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THE TELEVISION PICTURE TUBE—IV

Electronic TUBES
Techni-talk on AM, FM, TV Servicing

This is the fourth and concluding article in a series on the television picture tube. In the last three issues, the physical structure, operation and a number of defects were described. Suggestions on how to eliminate some defects were also included. In this issue, the construction and operation of a picture tube tester will be described.

PICTURE TUBE TESTING

The testing of a picture tube has always been somewhat of a mystery to most service technicians. This has been due primarily to the fact that test equipment manufacturers have been slow to market good usable equipment of this type. The unit described in this article has been designed to provide the technician with a dependable low-cost picture tube tester. This unit incorporates a test for "shorts" which is practically identical to that used in the General Electric picture tube factory.

In the manufacture of picture tubes, a great many tests are made to insure good picture quality and long life. If we exclude tests for screen defects such as blemishes, color, etc., it is a fairly simple matter to determine whether a picture tube is good. The necessary tests are:

1. Check for shorted elements.
2. Check for open connections.
3. Check for leakage between elements.
4. Check for cathode emission.
5. Check condition of cathode.
6. Check for gassy tube.
7. Check for air leaker.

The first four tests can be performed on the tester to be described. The fifth check on the condition of the cathode can be made by observation as described in the last issue. The last two tests for gassy tubes or air leakers can be performed with a commercial "sparker" unit. This unit will be described in the section on gas and air leaker tests.

PICTURE TUBE TESTER

The unit shown in Fig. 1 can be assembled and wired in a few hours time. The parts required will in most localities cost about $27.00 if all the parts have to be purchased. However, you will probably find that a number of these parts can be found in your "junk" box. This tester will save you many hours time making voltage tests and substituting picture tubes to determine whether the tube or the circuit is defective. The circuit for this unit is shown in Fig. 2. The following is a list of the parts required.

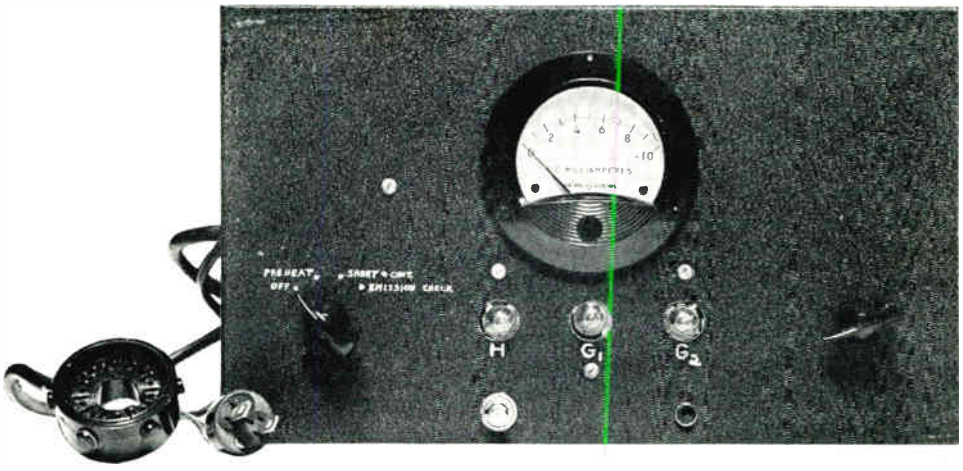

Fig. 1. Front view of Picture Tube Tester.

