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Electronic TUBES

Technni-talk on AM, FM, TV Servicing

THE USE OF NEW 600 MILLIAMPERE TUBES . . . IN EARLIER SERIES-HEATER RECEIVERS—I

The new 600-milliampere tubes with controlled heater warm-up time characteristics can be used in some of the earlier series-heater type receivers. Very few wiring changes are required and these can normally be made in less than half an hour. The advantages are:

(1) Receiver starts to operate in less than twenty seconds after switch is turned on, or in about the same time as receivers with heaters wired in parallel.

(2) Fewer customer complaints due to tubes with open heaters. Life tests and field reports indicate that the new type 600-ma tubes have proven more reliable than their 300-ma prototypes when used in series-heater type receivers. The maximum heater-cathode voltage rating has also been increased on the new 600-milliampere tubes. This should reduce the number of heater-cathode shorts which usually cause one or more tubes to burn out when tube heaters are connected in series. The improvement in heater-cathode voltage rating for the new 600-milliampere tubes is significant as can be seen in the following comparisons:

Tube Type	Heater-cathode Voltage Rating
3AU6 (new type)	200
6AU6	100
3CB6 (new type)	200
6CB6	90
12L6-GT (new type)	200
25L6-GT	90
12AX4-GT (new type)	300
25W4-GT	200

These increased ratings should materially decrease the possibility of heater-cathode shorts in these tubes and therefore result in extended tube life.

(3) Since most of the tubes in the receiver will be replaced with new tubes, the over-all operation and performance should be improved.

(4) The removal of the globar resistor will eliminate all complaints due to this component. Typical globar defects are increased warm-up time, arcing in resistor, poor contact between terminal wrap-around wires and resistor body or an "open" globar resistor.

GLOBAR ELIMINATED

The globar can be eliminated when new type 600-ma tubes are used because these tubes have controlled heater warm-up time which prevents the heater voltage on any one tube from exceeding one and one-half times its rated voltage during warm-up. A series string of tubes which do not have controlled warm-up may, on certain tubes, have two or three times the normal heater voltage when the receiver is first turned on.

The globar resistor limits this initial surge voltage and thereby reduces the possibility of heater burnouts. The controlled heater warm-up tubes also effectively reduces initial surges and eliminates the inherent defects of the globar.

For the purpose of this article the following G-E receiver models were selected for the modification; however, series-heater type receivers of other manufacture can probably be modified just as readily.

MODELS 20T2, 20C105, 6 and 21C200 REWIRED

Several models can be easily rewired to use the new 600-ma tubes. One such model is the 21C200. This same chassis is also used in models 20T2, 20C105, and 20C106. The only difference between the 21C200 and the other three models mentioned is the vertical output tube. The 21C200 uses a 25L6-GT whereas the other models use a 12BH7. The rewiring of model 21C200 will be described first, then the wiring changes necessary for the other models will be described. The original wiring of the heater circuit in the model 21C200 is shown in Figure 1. This receiver has a separate 6.3-v transformer which supplies the tuner; therefore, this

