Dec. 12, 1967 R. R. CONGER, JR 3,357,766

METHOD OF CONTROLLING CATHODE FORMATION IN TV TUBE GUN

Filed Aug. 17, 1966

FIG. 1

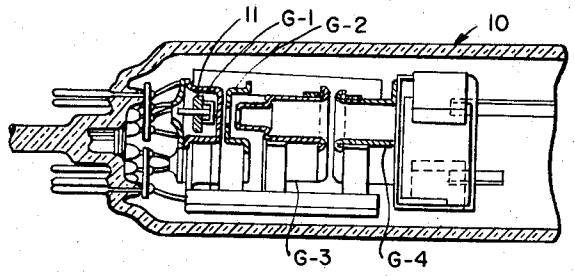


FIG. 2

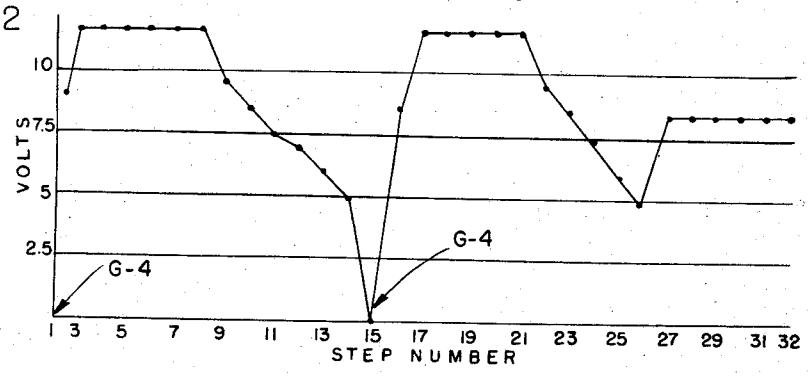


FIG. 3

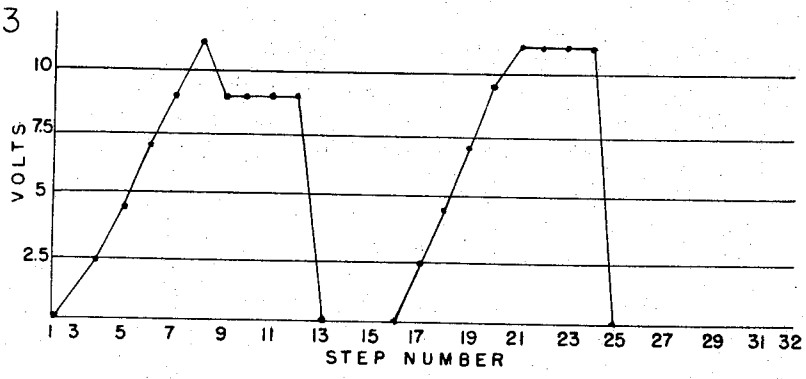
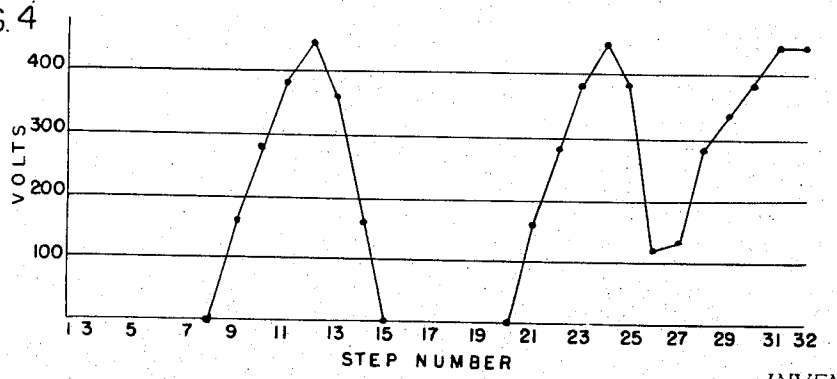


FIG. 4



INVENTOR:
ROBERT R. CONGER, JR.

BY

Dawson, Tilton, Fallon, Lungmus & Alexander

ATT'YS

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METHOD OF CONTROLLING CATHODE FORMATION IN TV TUBE GUN

Robert R. Conger, Jr., Chicago, Ill., assignor to National Video Corporation, Chicago, Ill., a corporation of Illinois

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This invention relates to a method of cathode formation in a TV tube gun, and more particularly, to a method of applying voltages to various parts of the gun according to a predetermined sequence.

Formation is a critical step in the manufacture of television picture tubes. Essentially it consists of "burning off" oxygen atoms from the barium lattice work to develop reproducible emmissivity. Historically, this formation has been performed after the tube has been evacuated and sealed. It will be immediately appreciated that imperfect forming can result in a loss of a virtually complete and relatively expensive product—the TV picture tube. In fact, in large-scale commercial operations, yields are often in the order of 50%. However, with the inventive procedure I am able to increase yields to the order of 90–95%. The provision of a method capable of this extraordinary yield enhancement constitutes an important object of the invention.

More particularly, the inventive method utilizes a deliberate decrease in filament voltage, and attendant increase in voltage of one of pre-focus grids to achieve this yield enhancement, it being appreciated that the prior art workers deemed mandatory at least the maintenance of the filament voltage. Provision of method for programming gun voltages for cathode formation thus constitutes a more specific object of this invention.

