TUBES FOR AMATEURS

For Experimenting with Cathode-Ray Television

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THE work of amateurs and experimenters has always been important to radio progress. This is largely because many amateurs are highly endowed with a Missourian point of view and a driving curiosity which leads them to prefer the by ways and unknown regions of their hobby rather than the beaten paths. Even though the individual findings of many in this group may be small, the total contributions and accumulated experience of all the radio amateurs and experimenters in the United States have been impressive.

That the radio amateur group has perhaps not yet contributed much to modern television progress is in no way due to lack of ability or resourcefulness on its part, but rather to the fact that this field of investigation requires devices outside the scope of the home workshop.

Of these devices, cathode-ray tubes suitable for television reception are perhaps the most important. Now that such tubes are available to the amateur, one of the major obstacles to his participation in experimental television activities is removed. The fact that the way of the amateur television experimenter is not easy should not be minimized. Even the hardy amateur who likes to pioneer, to build complex apparatus, to tear down and build anew, and who lives in one of the few favored areas which have television transmitters, should recognize that the transmissions in these areas do not as yet have a common standard and that transmitters are often off the air for long periods while changes are being made.

BOTH TUBES ELECTROMAGNETIC

A photograph of two new cathode-ray tubes suitable for television, and known as Kinescopes, is shown in Fig. 1. Both of these tubes are of the electromagnetic-deflection type and utilize a screen material which fluoresces brightly with a yellowish hue. The larger tube, RCA-1800, has a bulb-end 9 inches in diameter and accommodates a picture 5½ inches by 7⅜ inches in size, while the smaller tube, RCA-1801, has a bulb-end 5 inches in diameter and can show a picture 3 inches by 4 inches.

The electron gun in each of these tubes has been especially designed to give the small spot

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: required for high-definition television re- tion. The conical portion of the bulb of h tube is coated on the inner surface with a iducting material to prevent distortion of the m and spot at the outer edges of the picture a. The maximum anode No. 2 voltage for 1800 is 7000 volts and for the 1801, 3000 ts. Lower voltages can be used where it is ired to economize on power-pack cost, but at ne sacrifice in either picture definition or ghtness.

A diagram of a voltage-supply circuit for the)0 is shown in Fig. 2. This diagram gives table circuit constants. A bleeder current two to five milliamperes is adequate. Adjust- :nt of electrode voltages is provided by po- itiometers in the bleeder circuit. The video

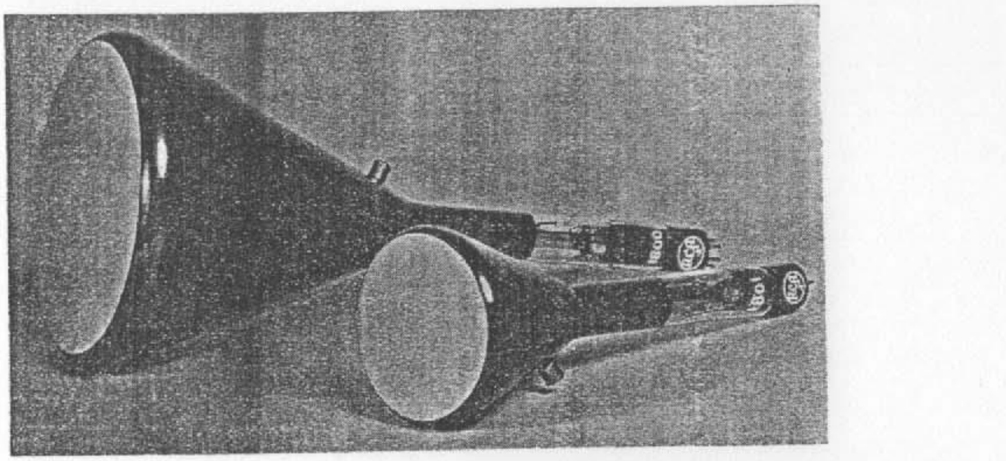

FIG. 1.
Photograph of Kinescopes RCA-1800 and RCA-1801

ignal and background-control bias are intro- uced between grid No. 1 and the cathode of ie cathode-ray tube.