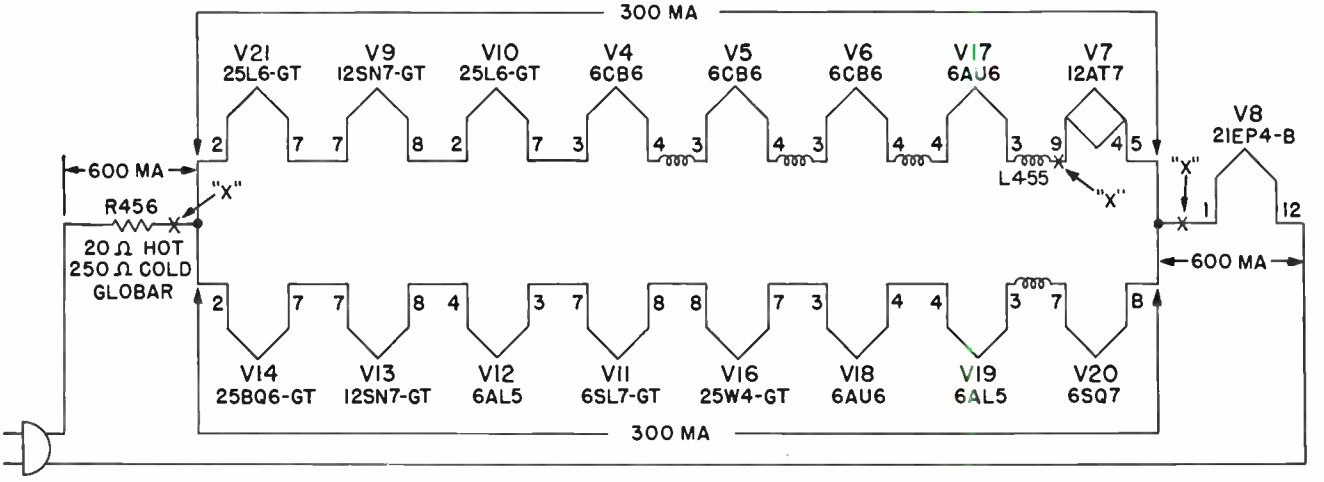

Fig. 1. Original heater circuit used in General Electric Model 21C200 receiver.

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portion of the heater circuit should not be disturbed. Be sure the a-c power plug is disconnected from the receiver before rewiring!

Since 600-ma tubes were used whenever possible the wiring had to be changed so *all* of the tube heaters shown in Fig. 1 were wired in series. It will be noticed in Fig. 1 that two parallel strings of the tubes are wired in series and connected together at both ends; one end goes to the globar resistor and the other end to pin 1 of the picture tube. Fig. 1 shows that each of these strings of tubes draws 300 milliamperes. Since both strings are connected together at each end, 600 milliamperes flow through both the globar and the picture tube heater.

WIRING CHANGES ON MODEL 21C200

The heater wiring was changed so that all tubes in the receiver were in series as shown in Fig. 2.

To accomplish this it was only necessary to break the wiring at the three points marked "X" in Fig. 1. These points were rewired as shown in Fig. 2. It should be pointed out that wiring changes could have been made at other places in the heater string which would connect all tube heaters in series. The reason for wiring the heaters as shown was to keep the 12AT7 and 6SQ7 heaters as close to the B minus end as possible.

Since both the 12AT7 and the 6SQ7 have a heater-cathode rating of 90 volts these tubes should be near the B minus end of the string.

Unfortunately, all of the tubes shown in Fig. 1 do not have 600-milliampere prototypes. It was therefore necessary to connect a 20-ohm, 10-watt resistor across the heaters of the 6SL7-GT, 6SQ7 and the 12AT7 as shown in Fig. 2.

Actually a 21-ohm resistor should be used but the closest standard resistor is 20 ohms. Ohm's law was used to determine both the resistance and wattage. Since the heaters on the 6SL7-GT, 6SQ7-GT and the 12AT7 (connected in parallel) each draw 300 milliamperes the resistor across each heater must also draw 300 milliamperes.

$$\text{Since } R = \frac{E}{I}$$

$$R = \frac{6.3v}{.3a} \text{ or } 21 \text{ ohms}$$

Only a 2-watt resistor would be necessary to carry the current as long as the tube heater remains intact. If, however, the tube heater should open, the 2-watt resistor would burn out and both the tubes and resistor would have to be replaced. While the tube heater is intact 300 milliamperes flow through the resistor.

Therefore $W = I^2R$

$W = .3^2$ amp. $\times$ 20Ω or 1.8 watts

If the heater opens, 600 milliamperes flow through the resistor.

Therefore $W = .6^2$ amp. $\times$ 20Ω or 7.2 watts.

Two of the 300-milliampere tubes could also be wired together with the heaters connected in parallel. This would work, but if one of the tubes connected in parallel developed an open heater, the heater in the other tube would probably burn out within a few minutes.

Since 600-ma versions of the 12AT7, 6SQ7 and the 6SL7-GT are not available, it might be expected that their life would be considerably reduced. Inasmuch as all of the other tubes either have controlled warm-up type heaters or have a resistor connected across the heater, the voltage across any tube during warm-up will normally be less than twice its rated heater voltage. This should not materially decrease the life of these three tubes. It should be kept in mind also that if any one of these three tubes should develop an open heater, only the tube with the open heater will go out. All other tubes will remain lighted.

