United States Patent [19]

Labudda

[11] **3,863,097**

[45] **Jan. 28, 1975**

[54] **CIRCUIT ARRANGEMENT FOR PRODUCING A VARIABLE ELECTRON ACCELERATION HIGH VOLTAGE IN AN ELECTRON BEAM PICTURE TUBE**

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[73] Assignee: **Licentia Patent-Verwattungs GmbH,** Frankfurt am Main, Germany

[22] Filed: **Aug. 17, 1973**

[21] Appl. No.: **389,201**

Related U.S. Application Data

[63] Continuation of Ser. No. 167,675, July 30, 1971, abandoned.

[30] **Foreign Application Priority Data**

July 31, 1970 Germany 2037982

[52] **U.S. Cl.** ..... **315/10,** 178/5.4 PE, 315/29, 315/379, 315/375, 315/14

[51] **Int. Cl.** **H01j 29/70**

[58] **Field of Search** ..... 178/5.4 PE, 5.4 F, 5.4 R; 315/21 R, 21 C, 28, 29

[56] **References Cited**

UNITED STATES PATENTS

3,114,795	12/1963	Moles	178/5.4 PE
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Primary Examiner—Maynard R. Wilbur
Assistant Examiner—J. M. Potenza
Attorney, Agent, or Firm—Spencer & Kaye

[57] **ABSTRACT**

An improved circuit arrangement for producing a variable electron acceleration high voltage in an electron beam picture tube of the type wherein the electron acceleration high voltage, and hence the speed of the electrons impinging on the phosphor of the tube, determines the color produced. The anode of the tube is connected to a constant d.c. potential, i.e., either ground or a high d.c. voltage and the voltage applied to the cathode of the tube is selectively varied or switched to provide the variable electron acceleration high voltage.