A typical vertical-deflecting circuit for tele- ision reception is shown in Fig. 3. This circuit enerates a saw-tooth deflecting current in the ollowing manner. In the 6N7 tube, the triode nit shown on the left operates as a blocking scillator. Oscollations are started in the circuit y the feedback action of transformer *T*. The low of grid current which accompanies these scillations causes a negative bias voltage to uild up across the condenser C_1 and the grid eak consisting of resistors R_1 and R_2. After very few oscillations, this bias voltage be- omes sufficiently large to cause the plate cur- ent of the triode unit to cut off and, by so loing, to stop oscillations. When the oscilla- ions cease, the charge on C_1 leaks off through R_1 and R_3 to a value such that the circuit can esume oscillation. The tube then blocks again, and the cycle repeats.

Because the grid of the right-hand triode unit is connected to the grid of the first triode unit, the d-c plate current of the former unit rises suddenly to a large value during the period of oscillations. When oscillations stop, the d-c plate current becomes zero and remains zero

crease in d-c plate current, the plate voltage drops abruptly because of the loss of voltage in resistors R_4 and R_5. During the period that the d-c plate current is zero, the plate voltage increases at a relatively slow rate, the rate being limited chiefly by the time constant of C_3, together with R_4 and R_5. Because the plate voltage thus goes through an abrupt decrease followed by a relatively slow increase, its varia- tion has a saw-tooth form. This voltage ap- plied to the grid of the 6C5 through C_4 and R_7 produces a saw-tooth current in the plate cir- cuit of the 6C5. In this manner, saw-tooth cur- rent is caused to flow in the vertical-deflecting coils.

In television circuits, it is essential that this saw-tooth wave be synchronized with that gen- erated in the vertical scanning circuit of the Iconoscope at the studio. Synchronization is accomplished by a vertical synchronizing signal which is transmitted with the picture signal and which consists of a series of voltage pulses. These pulses trigger the blocking-oscillator tri-

(Continued on next page)

Constants for Fig. 3

[*Diagram is on page* 15.]

C_1, $C_3 = 0.1$ mfd.
C_2, $C_4 = 0.25$ mfd.
C_5, $C_6 = 10$ mfd.
$R_1 = 200{,}000$ Ohms } Vertical-Speed
$R_2 = 10{,}000$ Ohms } Controls
$R_3 = 100{,}00$ Ohms
$R_4 = 2$ Megohms
$R_5 = 2$ Megohms, Vertical-Size Control
$R_6 = 100{,}000$ Ohms, Vertical-Peaking Control
$R_7 = 1$ Megohm
$R_8 = 100{,}000$ Ohms, Vertical-Distribution Control
$R_9 = 10{,}000$ Ohms
$R_{10} = 50{,}000$ Ohms, Vertical-Centering Control
$R_{11} = 50{,}000$ Ohms
$L_1 =$ Coupling Choke, 100 Henries
$L_2 =$ Vertical-Deflecting Coils
T = Feedback Transformer