The following is a list of the circuit changes and the order in which they were made:

(1) The end of choke L455 was removed from pin 9 of the 12AT7 socket. The wire from the bottom of the globar resistor to pin 2 on the 25BQ6-GT was removed from the 25BQ6-GT and connected to the end of L455 as shown in Fig. 2. The black wire from pin 1 on the picture tube was disconnected from pin 8 on the 6SQ7 socket and connected to pin 9 on the 12AT7 socket as shown in Fig. 2.

(2) The globar resistor was removed and a 10-ohm, 10-watt resistor substituted. This resistor was necessary because the heater voltage across each tube when added together totaled 110.25 volts as shown below.

V No.	Tube Type	Heater Voltage
V 21	12L6-GT	12.6
V 9	6SN7-GTB	6.3
V 10	12L6-GT	12.6
V 4	3CB6	3.15
V 5	3CB6	3.15
V 6	3CB6	3.15

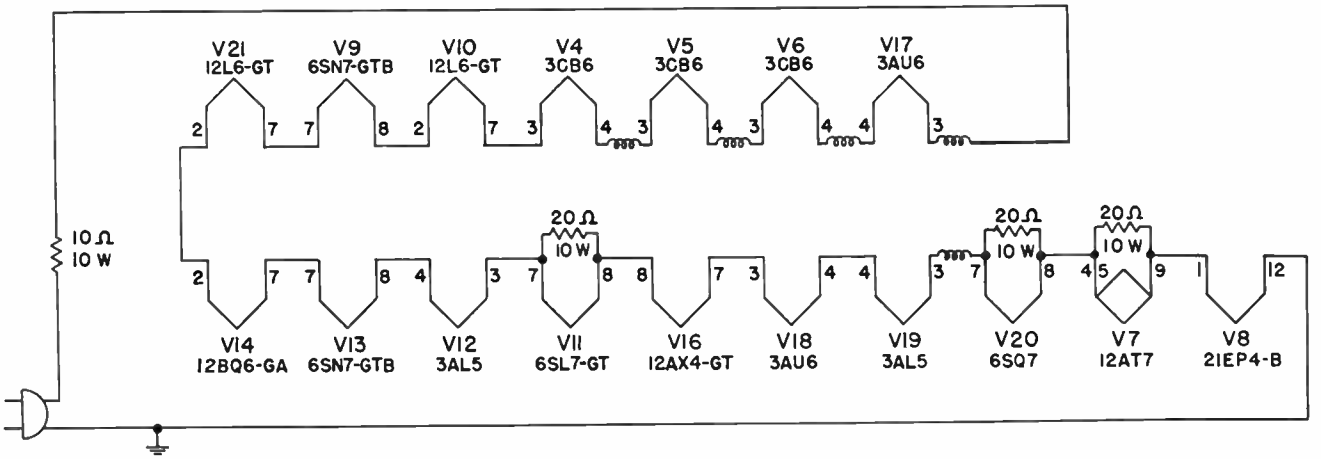

Fig. 2. General Electric Model 21C200 heater circuit rewired for new 600-milliampere tubes with controlled heater warm-up time.