13 Claims, 16 Drawing Figures

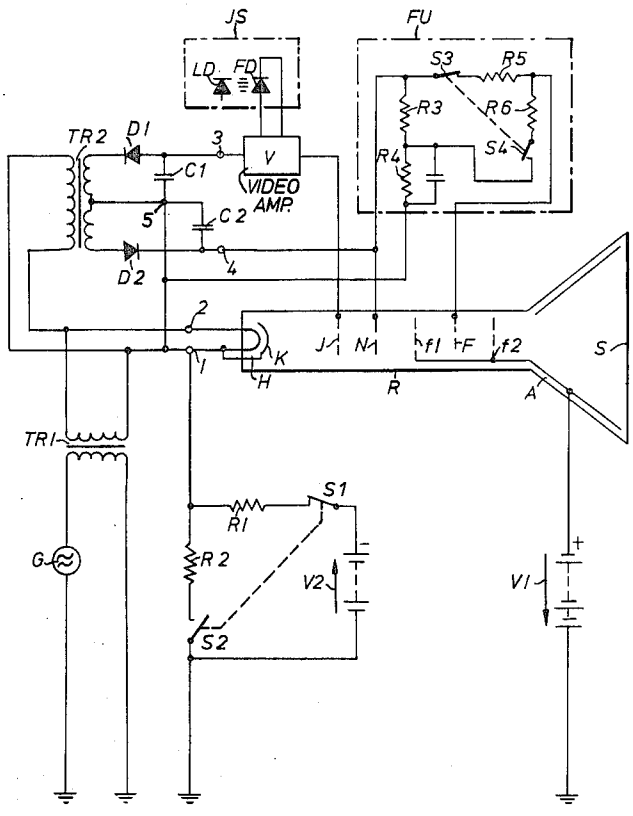


FIG. 1