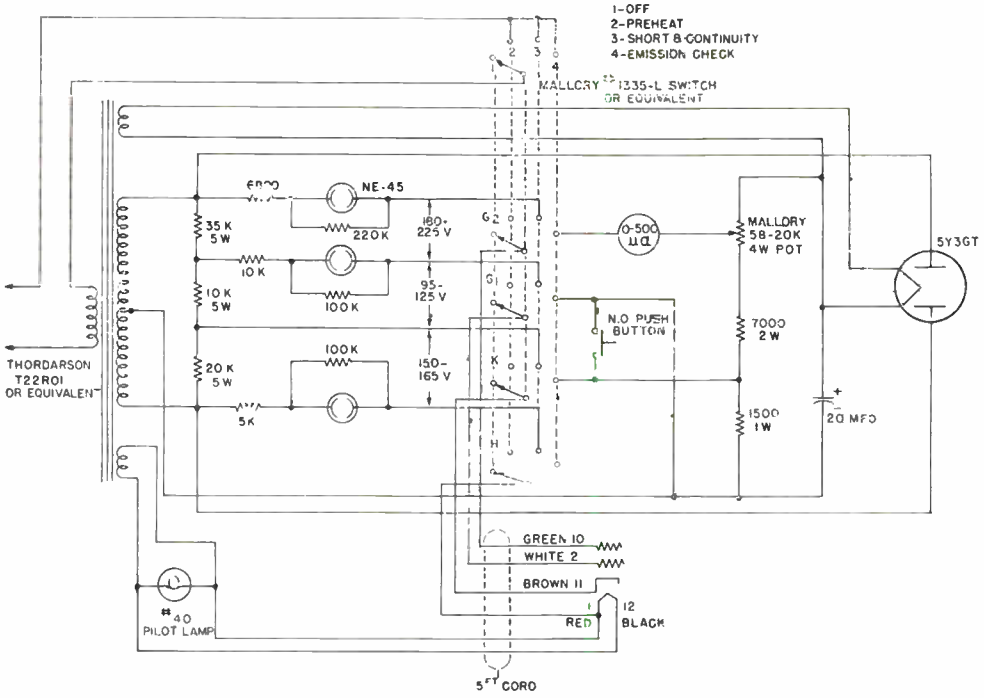

Fig. 2. Circuit diagram for tester shown in Fig. 1.

PARTS LIST

1 —Thordarson No. T22R01 transformer or equivalent. This type transformer has these voltage windings: 275 v–0–275 v at 50 ma, 5 v at 2 amp, 6.3 v at 2.5 amp.
1 —Mallory No. 1335L switch (this is a 3-gang, 6-pole, 5-position rotary switch).
1 —0–500 microammeter (preferred) or 0–1 milliammeter (3-in. or 3½-in. case).
1 —20,000-ohm, 4-watt potentiometer.
2 —1¼-in. pointer type bar knobs.
1 —Octal base tube socket.
1 —General Electric 5Y3GT tube.
1 —20-mfd 450-volt capacitor.
1 —Normally open SPST push-button switch.
3 —General Electric Type NE45 Neon bulbs.
3 —Adjustable slide, candelabra base, pilot light sockets.
1 —No. 40 pilot light.
1 —Adjustable slide, miniature screw, pilot

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TECHNI-TALK

on AM, FM, TV Servicing

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TUBE DEPARTMENT, ELECTRONICS DIVISION

GENERAL ELECTRIC

SCHENECTADY 5, N. Y.

R. G. KEMPTON—Editor

light assembly with ½-in. jewel.

1—Picture tube socket with 5-ft cable. (Picture tube extension cable can be used.)

1—Bud No. CB792 7 in. D x 12 in. W x 3 in. H Metal Utility Cabinet.

1—8-ft a-c line cord.

1—35,000-ohm 5-watt resistor (1–20K and 1–15K used).

1—10,000-ohm 5-watt resistor.

1—20,000-ohm 5-watt resistor (2–10K used).

1—7,000-ohm 2-watt resistor.

1—1,500-ohm 1-watt resistor.

1—5,000-ohm 1-watt resistor.

1—6,800-ohm 1-watt resistor.

1—10,000-ohm 1-watt resistor.

2—100,000-ohm 1-watt resistor.

1—220,000-ohm 1-watt resistor.

These parts were mounted in a 7 in. x 12 in. x 3 in. Metal Utility box, but any similar type box could be used. A rear view of the completely assembled unit is shown in Fig. 3. The only problem that you may have will be in drilling the metal panel for the meter and neon lamps. A 2¾-in. hole was required for the meter shown, and three ⅝-in. holes were needed for the neon lamps. Since the flange of the meter case usually covers at least ½ in. all around the hole, it can be cut out with a drill and a metal cutting saw.