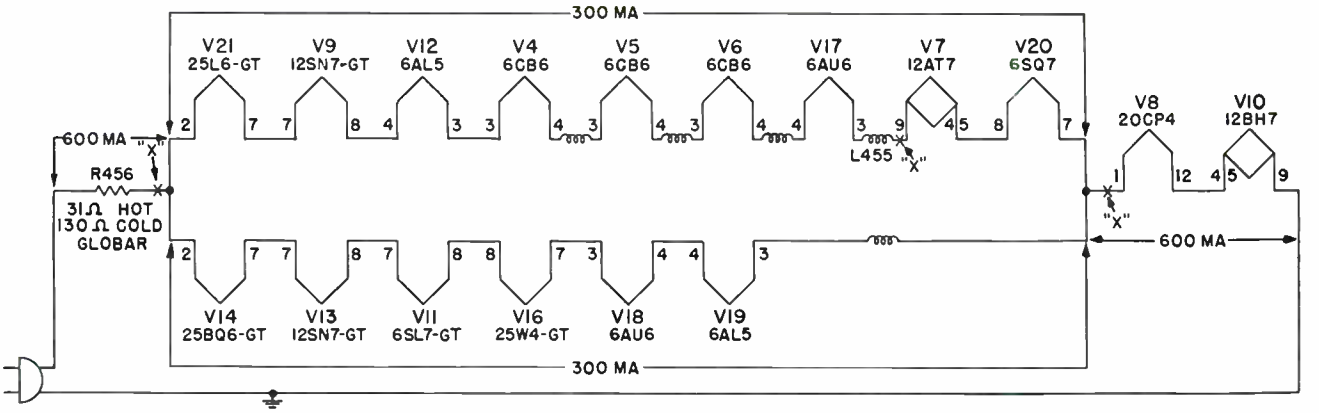

Fig. 3. Original heater circuit used in General Electric Models 20T2, 20C105 and 20C106 receivers.

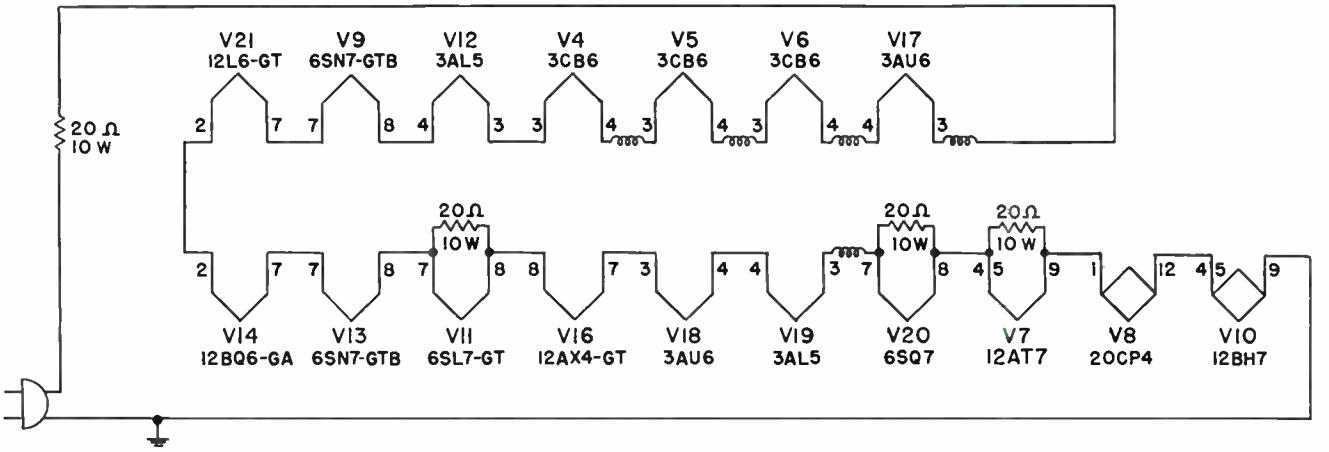

Fig. 4. General Electric Models 20T2, 20C105 and 20C106 heater circuit rewired for new 600-milliampere tubes with controlled heater warm-up time.

V 17	3AU6	3.15
V 7	12AT7	6.3
V 20	6SQ7	6.3
V 19	3AL5	3.15
V 18	3AU6	3.15
V 16	12AX4-GT	12.6
V 11	6SL7-GT	6.3
V 12	3AL5	3.15
V 13	6SN6-GTB	6.3
V 14	12BQ6-GA	12.6
V 8	21EP4-B	6.3
Total voltage across tubes		110.25

Voltage across 10-ohm resistor $E = I \times R = .6 \times 10 = 6.0$

Total voltage across tubes and resistor 116.25 volts

Since the normal line voltage is 117 volts a 10-ohm resistor was used which resulted in a total voltage of 116.25 volts.