Other objects and advantages of the invention may be seen in the details of construction and operation set down in this specification.

The invention is described in conjunction with an illustrative embodiment, in the accompanying drawing in which:

FIG. 1 is a fragmentary sectional view of the gun portion of the TV color picture tube;

FIG. 2 is a graph of voltage against time as applied to the filament; and

FIGS. 3 and 4 are graphs like that of FIG. 2 but referring respectively to the G–1 and G–2 grids.

In the illustration given, and with particular reference to FIG. 1, the numeral **10** designates generally a glass envelope constituting the sheath of a color television picture tube. The general arrangement is well known to the art and for that purpose only the various elements with which the invention is concerned will be pointed out. For example, in FIG. 1, the numeral **11** designates the filament or emisive element. In proceeding forwardly, i.e., to the front of the gun (to the right in FIG. 1), the pre-focusing grids include grids G–1 and G–2. The remaining grids are designated G–3 and G–4, the latter being the second acceleration grid previously referred to and which is ordinarily biased at 25,000 volts.

A commercially available tube which has been produced according to the inventive procedure in National Video Corporation Model No. 23EGP22, and the particular procedure employed is set down in the table below wherein the voltages are correlated with time in terms of various steps.

Step No.	Time	Filament	G–1	G–2
1	30 M	—	—	—
2	2 M	8.5	—	—
3	30 S	11.5	—	—
4	5 S	11.5	2.5	0
5	5 S	11.5	4.5	0
6	5 S	11.5	7.0	0
7	5 S	11.5	9.0	0
8	50 S	11.5	11.0	0
9	5 M	9.5	9.0	165
10	5 M	8.5	9.0	275
11	5 M	7.5	9.0	380
12	5 M	7.0	9.0	435
13	5 M	6.0	—	365
14	5 M	5.0	—	155
15	15 M	—	—	—
16	2 M	8.5	—	—
17	5 S	11.5	2.5	0
18	5 S	11.5	4.5	0
19	5 S	11.5	7.0	0
20	5 S	11.5	9.5	0
21	50 S	11.5	11.0	170
22	5 M	9.5	11.0	275
23	5 M	8.5	11.0	390
24	5 M	7.5	11.0	440
25	5 M	6.0	—	385
26	5 M	5.0	—	155
27	5 S	8.5	—	165
28	5 S	8.5	—	275
29	5 S	8.5	—	330
30	5 S	8.5	—	385
31	45 M	8.5	—	440
32	20 M	8.5	—	440
33	30 M	0	0	0

M—Minutes.
S—Seconds.
The dashes indicate ground.

Throughout the operation the G–3 grid was maintained at ground potential. In step **1** (a 30-minute operation where there was no voltage on any of the filament, G–1, G–2, and G–3 grids), the G–4 grid was given a "hotshot" of 35 kv. for 10 minutes and 40 kv. for 20 minutes. Thereafter, the filament voltage was applied as indicated in step **2**. The filament voltage at this stage is sufficient to cause the cathode to emit, even though unformed. At step 15, it should be noted that again all of the filament, G–1, G–2 and G–3 grid voltages were at ground for the 15 minutes constituting this step, the G–4 being biased to 40 kv. It will be seen that as the filament voltage was decreased—starting at step 9 and the voltage of grid G–2 was increased so that the lack of filament voltage was compensated for by increasing the grid voltage—this allowing for adequate emission for formation without approaching the temperature limited condition of the cathode.

The invention is based in part on the discovery that too high G–1, G–2 bias results in "temperature limited" conditions which may result in cathode poisoning. The so-called temperature limited condition ordinarily results from operating the G–1 and G–2 grids at too high a voltage which dissipates the protective cloud of electrons about the cathode, thereby permitting negative ion bombardment. Negative ion bombardment results in the disruption of the desirable barium alloy lattice work, i.e., poisoning. It will also be noted from a consideration of the charts in FIGS. 2–4 that subsequent to increase of the G–2 voltage and prior to the complete removal of voltage from the filament, the G–2 voltage is decreased, this again being found effective to prevent the cathode from entering the temperature limited condition. Still further, as can be appreciated from a comparison of FIGS. 2 and 4 with FIG. 3, I use the voltage on the G–1 grid to "anticipate" the voltage on the G–2 grid. It will be appreciated that the G–1 grid has an effect on the

formation of the gun even when the G–1 grid is at ground potential.

I claim:

1. In the method of controlling the forming of a cathode in a television tube, the step of reducing the filament volt while increasing the voltage of one of the pre-focus grids, the said filament voltage prior to decrease being of value such as to cause said cathode to emit when in unformed condition.

2. The method of claim 1 in which prior to removal of filament voltage, the voltage on the other prefocusing grid is decreased following increase thereof.

3. The method of claim 1 in which both prefocusing grids, i.e., grids G–1 and G–2, are biased during application of voltage to the filament, the application of voltage to the G–1 grid preceding the application of voltage to the G–2 grid.

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RICHARD H. EANES, JR., *Primary Examiner.*