ELECTRON TUBES

RCA Application Note

AN-134
June 15, 1948

Adjustment of Filament Voltage of RCA-1B3-GT by Observation of Filament Temperature

When RCA-1B3-GT is used as the high-voltage rectifier with an rf power supply or a pulse-operated power supply for a television receiver, its filament is supplied from a high-frequency power source which is at a high dc potential with respect to ground. Consequently, adjustment of the filament operating conditions by direct measurement of the filament voltage or current is usually impractical. However, a simple method utilizing visual comparison of filament temperatures can be used for adjustment of filament power. Such a method is described in this Note.

The cutaway view of the 1B3-GT, as given in Fig. 1, reveals that the filament is mounted well inside the plate cylinder. This mounting is an important feature of the tube because, if the emitting surface of the filament extended below the edge of the plate, electrons drawn from the filament could miss the plate, strike the glass with high velocity, and lead to gas liberation and early tube failure. The most common mounting position for the 1B3-GT is vertical, base down, inside a shield enclosing the power supply. In such a position, it is generally not possible to observe the filament directly for a temperature determination. In a dark room, however, it is possible to see the light from the filament reflected from the shield collar (Fig. 1). A feasible method for determining the filament temperature, therefore, involves observing the reflected light when the filament is heated with a measured dc or low-frequency ac voltage, connecting the high-frequency supply, and then adjusting the high-frequency power until the same light is obtained.

Procedure

When adjustments are made on high-voltage supply units designed for commercial production, it is desirable to use a measurement technique which does not depend on the memory of the operator from one measurement to another. The following method leads to accurate, reproducible results.

TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

Photolithographed in U.S.A.

1. Procure two high-voltage power supply units of the type to be adjusted; or alternatively, mount a second 1B3-GT socket near the power supply unit in such a position that the tube is observable from the same angle as the tube in the power supply unit.

2. Disconnect the high-frequency circuits and connect dc (or low-frequency ac) supplies to both sockets.

3. Insert tubes in both sockets. Adjust the voltage at one socket to the desired value (1.25 volts for normal line voltage); darken the test area and vary the filament voltage of the second tube until the light reflected from the shield of this tube appears to match that from the first tube. Then, read the voltage on the second tube.

4. Repeat step 3 several times to determine the accuracy with which readings can be duplicated. During the course of these tests, interchange the tubes. It is also desirable to have more than one observer participate.

5. If there is a consistent difference in the voltage required to obtain the same appearance with the two tubes used, try other tubes until a pair is found which match closely in reflected-light-vs-voltage characteristics.

6. Connect high-frequency power to one of the supplies. With test area darkened and light from other tubes in the unit under test blocked by shields, adjust the dc or low-frequency ac voltage on the second tube to obtain a visual match with the tube operated from the high-frequency supply. Measure the voltage on the second tube. Several repetitions with interchange of tubes will show whether consistent results are being obtained.

7. Make appropriate adjustments on the unit under test until the correct rf filament voltage is obtained.

8. Step 6 may now be repeated with other high-voltage supply units to determine variations among them. The filament adjustment finally made should, in general, be that indicating a filament voltage of 1.25 volts with an average tube in an average unit operated at rated line voltage.

If records are kept of the observations made during such a sequence of measurements, the observers will have data indicating the probable accuracy of the results. Tests made in the laboratories of the Tube Department indicate a standard deviation of 0.024 volts for a series of comparison readings made with dc on the filaments of both tubes of the pair under test. An accuracy of better than 5 per cent in the adjustment of filament voltage at standard line voltage is desired in order to minimize excessive deviation in one direction or the other with line voltage variation. Because the purpose of control of filament voltage and current is to control filament temperature, matching of brightness

between filaments is an effective procedure for establisning the desired operating conditions.

Methods Employing Direct Observation

With many power supplies, it is possible to place a small mirror near the base of the 1B3-GT in such a position that the reflection of the filament can be observed directly. Because this method permits direct comparison of filament colors, more light can be tolerated in the room when comparisons are being made. A further improvement is to project the images of the two filaments, side by side, on a translucent screen; two mirrors, two simple lenses, and a piece of tracing paper, arranged as in Fig. 1, are required. A very high accuracy of matching can be achieved with such an arrangement. It would also be possible to use an optical pyrometer with the aid of a mirror, but comparisons should still be made between color temperatures observed with dc and high-frequency power to avoid any error which might arise from discoloration of the mirror or the glass of the tube.

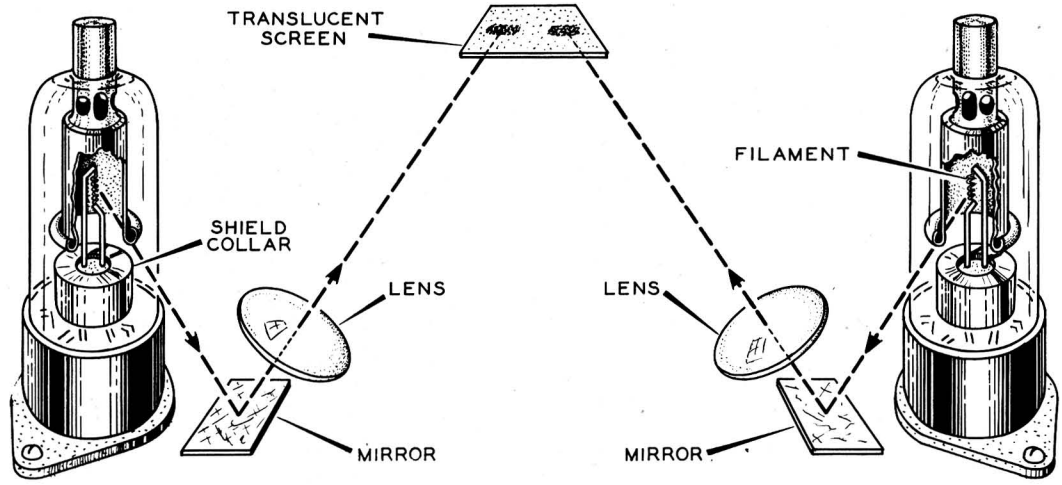

Fig. 1 - Method Utilizing Direct Observation for Adjustment of Filament Voltage. Plate Cylinders Cut Away to Show Filaments.