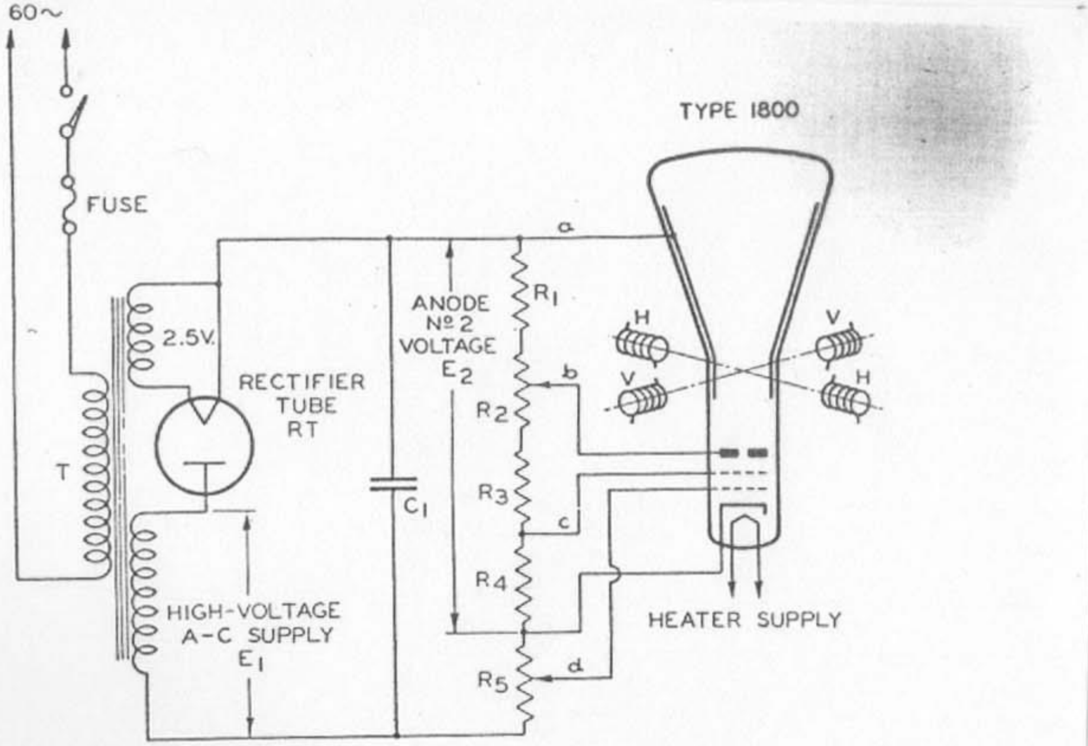

FIG. 2.
Voltage-supply circuit for RCA-1800.

Circuit Component	Specifications		
E_2	3,000 Volts	4,500 Volts	6,000 Volts
C_1	2 mfd., 3,000 Volts	2mfd., 4,500 V.	2 mfd., 6,000 V.
R_1	1 Megohm, 6 Watts	1 Megohm, 12 Watts	1 Megohm, 25 Watts
R_2	100,000 Ohms, 1 Watt	100,000 Ohms, 2 Watts	100,000 Ohms, 3 Watts
R_3	135,000 Ohms, 1 Watt	150,000 Ohms, 2 Watts	165,000 Ohms, 4 Watts
R_4	85,000 Ohms, 1 Watt	70,000 Ohms, 1 Watt	55,000 Ohms, 2 Watts
R_5	12,000 Ohms, 0.5 Watt	10,000 Ohms, 0.5 Watt	10,000 Ohms, 0.5 Watt
E_1	2,300 Volts RMS	3,400 Volts RMS	4,600 Volts RMS
RT	Type 879	Type 878	Type 878

a = Anode No. 2
b = Anode No. 1
c = Grid No. 2
d = Grid No. 1

H = Horizontal-Deflecting Coils
V = Vertical-Deflecting Coils
T = Power Transformer