Keep in mind when wiring the rotary switch that when looking at it from the rear, the terminal next to the rotor terminal is not used. Then come terminals No. 1, 2, 3 and 4 going counter-clockwise. You will notice that the switch specified has 5 positions when only 4 positions are required. This type switch normally has a stop-set washer which should be set to limit the number of positions to 4. Since the rotary switch is a six-pole type, one of the front sections which would have been difficult to solder was left unused.

The three candelabra sockets were fastened to the front panel with ½-in. angles soldered to the adjustable slide bracket. This positioned the neon bulbs so they just came through the front panel.

SHORT-OPEN-LEAKAGE TEST

When the unit is completely assembled and wired, it is ready to be used. The picture tube socket should be placed on the picture tube which may be either separate or in a receiver. If the picture tube is in a receiver, be sure that the receiver is turned "off" to eliminate any possibility of the voltage on the HV anode cylinder arcing over to one of the other elements inside the tube.

The rotary switch should be turned from the "off" position to the "preheat" position, and left there for three minutes. The switch should then be switched to the "short and continuity" position. If the tube is good, one-half of the G_1 and G_2 neon bulbs will glow as shown at the top of Fig. 4. You will probably find that the lighted half of the G_1 and G_2 neon bulbs are not in the position shown in Fig. 4. In some instances, the bulbs can be correctly positioned by turning them one way or the other in the sockets. In other cases, it may be necessary to build up the center contact on the bulb base with solder. The neon bulb on the left marked "H" can be in any position since both sides glow when some element is shorted to the heater.

While the tube is on this test, the neck should be tapped on the glass area near the tube base to show up any intermittent shorts. A tapper can be made in accordance with the drawing shown in Fig. 5. This is very simple to make since a pencil can be used as the dowel and a No. 15 cork can be obtained at most hardware stores. A hole should be drilled in the cork and the dowel or pencil cemented in place. The tapper should be held between the thumb and forefinger and used with a wrist action only. Tap the tube several times at different points going around the neck.

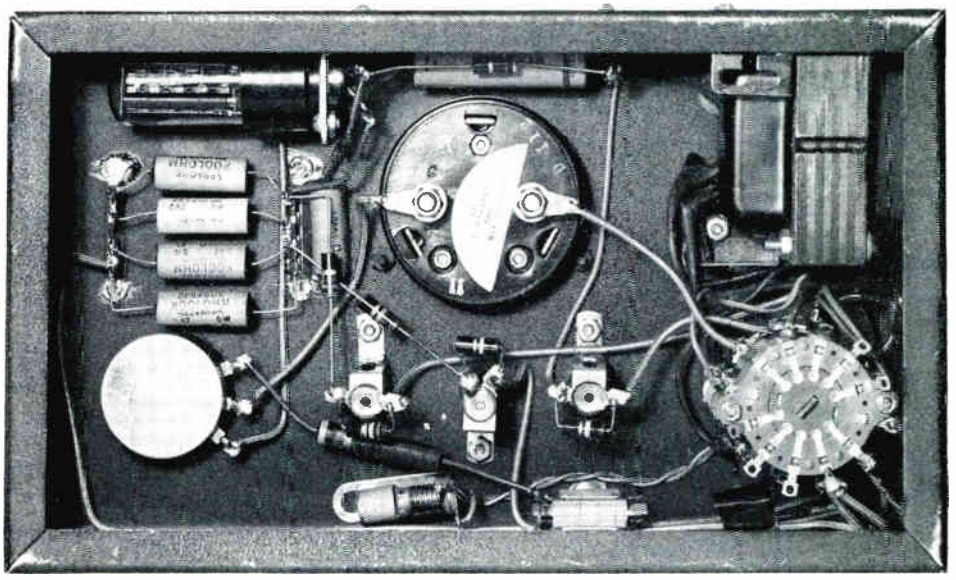

Fig. 3. Rear view of Picture Tube Tester.

