equipment report

B & K Model 467 Pix Tube Restorer/Analyzer

Circle 94 on reader service card

MANY MANUFACTURERS HAVE TEST instruments on the market today performing the job they were intended to do, all under the heading of picture tube checkers, rejuvenators or restorers. They range in price from $120 to almost $500.

The 467, a new unit from B & K, essentially combines the desirable features of the popular devices on the market in all price ranges and throws in some new features of its own.

Figure 1 is a typical electron gun. It is composed of a heater, cathode, control grid (grid No. 1), accelerating anode (gride No. 2), and a focusing anode (grid No. 3). The final anode (grid No. 4) at the end of the gun is electrically connected to the neck coating and to the shadow mask. The mask, coating, and grid No. 4 together form the ultor anode of the tube.

As in any other thermionic emission type device, the heater brings the cathode to its operating temperature to set free electrons in motion about the cathode. The control grid (G1) is biased typically at –70 volts. The video signal is applied between the cathode and the control grid. Once the positive excursion of signal is sufficient to overcome the negative bias potential at G1, beam current flows through the aperture at G1 from the cathode and continues on at an accelerated rate to strike its proper phosphor dot.

The potentials at G2, G3, and G4 are set to assure an accelerated electron beam which is finely pinpointed (focused) when it reaches the surface of the pix tube. Remember that, what is shown in Figure 1 is a simplified version of actual potentials applied to the elements and no consideration is given to signal applications and the grids as in an actual color pix tube.

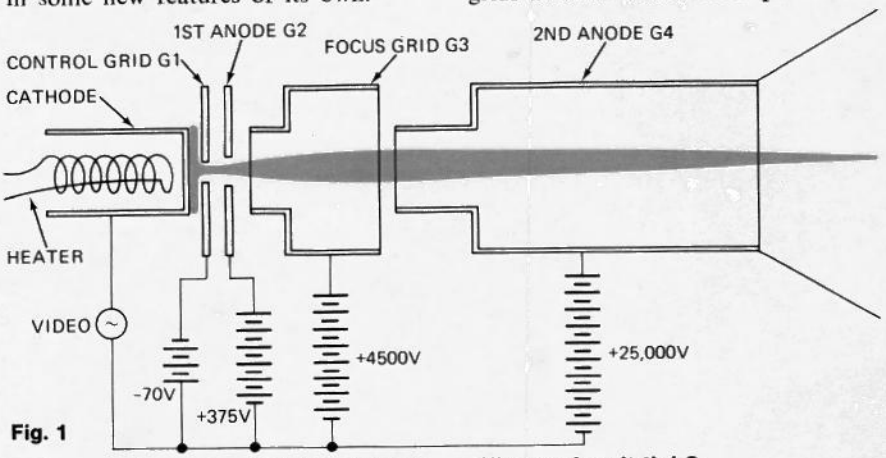

Fig. 1

Present day color TV uses mostly the three-beam tube with a magnetic convergence system. Other types of tubes are available too—the in-line, those with common elements, and the Trinitron.

What makes it tick?

Amazingly enough, regardless of the type of picture tube that's being tested, the procedure is the same. B & K's preliminary instruction book has stated

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"after the user has become thoroughly familiar with the instructions and the instrument itself, he will need only to refer to the SET-UP CHART booklet." This is indeed quite true. After only two weeks of use, I found only the need to verify the type of socket to be used for a particular tube and the G1 potential (either –50V or –70V). In most color pix tubes, socket 3 and a G1 potential of –50V are used. The set-up becomes almost second nature.

A tour of the 467 in operation is now in order. Let's assume we are checking a 25AP22A pix tube. The set-up manual says to use test adapter No. 3, the heater voltage is 6.3 volts and the G1 potential is –50 volts. (Anything other than –50V is noted with an * in the manual and the setting for G1 is then –70 volts.) We're ready to go. The TV receiver must be unplugged at all times for any testing!

With the function switch in the OFF position, select the proper heater voltage range. In the case of our 25AP22A we'll use a range of 4 to 7 volts.

Now rotate the function switch to the SET UP position. The G2 switch is

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n the NORM position (0-350 Vdc. In the SET UP position, a meter will indicate the precise heater voltage as determined by the SET HTR control. Meter **2** displays the G1 potential as determined by the SET G1 control. Meter **3** monitors the line voltage at the duplex outlet of the particular area you are in.

let's proceed to setting the precise cut-off potential of our picture tube.