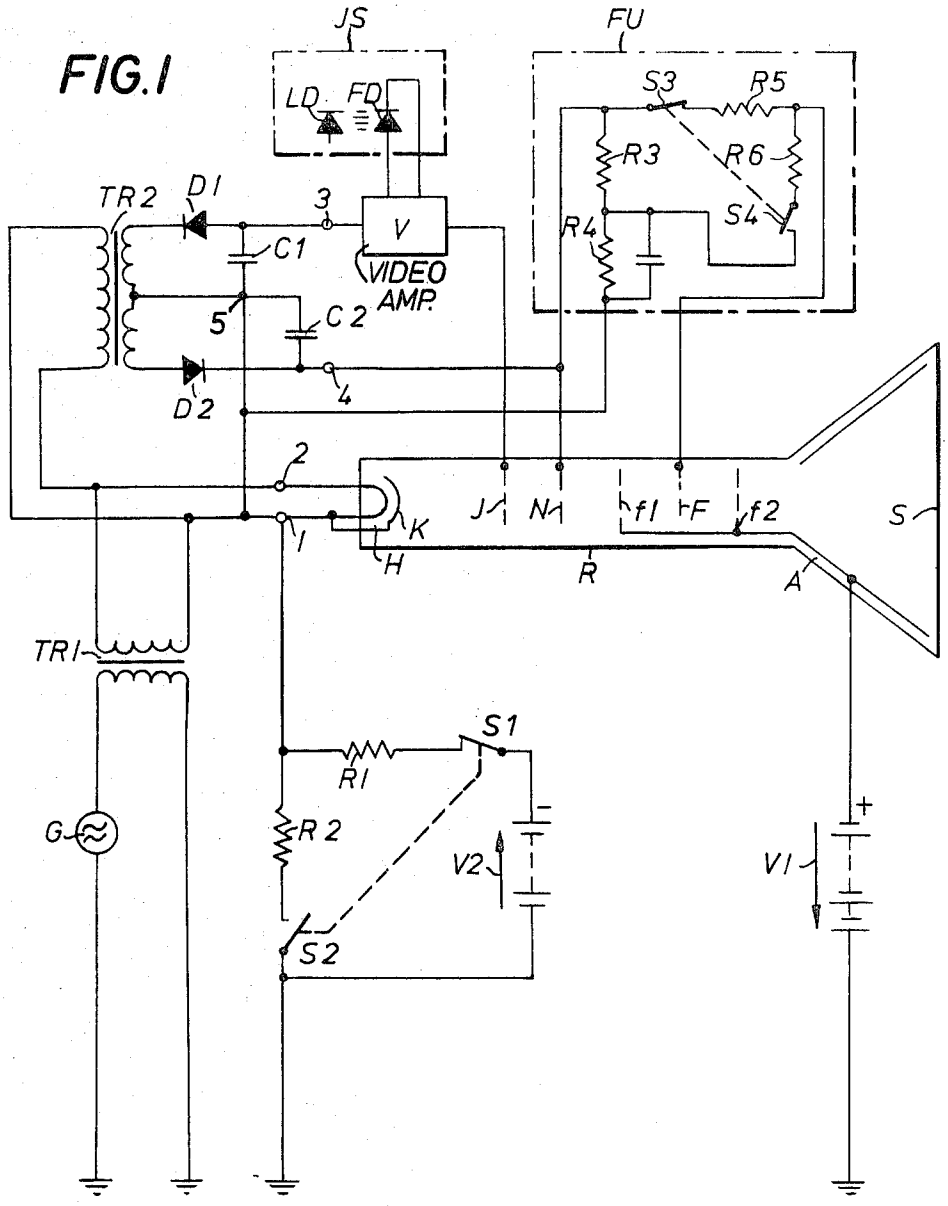
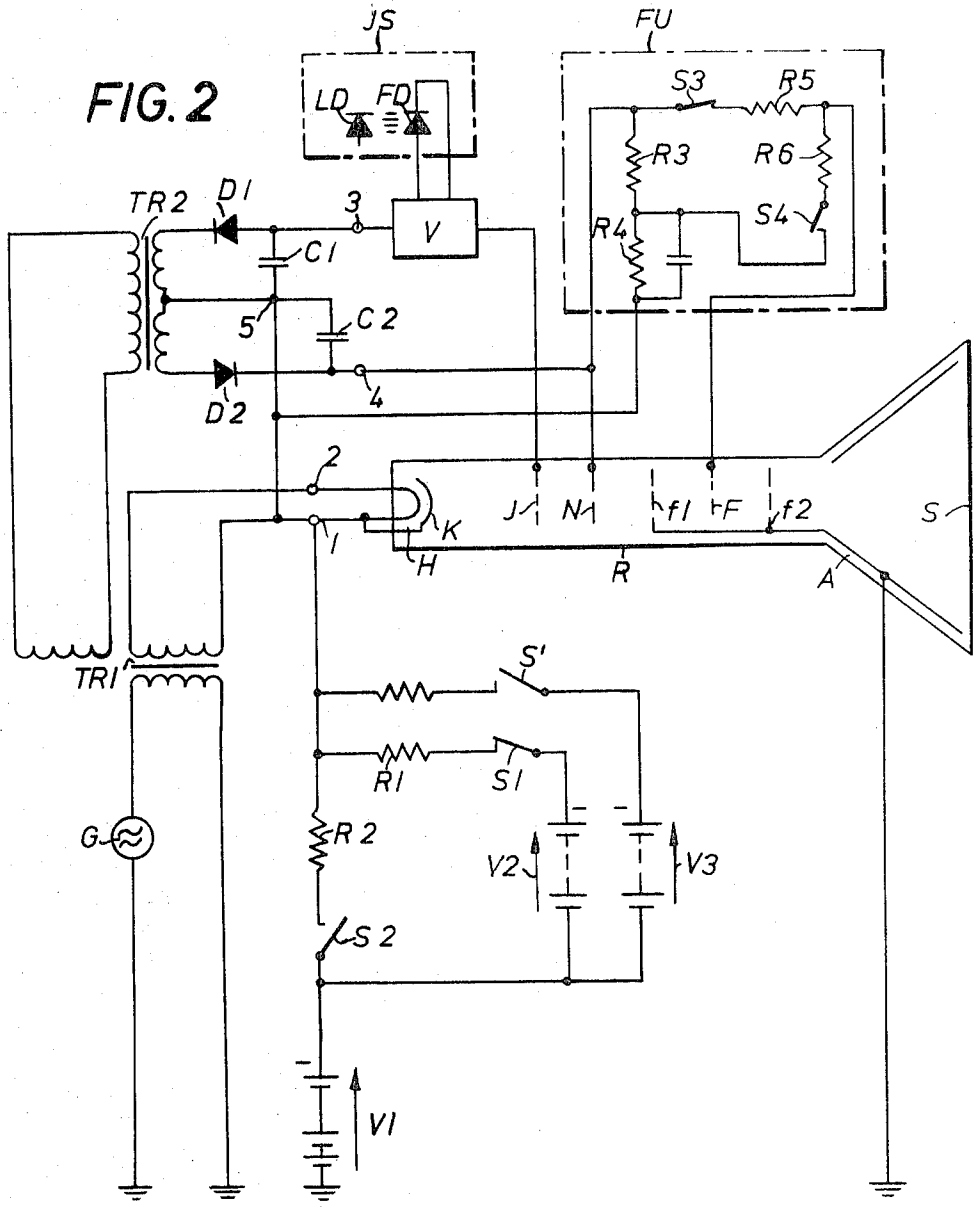