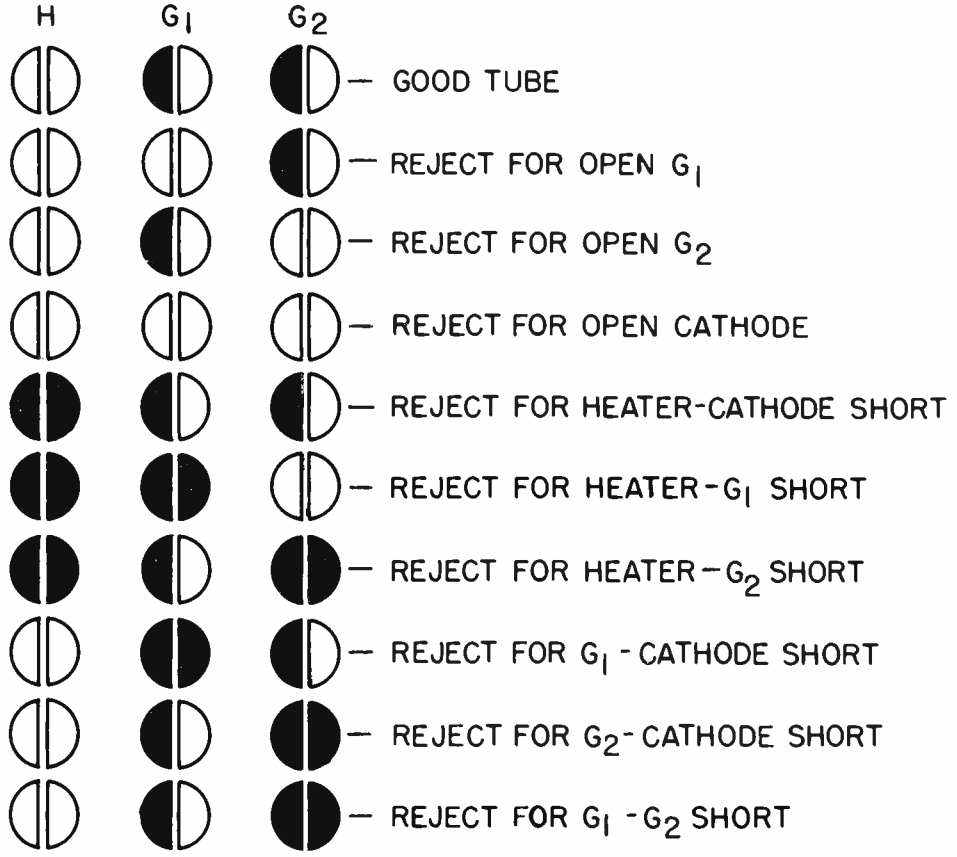

Fig. 4. List of neon glow lamp indications for tester shown in Fig. 1.

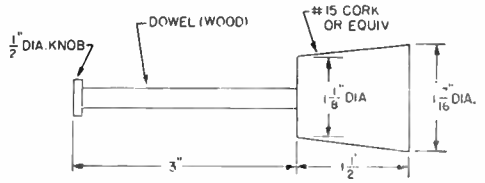

Fig. 5. Tube topper recommended for use when checking picture tubes.

The short and continuity test will indicate either an "open" or a "short" and in addition, it points out the tube elements which are defective. As mentioned in previous parts of this series, resoldering the base pins should always be tried whenever an "open" is indicated. If the neon lamps indicate that G_1 is "open," resolder pin No. 2. If G_2 is "open" resolder pin 10 and if the cathode is "open," resolder pin 11. An "open" in the heater does not show on the indicator lamps since this defect can be detected by looking at the gun inside the picture tube.