Rotate the function selector switch to the CUT-OFF position. We now use the meters to set *spot cut-off* of the pix tube to +1 division above zero. *Spot cut-off* is the point at which the pix tube at the threshold of conduction (or *cut-off*) for a fixed G1 potential of −50V and varying G2. To see how this operates let's refer to Fig. 2. Notice that a

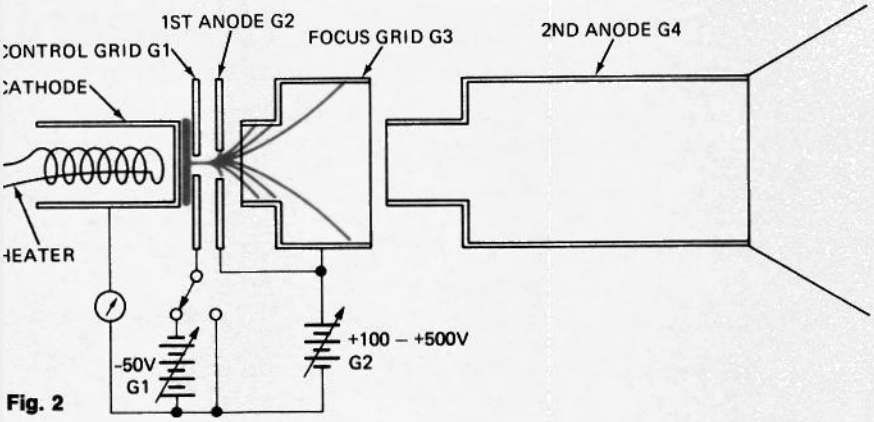

Fig. 2

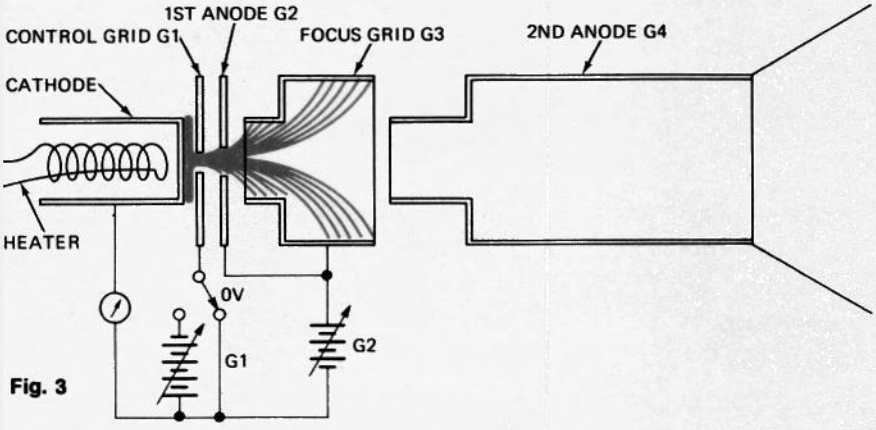

Fig. 3

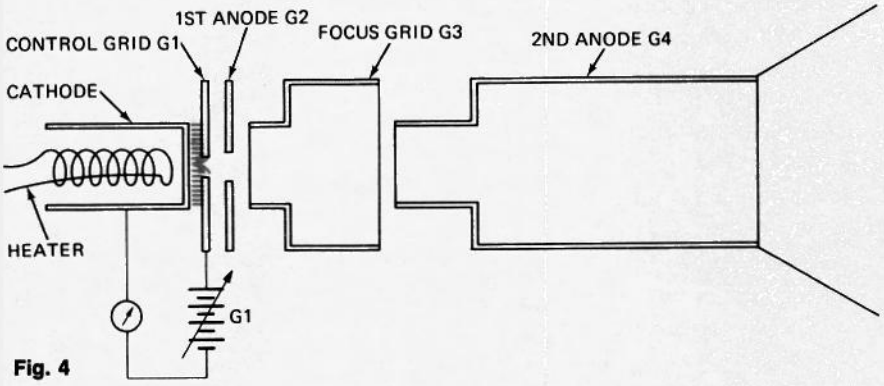

Fig. 4

No variable control is used. It's strictly a means of monitoring. The leakage lamps will automatically indicate any interelement leakage from heater-cathode or from K cathode (R, G, or B) to G1. If there is a heater-cathode short, there can be no repair. Either use a good isolation transformer or replace the tube.

Now that we have selected the proper heater voltage and G1 potential and made note of the line voltage, single gun is drawn. Now we don't have a general operation but rather we have the actual method by which the Model 467 connects elements of the pix tube under test. Remember, the heater voltage was previously set at 6.3 volts and G1 at −50 volts. Also note that the focus grid (G3) and the accelerating anode (G2) are common. The small amount of current flowing at the cut-off point is monitored by

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the meter. This current will be entirely dependent upon the setting of the G2 potential for each gun. Now we're ready to test.

Rotate the function selector switch to the TEST position. Automatically, the meters will indicate the condition of each gun. In the green area the gun is good. In the red area the gun is bad. You can also use the top scales of the meters for relative current indications if you wish to record data for your customer records. If the individual guns are well into the green area, we can be fairly sure the pix tube is good. Or is it? How will it track? Let's find out. See which gun provides the greatest emission. With this in mind, depress the TRACKING PUSH-BUTTON and set the best gun on the "set tracking" line of its respective meter by rotating the TRACKING control just above the TRACKING PUSH-BUTTON. The two weaker guns should now fall within the yellow wedges on their meters.