JS
FU
LD
FD
S3
R5
R3
R6
S4
R4
TR2
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VIDEO AMP.
C1
5
C2
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D2
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K
H
J
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f2
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R
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TR1
S1
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V2
S2
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FIG. 2


JS
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LD
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S3
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R3
R6
R4
S4
TR2
D1
3
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C1
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C2
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f2
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CIRCUIT ARRANGEMENT FOR PRODUCING A VARIABLE ELECTRON ACCELERATION HIGH VOLTAGE IN AN ELECTRON BEAM PICTURE TUBE

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation of application Ser. No. 167,675, filed July 30th, 1971, now abandoned.

BACKGROUND OF THE INVENTION

The present invention relates to electron beam picture tubes and in particular to an improved circuit arrangement for producing a variable electron acceleration voltage in such a tube.

Character-writing electron beam picture tubes for the colored display of characters or graphic displays having a phosphor coating on the picutre tube screen which, when excited by the impinging electron beam, lights up in a color dependent on the impinging speed of the electrons are known in the art. In these tubes an electron beam is provided which can be deflected according to the so-called stylus method by a character and possibly a vector generator, the travelling speed of the electron beam is made variable by changing the electron acceleration high voltage.

In the known tubes of this type, the variation in the electron acceleration high voltage is effected by switching the anode voltage between given values. Because of the considerable capacitance of the inner anode coating, the switching of the anode voltage requires that a certain relatively long switching time must expire when the anode coating is sequentially charged and discharged. This switching time, which is determined by the capacitance of the anode and the internal resistance of the charge source, limits the number of characters which can be displayed in a total picture, because the total picture must be written during a time period which permits its repetition at a frequency which is high enough to assure freedom from flicker. Additionally, the large anode capacitance causes a substantial energy loss and charges to occur on almost the entire picture tube surface. These additional charges on the picture tube surface have an annoying effect when the tube is touched and moreover radiate interfering fields.

SUMMARY OF THE INVENTION

The above-mentioned drawbacks of the prior art are eliminated or at least reduced according to the present invention by connecting the anode to a constant d.c. potential and switching the high voltage potentials applied to the cathode of the picture tube.

According to the invention, either a constant high voltage may be applied to the anode of the picture tube or the anode of the picture tube may be grounded and a constant high voltage connected in series with a switchable voltage or a plurality of such voltages applied to the cathode.

According to a further feature of the present invention, the switching voltages for the cathode are connected to the output of a first transformer which furnishes the operating voltages for the grids of the picture tube, with a voltage derived from a further transformer which furnishes the cathode heating voltage being fed to the primary side of the first transformer. The cathode heating voltage and the primary voltage of the first transformer are taken from the same or a pair of separate secondary windings of the further transformer whose primary is connected to a high frequency generator.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic circuit diagram of one embodiment of the invention.

FIG. 2 is a schematic circuit diagram illustrating a number of modifications of the embodiment of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1 there is shown a character-writing electron beam picture tube R. The beam deflection means for such a tube, which are controlled by a character or possibly a vector generator, are not shown since these devices are well known in the art and are of no interest for the present invention. The screen S of the tube is covered with a phosphor which lights up in different colors depending on the speed at which the electrons in the beam impinge thereon. In a conventional manner, the tube R is provided with an anode A, a cathode K, a heating filament H, an intensity control grid (intensity modulation grid) J, a preacceleration grid N, and a focusing grid F which cooperates with two grids *f*1 and *f*2 connected to the anode voltage.

Between the anode A and ground there is connected a high voltage source VI which keeps the anode at a constant direct voltage VI, for example, 14 kV. A further source for a constant direct voltage V2, e.g. 6 kV, is provided having its positive terminal connected to ground and its negative terminal connected, via the series connection of a switch S1 and a resistor R1, with the terminal 1 of the cathode K and the heating filament H. Terminal 1 is also connected to ground via the series connection of a switch S2 and a resistor R2. Connected across the cathode terminals 1 and 2 is the secondary winding of a transformer TR1 and the primary winding of a further transformer TR2.

Connected in the primary circuit of transformer TR1 is a generator G which produces a high frequency rectangular alternating voltage of, e.g., 30 volt in the primary winding.

The transformer TR1 is constructed so that the alternating voltage induced in the secondary winding of the transformer is, e.g., 6 volt which serves as the heating voltage for filament H.

