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THE TELEVISION PICTURE TUBE—III

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

This is the third of a series of articles on the television picture tube. In the last issue some defects which develop in the electron gun were described together with suggestions for eliminating these defects. The following is a continuation of the same subject.

CATHODE DEFECTS

Since the emitting surface of the cathode is relatively small and the grid cylinder is only a few thousandths of an inch away, even small positive voltages (in excess of 6 volts) will draw excessive current from the cathode resulting in a contamination of the cathode emitting surface. If the surface is not completely destroyed, it may be returned to its normal condition temporarily by the application of a "hot shot" treatment followed by reaging. This is the process performed by most picture tube reactivators now on the market. A typical "hot shot" treatment is as follows:

(1) Apply 12.6 volts to the heater for 2 minutes with +5 to +6 volts between control grid and cathode (grid #1 to be positive). No connection to G2 or HV anode. Caution: do not apply more than 6.5 volts to grid #1; otherwise, the emission of the cathode will be destroyed.

(2) The tube is now ready for reaging as follows:

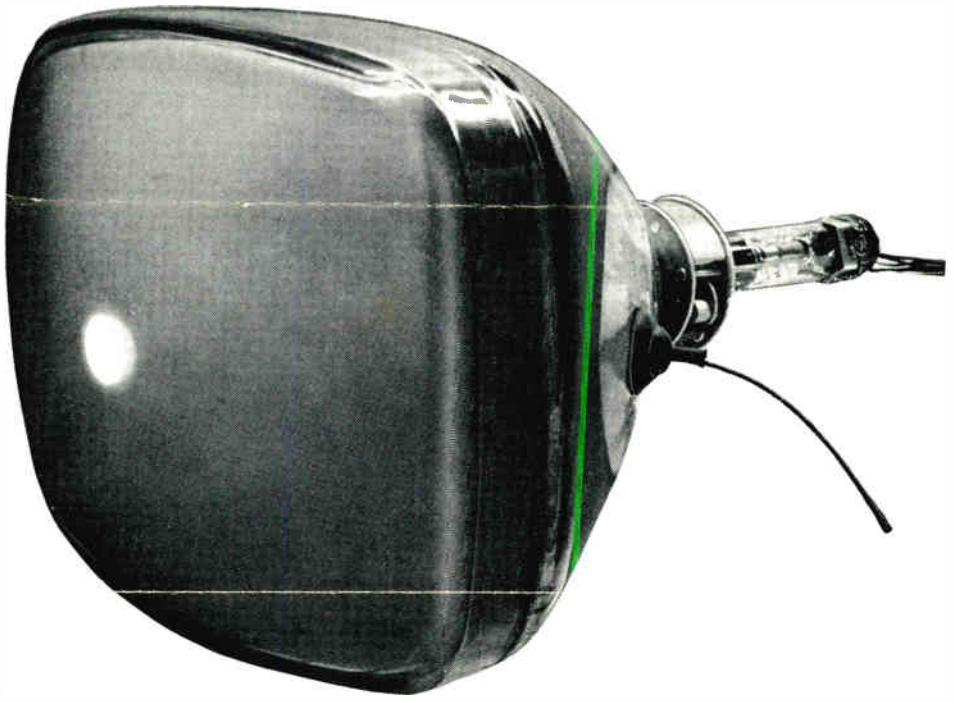

Fig. 1. Image of a normal cathode showing the relative size as it would appear on a seventeen-inch picture tube.

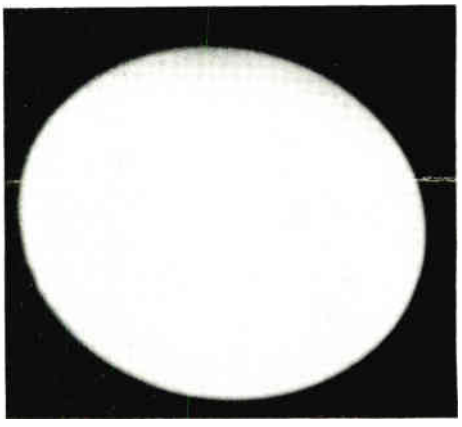

Fig. 2. Cathode image as it usually appears on a new picture tube screen.