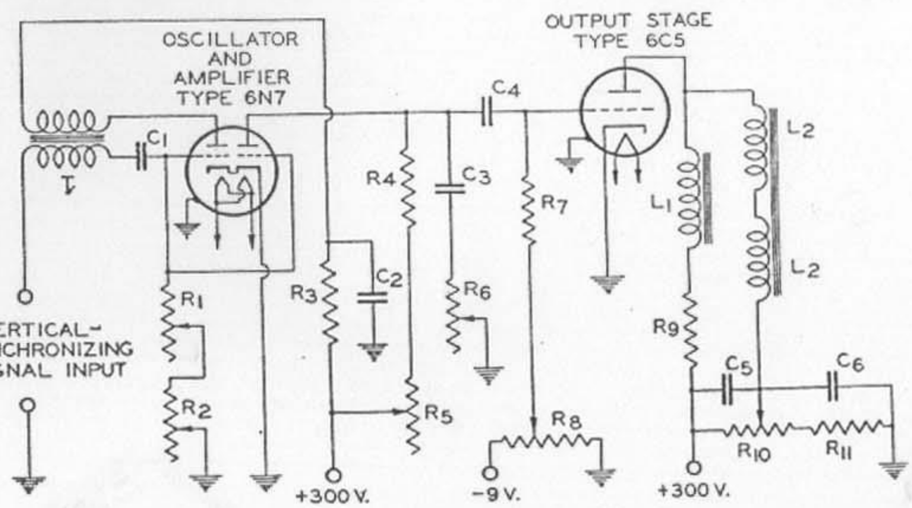

FIG. 3.
Vertical-deflecting circuit for RCA-1800 or RCA-1801. [See table, p. 14]

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o oscillation. In practice, the circuit of -hand triode unit is adjusted to function ite slightly slower than the rate of the ig synchronizing pulses. Hence, when the pulses are applied, the action of the blocking oscillator is speeded up to the proper rate for synchronization. Controls are provided so that the circuit can be adjusted for optimum operation. (Continued on next page)

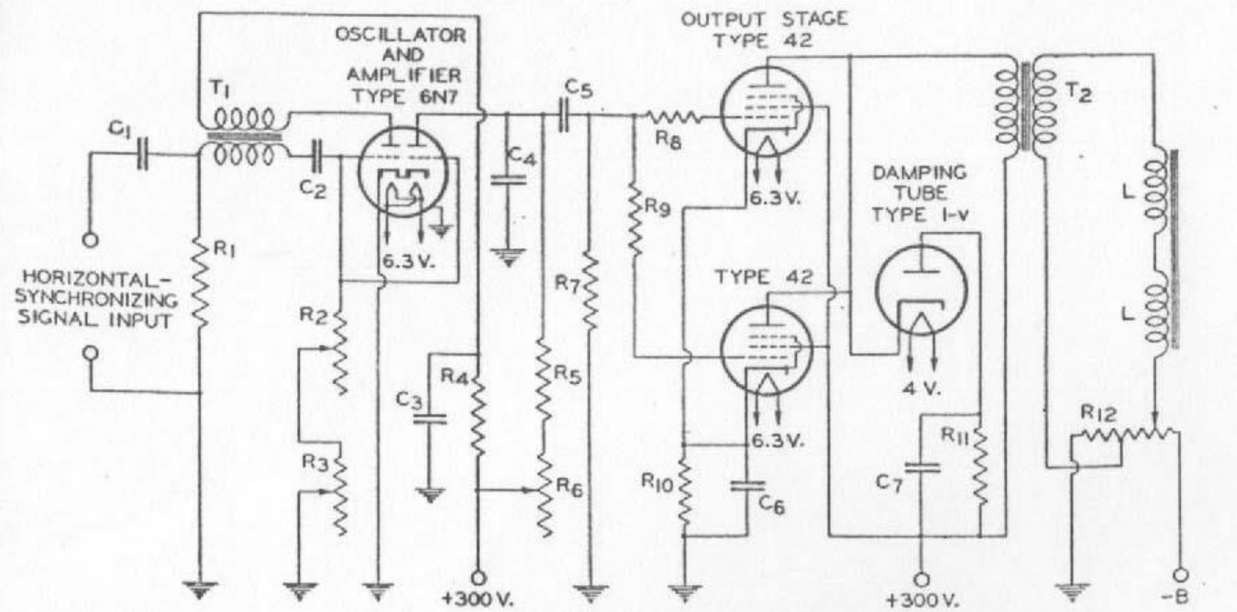

FIG. 4
Horizontal-deflecting circuit for RCA-1800.

