in the Kenyon deflecting tube T-709.

**SUGGESTED METHOD OF CENTERING**

In order to center the beam a direct current of the order of 300 M.A. may be necessary in either of both horizontal and vertical deflecting coils. The circuit Fig. 2A shows how to employ the total supply to sweep circuits and receiver for this purpose. No serious voltage drop is involved for the D.C. resistance of the deflecting coils is small.

The resistor shown in circuits, Figs. 2 and 3, have an important bearing on operating characteristics, and are therefore shown as variable types. However, when proper values are determined, fixed type resistors may then be substituted.

**LIST OF PARTS**

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<th>Part</th>
<th>Description</th>
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<tr>
<td>R1</td>
<td>40-25,000 ohm 1 watt carbon on form No. 1</td>
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<tr>
<td>R2</td>
<td>5—25,000 ohm 1 watt carbon on form No. 2</td>
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<tr>
<td>R3</td>
<td>300,000 ohm volume control, no taper or form No. 2</td>
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<tr>
<td>R4</td>
<td>4—20,000 ohm 1 watt carbon, plus 1—5,000 ohm 1 watt carbon on form No. 2</td>
</tr>
<tr>
<td>R5</td>
<td>5—10,000 ohm 1 watt carbon, plus 1—5,000 ohm 1 watt carbon on form No. 2</td>
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**METHOD OF MOUNTING RESISTORS TO STRIP**

- **Fig. 6**
  - Joint soldered top view
  - Joint soldered bottom view

**POWER SUPPLY CONSTRUCTION**

The first item which meets the eye in looking over the power supply diagram (Fig. 4) as furnished for the Kenyscope, is the fact that the bleeder is made up of a 1 Meg. 25 watts resistor, which is hard to obtain, particularly in the voltage class of this supply, 6000 V. D. C. However, a little thought evolved a suitable system. The bleeder in its entirety was made up of common one watt carbons, of small enough resistance so that when combined in series, their wattage rating would be sufficient. For instance, the megohm bleeder is made up on a baseplate strip, Fig. 5, designated as form No. 1, of forty equal one watt resistors, giving it a wattage rating of 40 which is more than sufficient.
The resistors are mounted on the two sides of the strip, as shown in Fig. 6 to make a series connection.

The other resistors are made up in the same manner. For variables, since very little current is drawn by the tube itself, a low wattage rating potentiometer was shunted across a fixed resistor, Form No. 2. (Fig. 5A). This is desirable, since a single unit, 100,000 ohm potentiometer capable of handling 3 watts, as required, is unusual.

It is recommended that all wiring on the high voltage side of the power supply be done with some type of high voltage cable, with at least a 13,000 volt test rating. The socket for the 87R rectifier should either be mounted on a bakelite plate with a minimum of 5/8" spacing from ground, or else mounted on ceramic stand off insulators, to withstand the high voltage.

**EXPERIMENTAL MOUNTING FOR TUBE**

The cathode ray tube comes packed in a carton which makes an excellent mount for experimental purposes, with a little revision. See sketch, Fig. 7. First, cut out handle (a) remove part (b) and remove tube. Remove straps from part (b), cut a suitable mask for the tube screen. (Size is given in tube data).

Now, remove the bottom of the carton by cutting above the wooden bottom at (c) all around the carton. Remove part (d) and reverse directions, so that the flaps point into the box, and replace, bringing it just flush to the line cut at (e).

**NEW KENYON TELEVISION COMPONENTS**

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