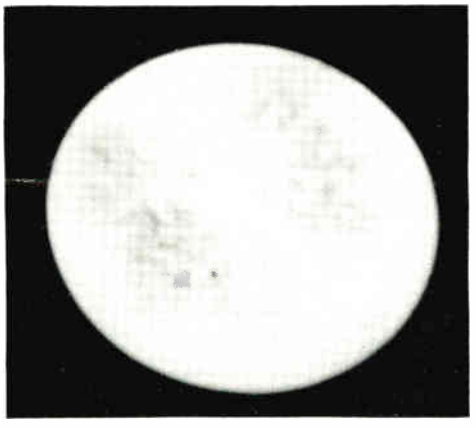

Fig. 3. Cathode image as it normally appears after picture tube has been in use for a period of time.

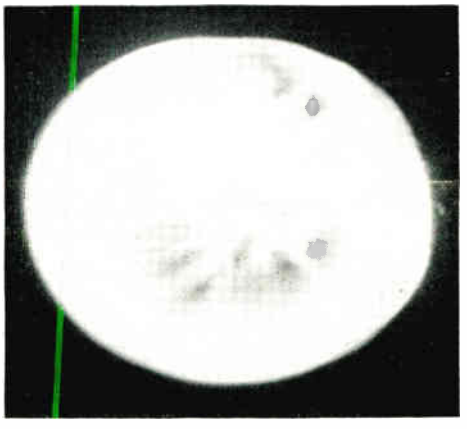

Fig. 4. Cathode image beginning to show a reduction in emitting area.

Heater voltage 8.0 volts
Grid #1 voltage +5 volts
Grid #2 voltage 100 to 150 volts
Time 2 hours

It should be emphasized again that this hot shot and reaging treatment will not extend the life of a *worn out picture tube*. At best it can only give a few more days of life and a dissatisfied customer.

At this point, we would like to point out that it is not *only* the cathode that wears out with long life but that the phosphor screen does likewise. Since many "rebuilt" tubes use the original phosphor screen, reduced brightness as well as a shorter life may result.

Inasmuch as the cathode is the part of a picture tube which most frequently "wears out," it is important that the service technician be able to recognize and identify this defect. One method is to use a picture tube emission tester such as the unit which will be described with complete information on its construction in the next issue. Another method is to observe an enlarged image of the cathode on the face of the picture tube. A certain amount of care must be taken when making this test since all of the electron stream is concentrated on a very small area of the picture tube screen. The picture tube should be removed from the receiver so that the deflection yoke and focus coil are not around the neck of the picture tube. In receivers which have the picture tube mounted to the cabinet, it may only be necessary to remove

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R. G. KEMPTON—Editor

the yoke and focus coil assembly from the neck of the picture tube. These units should not be disconnected electrically from the circuit. Also make sure that the picture tube is held firmly in place with the yoke assembly removed. Otherwise, it might fall out and either implode or damage the neck.

If the picture tube requires an ion-trap magnet, place it on the neck of the tube. Connect the HV anode cap and the picture tube socket. In many instances, it will be necessary to use extension leads on both the HV anode and the picture tube socket. These can be obtained from your General Electric Tube and Parts Distributors. Be sure to *turn the brightness control to minimum* before turning the receiver on. When the receiver is turned on, advance the brightness control slightly and at the same time adjust the ion-trap for maximum brightness. DO NOT ADVANCE THE BRIGHTNESS CONTROL BEYOND THE POINT WHERE THE IMAGE IS VISIBLE AND CLEAR. Otherwise, the screen material may be damaged.

If a somewhat larger cathode image is desired, a focus coil can be placed on the neck as close to the bell as possible. Fig. 1 is a photograph of a picture tube with a permanent magnet type focus unit in place. The spot on the face of the picture tube indicates the comparative size of the cathode image as it appears on a 17-inch picture tube.