Assume that we have what appear to be three good guns. How good are they? We know that under normal heater voltage the emission is "up" and that it will track. Depress the LIFE pushbutton. This reduces heater voltage by 15% and simulates reduced line voltage. If the drop in emission is negligible you can assume not only good emission but a good life expectancy. Tracking can be checked under this reduced heater condition too. If there is good tracking, then only one other test need be made. Depress the FOCUS pushbutton. If the FOCUS OK lamp lights, the focus element is good.

The quality test that was just performed is one of the most important features of the Model 467. It rapidly tells the technician the emissive condition of each gun at a mere glance of the three meters, and the tube's ability to track (grey scale). Relative life span has been determined.

This is where B & K's claim of "true" beam current measurement and the multiplex system come into the act. Refer to Fig. 3. In the TEST position of the function selector switch, G1 is set to 0 volts. The tube now attempts to conduct at its maximum. Notice that the meter is connected (as before) so it measures the current that flows from K to G2 (G3). This is what B & K calls the *"true" beam current* and (according to B & K) is more meaningful for analysis purposes.

Our pix tube under test is still hooked up in a triode configuration. At the same time each gun is being pulsed 20 times per second. The guns

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are pulsed sequentially so that only one gun at a time is conducting. During the conduction interval, the G2 voltage is automatically adjusted by a programmable shunt regulator controlled from a multiplex generator. They have very conveniently used the line frequency to trigger their multiplex generator. The generator itself is a TTL chip consisting of two JK flip-flops. The clock driver is essentially ½ of a TTL 7400 Quad NAND gate. What we have is a signal-driven (digital) pix tube providing a dynamic emission test as opposed to the more widely used "Static Emission Test." Figure 4 shows the basic test set-up for measuring emission with the pix tube hooked-up as a 2-element device.

We are still in the TEST position of the function switch. Let's assume that our 25AP22A has low emission on all three guns. Proceed to the next step.

Rotate the function switch to the RESTORE position. There are three restoration functions that can be performed in this position: remove shorts, clean-balance, rejuvenate.

At this time the pix tube we are testing has no shorts or leakage indications—just very low emission (in the red). Put the REJUVENATE/CLEAN-BALANCE switch into the REJUVENATE position. With the function switch in the restore position, the heater voltage will be increased by 58% from the initial setting of 6.3 volts to 10 volts. There will be a 30-second wait until the proper operating temperature is reached. At this time we depress the RED REJUVENATE pushbutton. The heater voltage automatically decreases to zero. At the same time the meter directly above the pushbutton should show a marked rise in current that drops off toward the meter's red region.

When the current has decreased to the red region and is approaching zero, release the pushbutton. This is an automatic timing feature for the process and leaves very little chance for stripping the cathode. Immediately return the function selector switch to the TEST position. All things being normal, the gun usually comes up to a very good emission reading. Repeat the process with the green and blue guns, using the GREEN and BLUE REJUVENATE pushbuttons. Now recheck the TRACKING and LIFE tests. The results should be remarkable.

Let's assume that in the SET-UP position of the function selector switch that LEAKAGE was indicated from G1 to the blue cathode. This immediately suggests that a current path exists between these two elements that is below 2 megohms. However, in the RESTORE

position the G1-cathode short lamp is *not* lit. This means that the leakage path is greater than 20,000 ohms. We then attempt a CLEAN-BALANCE operation for the gun in question. Simply put the function switch in the RESTORE position and the REJUVENATE/CLEAN-BALANCE switch in the CLEAN-BALANCE position. Wait the required 30 seconds and depress the BLUE REJUVENATE pushbutton and watch its respective meter drop toward zero. Then release when the pointer reaches 0.2.

Let's set up a third (and final) condition with our 25AP22A. Assume that in the SET-UP position the G1 and K BLUE lamps were again lit. This still indicates a leakage path between the elements of less than 2 megohms. However, when the function switch is rotated to the RESTORE position the G1-K short lamp is lit. This now indicates that the leakage path is *less than* 20K and possibly a dead short. Merely depress the REMOVE SHORTS pushbutton and (unless the elements are welded together) the short should disappear.

We can now faithfully draw definitive conclusions about the model 467 and comment on the equipment based on real field experience. I have had approximately one month of use of the 467 for analysis of good tubes and bad tubes. The restoration process has had successes and failures. The results and conclusions were immediate. No tube during this period was ever "destroyed" by the equipment. I would like to qualify what I mean by "success" or "failure."

- In all cases thus far, the instrument accurately analyzed any given defect in picture tubes tested;
- The 467 would not restore tubes which had had a booster installed for a prolonged period of time;
- The 467 would not restore tubes which had previously been "rejuvenated" by another process.
- In all cases, when the picture tubes were "virgin," that is to say had not had a booster on it or no other restoration process applied, the 467 *did the job* and did it well.

Conclusion

From the *analysis standpoint,* the B & K Model 467 does a total job in determining that any given pix tube is good, bad, or marginal. It has performed its functions rapidly and has added only 3-4 minutes total diagnosis time (including set-up and restoration) to the in-home service call. Based upon this alone, it would be a welcome addition to any technician's list of valuable test equipment.

In many instances it has outshone it's own predecessor, the B & K Model 466. The new unit costs $279. **R-E**