(3) A 20-ohm, 10-watt resistor was connected across pins 4 and 9 of the 12AT7 (V7) as shown in Fig. 2.

(4) A 20-ohm, 10-watt resistor was connected across pins 7 and 8 on the 6SQ7 (V20) as shown in Fig. 2.

(5) A 20-ohm, 10-watt resistor was connected across pins 7 and 8 on the 6SL7 (V11) as shown in Fig. 2.

(6) The following tube replacements were made:

Original Type	Replaced with Type	V No.
25L6-GT	12L6-GT	V21, V10
12SN7-GT	6SN7-GTB	V9, 13
6AL5	3AL5	V12, 19
6CB6	3CB6	V4, 5 and 6
6AU6	3AU6	V17, 18
25W4-GT	12AX4-GT	V16
25BQ6-GT	12BQ6-GA	V14

Other tubes not replaced.

(7) Recheck all wiring changes before turning on receiver to prevent any possibility of burning out tubes because of incorrect wiring. An ohmmeter across the a-c terminals should show about 60 ohms. If either the 6SL7-GT, 6SQ7-GT or the 12AT7 tubes are removed, the resistance will increase to 70 ohms. The removal of any of the other tubes shown in Fig. 2 will increase the resistance to about 300 ohms.

WIRING CHANGES ON MODELS 20T2, 20C105 AND 106

It was previously mentioned that the only difference between model 21C200 and models 20T2, 20C105 and 106 was the vertical output tube. The 20-inch models used a 12BH7 with the two sections of the heater connected in parallel as shown in the complete heater drawing, Fig. 3. It will be noticed that 600 milliamperes would flow through both the 20CP4 and the 12BH7 in Fig. 3. Therefore the wiring on the 12BH7 will not have to be changed.

The following is a list of the circuit changes and the order in which they were made.

(1) Same as model 21C200.

(2) The globar resistor was removed and a 20-ohm, 10-watt resistor substituted. This was necessary because the heater voltage across each tube when added together totaled 103.95 volts. It was necessary to add a resistor which would produce a voltage drop of about 13 volts. The closest standard 10-watt resistor was 20 ohms which in this circuit dropped the voltage by 12 volts which was adequate.

(3, 4 and 5) Same as model 21C200.

(6) Same as model 21C200 with the exception that only one 25L6-GT was replaced with a 12L6-GT instead of two.

(7) Same as model 21C200.

Information on changing the wiring of other receivers to use tubes with controlled warm-up time will be included in future issues.

BENCH NOTES

Contributions to this column are solicited. For each question, short-cut or chronic-trouble note selected for publication, you will receive $10.00 worth of electronic tubes. In the event of duplicate or similar items, selection will be made by the editor and his decision will be final. The Company shall have the right without obligation beyond the above to publish and use any suggestion submitted to this column. Send contributions to The Editor, Techni-talk, Tube Department, General Electric Company, Schenectady 5, New York.

UHF TUNER REPLACEMENT

Subject: How to remove UHF tuners in some G-E TV receivers for either replacement or repair without removing the chassis or restringing dial cord.

1. Tape the two drive lines to the chassis with scotch tape as shown in drawing.
2. Remove the dial cord from the UHF tuner drive wheel.
3. Remove the three machine screws which hold the UHF tuner in place.
4. Remove all of the electrical connections on the tuner and remove from chassis. Make same electrical connections when replacement is made.
5. Mount the repaired or new unit in place and restring dial cord around the tuner drive wheel. The job is now complete without restringing the dial cord or removing the chassis.

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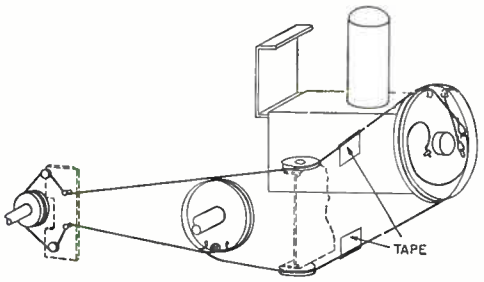
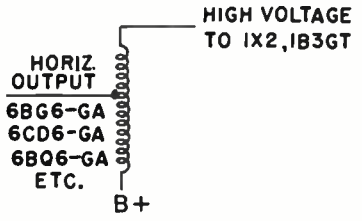


HV TRANSFORMER TEST

In our television service shop, we have found a short cut to confirm the troublesome problem of a short in a high-voltage transformer which results in no high voltage.