A new picture tube will produce an image similar to that shown in Fig. 2. After a picture tube has been in use for a period of time, the shadows increase and dark spots develop. Figs. 3 thru 10 illustrate several different stages of cathode deterioration which may occur in various picture tubes. Fig. 3 is a normal image after a picture tube has been used for a period of time. Figs. 4, 5 and 6 have areas which are practically dead and may, therefore, have poor spot size. If an emission test indicates a normal emission level, these tubes can be considered as "good." Figs. 7, 8, 9 and 10 show large areas which are "dead." Tubes which produce cathode images like these usually also have "low" emission and should be replaced. It should be kept in mind that these images represent an enlargement of the spot which scans the face of the picture tube. If this spot is distorted in shape such as Figs. 7 thru 10, the clarity as well as the shading of the picture will be impaired. A receiver may deliver a perfect video signal to the picture tube but if a sizable portion of the cathode area is lost the picture will be poor. The cathode image test will in most cases only indicate *why* emission has fallen off. It should be kept in mind, however, as a possible explanation for loss of picture quality. In these cases loss of a sizable portion of the cathode emitting area, even though the emission test is passable, would justify replacing the picture tube.

GRID NO. 1

The first grid (G_1) in a picture tube has the same function as the control grid in other electronic tubes; although it is considerably different in both construction and appearance. The picture tube grid is made in the form of a cup which holds the cathode and heater assembly in place. This element was shown in the cut-away drawing on page 2 of the last issue. In some TV circuits the video signal is fed to the control grid and in other TV circuits to the cathode. When the video signal is fed to the cathode the control grid is connected to the brightness control circuit.

GRID NO. 1 DEFECTS

Due to the structure of grid No. 1, the only defects which develop in this element are an open circuit or a G_1-cathode short. If an open circuit is indicated, try resoldering the base pin. This type of defect does not develop as fre-

Fig. 5

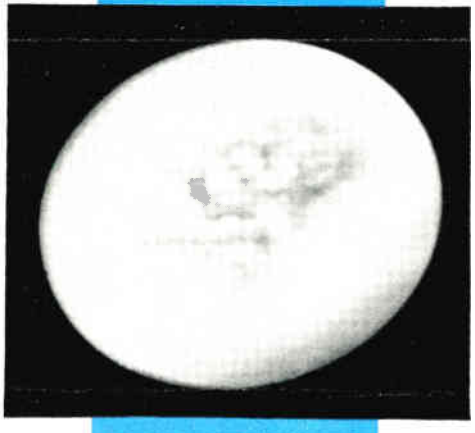
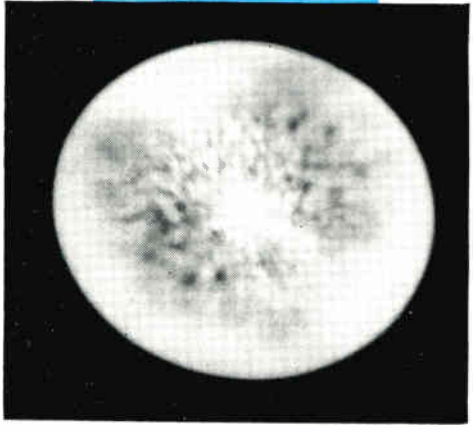


Fig. 6



Figs. 5 and 6. Cathode images with small areas which are practically dead.