If a short or leakage is indicated on the tester, try using a "sparker" to burn off the material causing this defect. A typical "sparker" is the Model BD10 manufactured by Electro Technic Products, 4602 Montrose Ave., Chicago 4, Ill. This unit, as mentioned in previous issues, has a list price of $12.10 and can be obtained from your tube and parts distributor or the manufacturer. Be sure to ground one of the shorted elements and then apply the sparker to the other shorted element. The heater and cathode should always be tied together unless the short exists between these two elements. Limit the application of the sparker to about 30 seconds. If this does not eliminate the short, try again for the same length of time. Do not use the "sparker" for any longer period of time than is necessary since prolonged sparking between heater and cathode or between cathode and G_1 may permanently damage the picture tube.

A somewhat different method should be used when a "hot" G_1 –cathode short occurs. This type of short occurs *only* after the tube has been in operation for a period of time, and is indicated by the complete loss of control over brightness. A short of this type can sometimes be eliminated by the application of about 150 volts d-c between G_1 and cathode while the tube is hot. This voltage should be applied with the negative side connected to G_1 and with a 500-ohm resistor placed in series with one of the leads.

EMISSION TEST

If the short and continuity test indicates that the tube is good, turn the rotary switch to the "emission check" position. Then turn the right hand knob to the point where the meter reads 10 microamperes. This current reading is important and requires careful adjustment particularly if an 0–1 milliammeter is used. The 10 microampere point on the meter shown in Fig. 1 would be midway between 0 and the first mark on the scale. The 10 μa point would be much easier to locate on a 0–500 microammeter and it is for this reason that a 0–500 microammeter is preferred. After the meter is set at the correct point, press the push-button switch below the "H" neon lamp. The meter should read between 350 and 550 microamperes if the emission is normal. If the emission reads between 250 and 350 microamperes, it is questionable and below 250 it should be replaced. In most cases, it will be found that tubes below the 300 microampere reading will have large dead areas on the cathode surface. The method of observing an enlarged image of the cathode surface was given in the last issue.

The limits indicated above are based on a line voltage of 115 v a-c. If the line voltage is low, the limits should be decreased by 10 μa for each volt below 115 v. If the line voltage is high, the limits should be increased by 10 μa for each volt above 115 v. These readings are, like *all* tube tester readings, subject to exceptions due to tolerance variables and "cut-off" characteristics. It will, however, provide the service technician with a reasonably accurate and reliable indication of the condition of a picture tube.