All you have to do is take a three-lead air-core autotransformer, such as a Stancor No. 8131, and connect the three wires, as per the diagram below, to make the test.

This method may be used on any make television set.



Be sure to remove the anode connection from the old transformer to the horizontal output tube and HV rectifier tube.

Ted E. Dietenhofer
1255 So. Cochran Ave.
Los Angeles 19, Calif.

PUNCTURED GLASS

Several General Electric "G" line chassis have developed defective 6BQ6-GA horizontal output tubes. Inspection of the tube showed that the wire shield around the tube caused the glass to burn at the point where the end of the wire touched the glass. This caused a leak in the glass resulting in tube failure. This trouble has been eliminated by bending the end of the wire so the point does not touch the glass.

John Kaye
Kaye Electric & Appliance Co.
209 1st St., E.
Independence, Iowa

What's new! 6CN7

DUPLEX-DIODE TRIODE

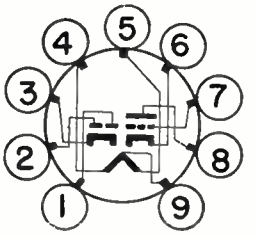
The 6CN7 is a duplex-diode high-mu triode in which separate cathodes are provided for the diode and triode sections. The triode section of the 6CN7 is electrically identical to the triode section of the 6T8. The tube is intended primarily for service as a combined horizontal phase detector and reactance tube in television receivers. The triode section may also be used in a variety of other applications, such as in sync-separator, sync-amplifier, or audio-amplifier circuits.

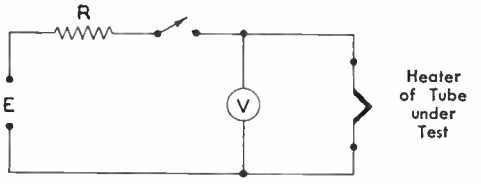
	Series	Parallel
Heater Voltage, AC or DC	6.3	3.15 Volts
Heater Current	0.3	0.6 Amperes
Heater Warm-up Time*		11 Seconds

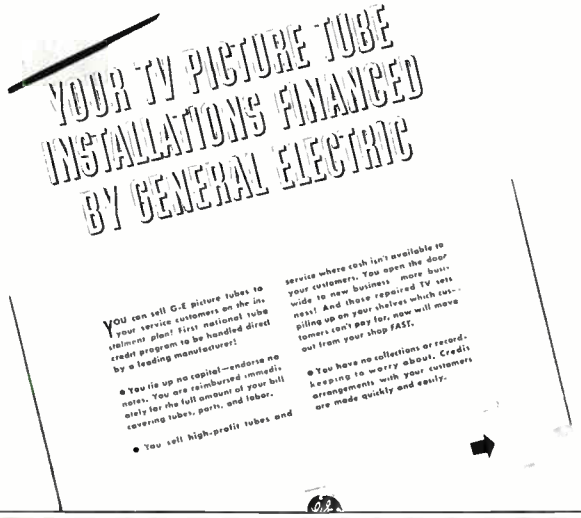
CHARACTERISTICS AND TYPICAL OPERATIONS

CLASS A_1 AMPLIFIER		
Plate Voltage	100	250 Volts
Grid Voltage	−1.0	−3.0 Volts
Amplification Factor	70	70
Plate Resistance, approximate	54000	58000 Ohms
Transconductance	1300	1200 Micromhos
Plate Current	0.8	1.0 Milliamperes
Average Diode Current, Each Diode with 5.0 Volts DC Applied		20 Milliamperes

* Heater warm-up time is defined as the time required in the circuit shown below for the voltage across the heater terminals to increase from zero to the heater test voltage (V_H). For this type, E = 12.5 volts (RMS or DC), V_1 = 2.5 volts (RMS or DC), and R = 15.8 ohms.







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