Fig. 7

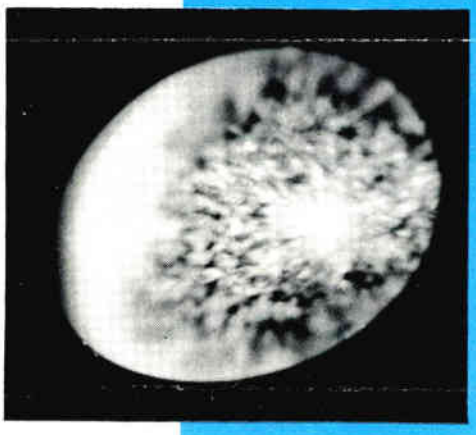


Fig. 8

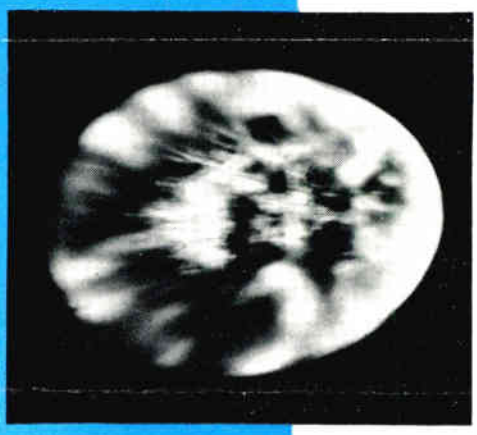


Fig. 9

Fig. 10

Figs. 7, 8, 9, 10. Cathode images with large areas dead. These tubes had low emission and poor picture quality.

Fig. 11. Normal masking aperture at one end of HV anode cylinder.

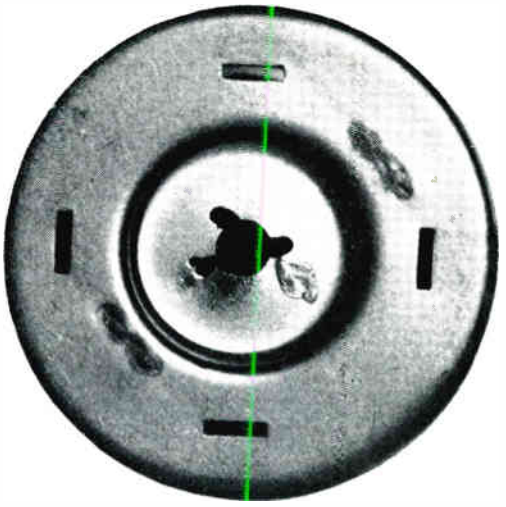


Fig. 12. Masking aperture with edges burned due to misadjustment of ion-trap magnet.

quently as in the heater base pins but occasionally a "cold" solder connection is found. Since the G_1 cup is only separated from the cathode by about four thousandths of an inch which is reduced to about two thousandths when the tube is in operation, a short may occasionally develop between these two elements. This type of short can, in many instances, be eliminated by the application of a high voltage spark. This type spark can be obtained from a "sparker" such as the model BD10 manufactured by Electro Technic Products, 4602 W. Montrose Ave., Chicago 4, Ill. This unit, as mentioned in the last issue, has a list price of $12.10 and can be obtained from your tube and parts distributor or the manufacturer. Note: Before sparking, the cathode and heater should be connected together. Also the minimum amount of sparking should be applied since excessive use of the sparker may destroy the cathode coating.

ACCELERATOR OR NO. 2 GRID

One of the functions of the number two grid is to cause the electrons to move more rapidly toward the screen. This is accomplished by making it positive in respect to the grid by approximately 300 volts. Another purpose which is performed by the G_2 element is to minimize brightness level changes as the high voltage varies. This is particularly valuable since most HV power supplies have very poor regulation which allows a considerable voltage variation as the screen illumination changes.

Physically the appearance of G_2 is similar to G_1 in that it is cup shaped with an aperture at the center of the closed end. In the straight type gun shown at the top of page one in the last issue all sides of the cup are equal. This type gun does not require an ion-trap magnet. The bent gun type shown on page two of the last issue has the open edge of the cup cut at an angle. It is the electrostatic field created by the slanted edges of the G_2 and HV anode cylinders which deflects the electron stream so that its normal path is toward the closed portion of the HV anode cylinder. The ion-trap magnet only affects the electrons and causes them to separate from the ions and go through the aperture in the HV anode cylinder, whereas the ions follow their normal path and are trapped within the HV anode cylinder. A brief explanation is as follows: the electron stream is composed principally of electrons, however, some ions are also present. Since the ions are heavier and larger than electrons, their normal course cannot be diverted as easily by a magnetic field as can the electrons. This is the reason why an ion spot always appeared only at the center of the screen on older type picture tubes. Since the electrons were deflected by the magnetic field of the deflection yoke and the ions were not, the constant ion bombardment of that small screen area resulted in a deterioration and discoloration (brown) of that portion of the screen. An illustration of this can be seen by referring to Tele-Clue H-61. The ion-trap magnet like the deflection yoke is only strong enough to change the course of the electrons, and in this way it traps the ions by separating them from the electrons.