.005 mfd.
= 0.001 mfd.
. C_7 = 0.05 mfd.
.5 mfd.
00 Ohms
00,000 Ohms } Horizontal-Speed
10,000 Ohms } Controls
00,000 Ohms
0,000 Ohms

R_6 = 0.25 Megohm, Horizontal-Size Control
R_7 = 0.5 Megohm
R_8, R_9 = 100 Ohms, Non-inductive
R_{10} = 200 Ohms
R_{11} = 8000 Ohms, 5 Watts
R_{12} = 5 Ohms, Horizontal-Centering Control
L = Horizontal-Deflecting Coils
T_1 = Feedback Transformer
T_2 = Output Transformer

A typical horizontal-deflecting circuit for the 1800 is shown in Fig. 4. In this circuit, a 6N7 and an output stage generate a synchronized, saw-tooth current in a manner similar to that described for the vertical-deflecting circuit. However, the horizontal-deflecting circuit operates at a much higher frequency than the vertical-deflecting circuit. Because the horizontal-deflecting frequency is high, the deflecting current decreases very rapidly on the return portion of the deflecting cycle. This rapid decrease in current causes shock-excited oscillations in the plate circuit of the output stage. To damp out these oscillations, a Type 1-v tube is connected across the primary of the output transformer T_2. When oscillation starts, the primary first applies a high positive voltage to the cathode of the 1-v and then applies a negative voltage. As soon as the cathode becomes negative with respect to the plate of the 1-v, the 1-v conducts current. Thus, the flow of current through the 1-v quickly damps out the oscillations caused by shock excitation.

CUTS DISTORTION

A deflection yoke is shown in perspective in Fig. 5. This yoke is designed to minimize pin-cushion distortion and defocusing of the spot at the edges of the picture.

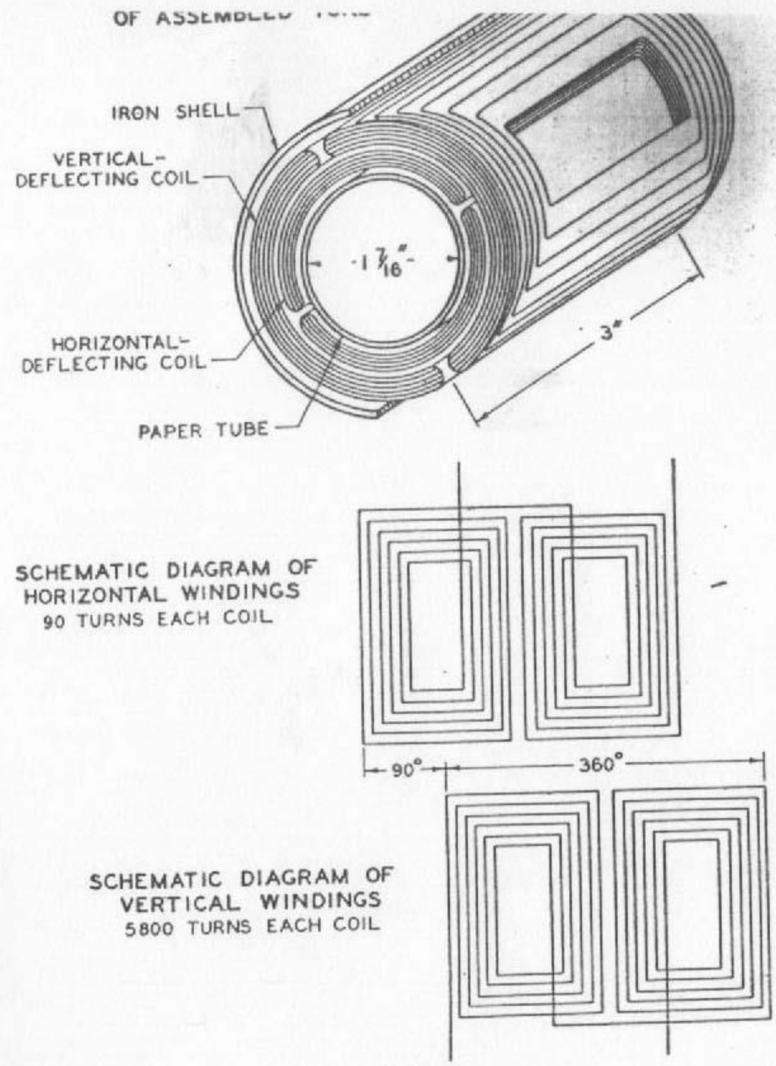

FIG. 5.
Perspective view of a deflection yoke.