ELECTRON TUBES

RCA Application Note

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Overload Protection for the Horizontal Deflection Circuit in Television Receivers

This Note describes a method of protecting the horizontal-deflection circuit of a television receiver using magnetic deflection from excessive current due to a short circuit. Because the horizontal-deflection circuit requires a considerable amount of power, a short-circuit current of approximately 3/4 ampere can be drawn from the power supply through the horizontal-deflection transformer of a typical receiver. This amount of current is sufficient to destroy the transformer with the generation of a great amount of smoke and, possibly, fire. A short circuit can take place in the horizontal-deflection circuit if the 6BG6-G output tube develops a slow air leak or if an internal short occurs from plate to cathode.

Fusing

The best protection against damage from excessive current in the horizontal-deflection circuit is provided by the use of a fuse in series with the primary winding of the horizontal-deflection transformer. A suitable fuse for a circuit such as that of Fig. 1, with the voltages and components as illustrated, is one of 1/4-ampere capacity. The reasons for this specific recommendation are:

1. The current through the transformer has a waveform approximately represented by a half-wave sawtooth. This waveform has an RMS value 60 per cent higher than the average value. In a typical receiver, the average current value is in the order of 77 milliamperes; the RMS value, therefore, is about 123 milliamperes. This value of current requires a 1/4-ampere fuse to give an adequate factor of safety against both high line voltage and variations in tubes and components. An 1/8-ampere fuse would be too small.

2. Although the transformer will not carry the maximum current allowed by a 1/4-ampere fuse continuously, the occurrence of a fault which will cause the current to remain at a level high enough to damage the transformer but not high enough to blow the fuse in very improbable. In a receiver using the circuit of Fig. 1, tests made by artificially producing

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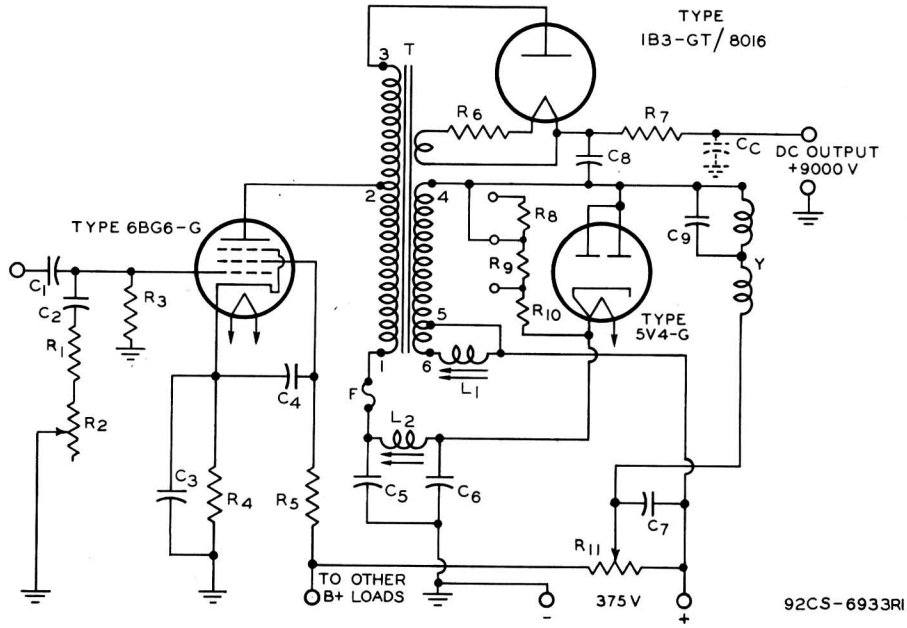
a slow air leak in the horizontal-deflection amplifier tube showed that a 1/4-ampere fuse would blow almost instantly when an arc started in the tube.

3. When a single power supply is used for a television receiver, a fuse in the primary circuit of the power transformer will not give adequate protection against a short in the horizontal-deflection circuit because the power taken by the deflection circuit is small in comparison with the total power required by the receiver.



R1 = 6800 ohms, 0.5 watt
R2 = Peaking Control, 20000 ohms, carbon potentiometer
R3 = 1 megohm, 0.5 watt
R4 = 100 ohms, 2 watts
R5 = 11000 ohms, 2 watts
R6 = 3.3 ohms, 0.5 watt
R7 = 750000 ohms, 0.5 watt
R8 R9 = 500 ohms, 5 watts
R10 = 5300 ohms, 20 watts
R11 = Horizontal Centering Control, 20 ohms wire-wound potentiometer
C1 = 3900 $\mu\mu$f, 400 volts
C2 = 150 $\mu\mu$f, 400 volts, mica
C3 = 0.1 μf, 400 volts
C4 = 0.05 μf, 400 volts
C5 = 0.035 μf, 600 volts
C6 = 0.05 μf, 600 volts
C7 = 30 μf, 10 volts
C8 = 500 $\mu\mu$f, 10000 volts
C9 = 56 $\mu\mu$f, 1000 volts, mica
CC = Kinescope Capacitive Coating
L1 = Width Control, RCA Inductor Type #201R1
L2 = Horizontal Linearity Control, RCA Inductor Type #201R3
Y = RCA Reflection Yoke Type #201D1
T = RCA Transformer Type #211T1
F = Fuse, 1/4 ampere, 3AG

Fig. 1. Horizontal-Deflection Circuit and Pulse-Operated High-Voltage Supply for the 10BP4 Kinescope.

Screen-Grid Circuit Considerations

In the circuit of Fig. 1, the series screen resistor limits the amount of current which would flow through the tube in the event of a short circuit between grid No.1 and either the cathode or screen to a value low enough to prevent damage to the circuit components. This circuit feature is desirable because short-circuit faults of this kind are frequently of a temporary nature. The use of a fuse in the primary of the deflection transformer does not, however, protect the screen resistor from overload in the event of a tube failure. Placing the fuse in series with the cathode of the horizontal-deflection output tube is not desirable because a gas arc in the tube could continue between the plate and the heater leads after the fuse had blown. If the centering control of Fig. 1 were omitted, it would be possible to use a single fuse, protecting the plate and screen circuits of the 6BG6-G but carrying no other current. Another possible change which would protect the screen circuit would be to connect the screen resistor to terminal 1 of the horizontal-deflection transformer. This arrangement, however, changes the loading of the diode circuit and may require extensive readjustments to restore linearity to the system. The value of the screen resistor, of course, will have to be increased to compensate for the increased screen supply voltage due to power feedback.

The protection of the transformer, however, is the most important consideration not only because of the smoke and fire hazard, but also because of the cost of the unit. It is recommended, consequently, that fuse protection at least equivalent to that shown in Fig. 1 be provided in all television receivers using magnetic deflection.