GRID NO. 2 DEFECTS

The structure of this grid also limits its defects. About the only defects which can occur are an open circuit which may be corrected by resoldering the base pin, or a G_2-G_1 short which may be eliminated by using the "sparker" previously mentioned.

HV ANODE

The high voltage anode cylinder can also be seen in Fig. 2 on page two of the last issue. The function of this element is to greatly accelerate the speed of the electrons. The voltage on this element also determines the spot size and, therefore, contributes to the picture definition.

The masking aperture on one end of the anode cylinder defines the edge of the electron beam. When the ion trap magnet is properly adjusted practically all of the electron stream is directed through this aperture. Fig. 11 is a photograph of a normal aperture and Fig. 12 illustrates a masking aperture on which the metal was burned due to incorrect adjustment of the ion-trap magnet. In ordinary receiver type power supplies which in most cases have poorly regulated voltages, the metal would not be burned as much as shown. If the ion-trap magnet is not correctly adjusted, the metal near the edge of the aperture is heated far above the normal operating temperature. This excess heat will cause gases to be given off in direct proportion to the length of time the trap is misadjusted. These gases contaminate the cathode and thereby shorten the life of the picture tube. Another important point is that when the anode voltage is increased, the speed of the electrons in the beam is also increased. The faster these electrons travel, the harder they hit the metal around the aperture. This will in turn increase the temperature and, therefore, the amount of gas or vaporized metal which will be given off. If any of the metal is vaporized, it will affect the picture definition since this aperture defines the edge of beam. In no instance should the wattage to the picture tube anode exceed 6 watts, otherwise the aperture will melt.

The spacing clips on the masking aperture ring contact the inside graphite coating which also contacts the anode button. This graphite coating may serve as one side of an HV filter capacitor as described earlier in this series of articles. The anode voltage present on this coating also attracts the secondary electrons which are emitted from the fluorescent screen due to bombardment by the electron beam. This prevents a large accumulation of secondary electrons in back of the screen. This accumulation when not properly drained off results in uneven light distribution over the screen area or a distorted raster for the first few minutes after the set is turned on. This condition occurs when the inside coating is located too far back of the screen.

HV ANODE DEFECTS

About the only defect which can occur in the picture tube HV anode is poor contact either between the anode button and the graphite coating or between the graphite coating and the spacing clips on the HV anode cylinder. If this condition should develop, arcing will usually occur at the point of contact and the picture tube will have to be replaced.

In the next issue the picture tube tester will be described together with construction details.

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 Division, General Electric Company, Schenectady 5, New York.

INTERMITTENT INTERFERENCE

Complaint was of intermittent interference of approximately four-second duration with approximately eight-second interval. Effect was similar to auto ignition with two distinct bands across the picture, sound effect was a buzzing. It also blocked out radio reception even on local station. Neighbors near-by reported same trouble. Lower channels affected more than others. All electrical items in house were disconnected with no results. Antenna was disconnected and trouble stopped. Finally was traced to a heating pad which had been left plugged in on low heat, and had escaped detection. Pad unplugged and no more trouble, except for the poor wife to explain, as this had been going on for almost a month.

Vincent Meninno
481 Ash St.
Brockton 16, Mass.

JUMPER CORD VERSATILITY

I had a record changer out of the cabinet in a customer's home, and was about to try it out for adjustments. But I found I had forgotten to take along the female motor plug line cord attachment.