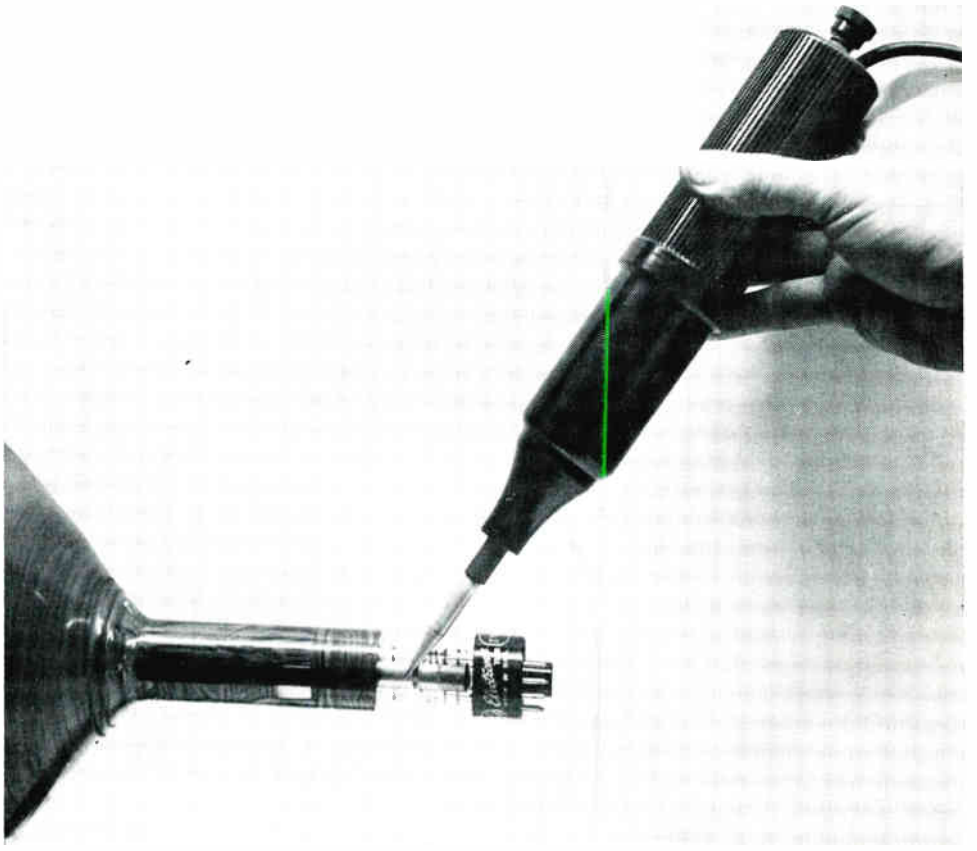

Fig. 6. Sparker applied to neck of picture tube to check for "gas" or "air leaker."

GASSY TUBES AND AIR LEAKERS

Another defect which develops in a picture tube is that it becomes "gassy." The sparker previously mentioned can be used to detect gas by placing its tip on the glass near the base of the picture tube as shown in Fig. 6. If the tube is gassy, the area near and in the electron gun will have a pink glow. A similar condition will be noticed if the tube is an "air leaker" except that sparks may jump through the glass to the gun and between the elements in the gun. Another indication is the milky appearance of the getter on the neck of the picture tube. This milky area will appear on the clear glass window sometimes left in the inside graphite coating near the position of the getter bar and shield as shown on page 2 of the Vol. 4 No. 5 issue. There is nothing the technician can do to correct either a gassy tube or an air leaker except to replace the picture tube.

It might be well to point out here that when using the tester described above, a tube very low in emission may show as an open cathode. This is to be expected because it is the current flow between the cathode and the G_1 and G_2 elements in the picture tube which causes the neon bulbs to glow. If the cathode is not emitting a sufficient number of electrons, these two lamps may not light up.

This tester will not check electrostatic deflection type picture tubes or those with triode guns. It may be used, however, to indicate a "short" or "open" in tubes with triode guns. Obviously the G_2 bulb will not operate on tubes of this type.

The picture tube tester described in this issue can be used effectively to increase your picture tube business. A good practice would be to test the picture tube on every receiver serviced. A notation could be written on the customer's bill as well as the job record. In this way the customer is aware of the condition of the picture tube and the job of selling a new tube either at the present time or some time in the near future should be easier.

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.

TV INTERFERENCE

I had a call one day last month on an interference problem which had the appearance of 32-volt Truck Electric System interference. Since there wasn't a major highway within 3 miles, that cause was ruled out. I checked all the electrical apparatus throughout the home but found nothing to remedy it. In desperation, I started checking the neighbors' homes in the immediate area. In the first four homes checked, I found the same condition on their TV sets. In the fifth home, I found an immersion heater for a fish tank which had been recently purchased. It operated off of 110 volts a-c. I had my doubts whether this was the answer. But after disconnecting it from the power source, all interference disappeared. I coated this heater with a lead shield which eliminated all signs of this interference.

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TV HEADACHES

(1) ADMIRAL 20B1 TV Chassis. This set came in shop with no video, audio apparently normal. All tubes and voltages checked good, except that AGC was very low. Checking video on the 'scope indicated good signal up to video output grid, plate having no signal at all.

Analysis of pulsed AGC circuit used in this model showed that plate of 6AU6 AGC tube operates during positive pulse from winding on width coil. Pulse was there, but not of amplitude indicated (200 v p-p). Secondary of width coil was found to be open, causing insufficient peak pulses on plate to conduct and rectify, thus no AGC. The reason the 6AC7 video amplifier did not function was that the grid was blocked due to overdriving signal.