I tried a TV jumper cord and sure enough it worked perfectly on the male plug of the changer motor.

So, when in a similar situation, servicemen, try a TV jumper or line cord.

Sol Sukenick
5160 Arbor St.
Philadelphia 20, Pa.

REMOTE TUNER CONNECTION

When connecting an F-M tuner in a high fidelity installation or adding F-M to a radio or TV set, it is often necessary and desirable to locate the tuner at a considerable distance from the power amplifier. If the audio from the tuner comes directly from the detector, and not through an audio amplification stage, it is possible to maintain h-f response without resorting to cathode followers etc. Simply disconnect the capacitor used in the de-emphasis network, first, then determine the length of shielded cable needed to connect the tuner to the amplifier. Since the capacitance per foot is given by the manufacturer, it is simple to calculate the total capacitance. If this capacitance in combination with the rest of the de-emphasis network gives a time constant greater than seventy-five microseconds then the cable must be shortened, however, if the time constant is less than seventy-five microseconds connect a capacitor of suitable value at the point where the original capacitor was connected.

It is possible using this method to place the tuner at a considerable distance from the power amplifier depending on the type of cable used and the de-emphasis network configuration, without loss of high frequencies.

Frederic T. C. Brewer
144 Haddon Place
Upper Montclair, New Jersey

DAMPER CIRCUIT BREAKDOWN

When an RCA TV set comes in the shop with the high-voltage compartment fuse blown, look for an arc from the damper tube heater wires to chassis. The voltage here is quite high, and unless the wiring is well insulated, it will break down, especially where the wires pass through the chassis, or rest against any sharp edge of the chassis. Taping the wires well with "Scotch" plastic tape and replacing the fuse will eliminate the trouble. Incidentally, an excellent method of locating troubles of this nature is to place a milliammeter across the blown fuse for a few seconds . . . then the arc is easily located.

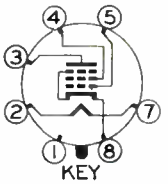
James C. Davis
2820 Phillips Ave.
Charlotte 8, N. C.

What's new!

12V6-GT

The 12V6-GT is a beam pentode designed primarily for use in the audio output stage of a-c and storage-battery-operated equipment. It is capable of supplying high power output with high sensitivity, high efficiency and low third and higher-order harmonic distortion. Except for heater ratings, the 12V6-GT is identical to the 6V6-GT.

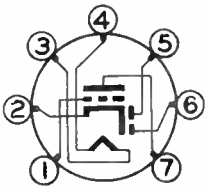
Heater Voltage (A-C or D-C)				12.6 Volts
Heater Current				0.225 Ampere
CHARACTERISTICS				
CLASS A_1 AMPLIFIER				
Plate Voltage	180	250	315	Volts
Screen Voltage	180	250	225	Volts
Grid Number 1 Voltage	−8.5	−12.5	−13.0	Volts
Peak A-F Grid Number 1 Voltage	8.5	12.5	13.0	Volts
Plate Resistance (Approx)	50000	50000	80000	Ohms
Transconductance	3700	4100	3750	Micromhos
Load Resistance	5500	5000	8500	Ohms
Total Harmonic Distortion (Approx)	8	8	12	Per Cent
Power Output	2.0	4.5	5.5	Watts



12BF6

The 12BF6 is a miniature duplex-diode medium-mu triode designed for use as a combined amplifier, detector, and automatic-volume-control rectifier in radio receivers. The triode section is particularly useful as a driver for impedance- or transformer-coupled output stages. Except for heater ratings, the 12BF6 is identical to the 6BF6.

Heater Voltage (A-C or D-C)	12.6 Volts
Heater Current	0.15 Ampere
CHARACTERISTICS	
CLASS A_1 AMPLIFIER	
Plate Voltage	250 Volts
Grid Voltage	−9.0 Volts
Amplification Factor	16
Plate Resistance (Approx)	8500 Ohms
Transconductance	1900 Micromhos
Plate Current	9.5 Milliamperes



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