Upon installing new width coil, it was discovered that the primary to secondary phase relationship had to be correct, otherwise, negative pulses would result on 6AU6 plate. Reversing primary connections corrected this and set worked in normal maner again.

(2) STROMBERG-CARLSON TC-125. Owner had complained of poor vertical hold as long as we had been servicing set. The hold did seem critical, but we found no tubes bad or other obvious causes. When set did finally get to the shop, tracing down the vertical and sync circuits with 'scope and VTVM still showed no fault. However, the video signal on the 'scope did show a definite depression at the 60-cycle point where the vertical sync pulse was. Finally, a check of the AGC voltage with a 'scope showed a pip at the 60-cycle portion of the sweep, which of course would be impossible with the normal AGC filtering circuits used. In this case, the .25 mfd AGC filter condenser had been left out in manufacture, but of course any decrease in AGC filtering action on any set might result in the same symptoms, for the AGC naturally tends to follow the video, which peaks at the vertical sync pulse and thus reduces gain for that portion of the signal, if not properly filtered.

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VERTICAL ROLL

The complaint was a continuous vertical roll on Channels 4 and 7 only. The set was a Dumont "Tarrytown." I checked the antenna lead from roof down to the set and continued to check through the vertical circuit without success. I then tried changing the 6J6 in the tuner and the trouble was corrected.

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What's new!

21ZP4-A

The 21ZP4-A is a magnetic-focus and magnetic-deflection, direct-view all-glass picture tube for television applications. It provides a $19\frac{3}{16}$- by $14\frac{5}{16}$-inch picture and has an electron gun which is used with an external single-field ion-trap magnet. Other features of this tube include a high quality gray faceplate which increases picture contrast and detail under high ambient light conditions, and a space-saving rectangular face shape. An external conductive coating serves as a filter capacitor when grounded.

Deflection Angle, approximate	
Horizontal	67 Degrees
Diagonal	70 Degrees
Over-all Length	$23\frac{1}{32} \pm \frac{3}{8}$ Inches
Greatest Bulb Dimensions	
Diagonal	$21\frac{7}{32} \pm \frac{1}{8}$ Inches
Width	$20\frac{1}{4} \pm \frac{1}{8}$ Inches
Height	$15\frac{3}{4} \pm \frac{1}{8}$ Inches
RECOMMENDED OPERATING CONDITIONS	
Anode Voltage	16000 Volts
Grid No. 2 Voltage	300 Volts
Grid No. 1 Voltage	−33 to −77 Volts
Focusing Coil Current, approximate (RTMA Coil No. 109 at $3\frac{3}{4}$ inches)	118 Milliamperes
Ion-Trap Field Intensity, approximate (single-field ion-trap magnet)	40 Gausses

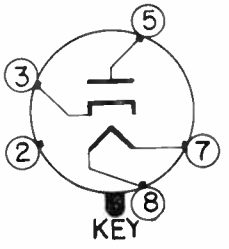
6AX4-GT

The 6AX4-GT is a heater-cathode-type diode suitable for application as a damping diode in television sweep circuits, or as a half-wave rectifier. Two of these tubes may be used in a full-wave rectifier circuit.

Heater Current	1.2 Amp	
Heater Voltage (A-C or D-C)	6.3 Volts	
MAXIMUM RATINGS, Design-Center Values:		
Peak Inverse Plate Voltage	4000* max.	volts
Peak Plate Current	600 max.	ma
Hot-switching Transient Plate Current		
For duration of 0.2 second maximum	3.0 max.	amp
D-c Plate Current	125 max.	ma
Peak Heater—Cathode Voltage:		
Heater negative with respect to cathode	4000† max.	volts
Heater positive with respect to cathode	400 max.	volts

* The rating applies only to television damping applications where the duty cycle of the voltage pulse does not exceed 15% of one scanning cycle and the duration of the pulse is limited to 10 microseconds.

† The d-c component of the heater-cathode voltage must not exceed 900 volts absolute maximum.



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