The secondary winding of transformer TR2 is provided with a center tap 5 which is connected with terminal 1, i.e., to the output of high voltage potentials applied to the cathode K as a result of the respective opening and closing of switches S1 and S2. As a result of this center tap connection, the winding ratio of transformer TR2, and the diodes D1 and D2 connected to the respective ends of the secondary winding of transformer TR2, a rectified voltage of, e.g. — 100 volt, will appear at terminal 3 and of, e.g. + 600 V, will appear at terminal 4. Operating voltages for the grids J, N, F are then tapped from the voltages appearing at terminals 3, 4. Capacitors C1 and C2 which connect the center tap 5 to the terminals 3 and 4 respectively are filter capacitors.

Disposed between terminal 3 and intensity control grid J is a video amplifier V whose output voltage can be controlled by an intensity control circuit JS. The amplifier V is provided with high-voltage insulation be-

tween the controlling and the controlled element. Although the control may be effected in any approriate manner, preferably as illustrated the control is effected by a controlled luminous diode LD whose output radiation controls a photodiode FD.

The voltage for the focusing grid F is generated by a focusing voltage switching device which in its entirety is identified as FU and whose input is connected to terminal 4. Grid N is also connected to terminal 4.

Switches S1 and S2 operate in a push-pull arrangement, i.e., when one switch is open the other is closed. In the case where switch S1 is closed and switch S2 is open, the negative direct voltage V2 will be applied to cathode K and filament H via resistor R1 (of e.g. 10 $k\Omega$) and to the primary windings of transformer TR2 and to the secondary winding of transformer TR1. The voltage effective as the electron acceleration voltage in tube R between anode A and cathode K is then V1+V2, i.e., for example 20 kV. The electron beam, when intensity modulated for displaying an alphanumerical character or a vector, thus produces the character on the screen in a color which is determined by the impingement speed of the electrons produced by the above-mentioned anode-cathode voltage. If a subsequent character is to be written in another color, the anode-cathode voltage must first be switched or changed to the value required to cause the other color to be produced. For this purpose, switch S1 is opened and switch S2 is closed. Terminal 1 is thus connected to ground via resistor R2 (e.g. 10 $k\Omega$). This consequently also causes the cathode K, the filament H, the transformer TR2 and the secondary winding of the transformer TR1 to be connected to ground and the total capacitance of these circuit elements to be discharged to ground. This capacitance is relatively low so that the discharging can take place in a few microseconds. This is considerably shorter than the recharging time required when changing the voltage at the anode A as in the prior art, which recharging time would lie in the millisecond range. As a reuslt of opening switch S1 and closing switch S2, the anode-cathode voltage of tube R is now V1, i.e., for example 14 kV, which produces another color in the pictorial display.

If the first-mentioned color is to be shown again, switch S2 is opened and switch S1 is closed again with the effect that the voltage V2 which increases the anode-cathode voltage of tube R is again applied to the cathode K, heating filament H, the transformer TR2 and the secondary winding of transformer TR1.

Since the alternating heating voltage for the heating wire H of e.g. 6 volt, which is simultaneously applied to the primary winding of transformer TR2, is induced in the secondary winding of transformer TR1 by a high frequency primary alternating voltage of, e.g. 30 volt to ground, it is sufficient for the secondary winding of TR1 to have only 1 to 2 windings which can be sufficiently insulated by an insulating covering so that they are insulated against the primary winding when voltage V2 is applied.

The generation in transformer TR2 of the grid operating voltage from the alternating heating voltage makes it possible to "pull along" the grid operating voltages in a simple manner with the changes in the cathode voltage. Alternatively as shown in FIG. 2, the primary alternating voltage of transformer TR2 can be generated in a separate secondary winding of transformer TR1, also with only a few windings.

The swtiching arrangement for the focusing voltage may be realized, for example by switching means as shown in the box FU which operates in a manner similiar to the cathode voltage switching arrangement. The switching arrangement FU contains a switch S3 which is closed in synchronism with switch S1, and a switch S4 which is closed in synchronism with switch 2. With switch S3 closed (S4 open), the voltage from terminal 4 or a voltage derived from this voltage via a resistor voltage divider is pulled via diode D2 and the secondary winding of TR2 to the voltage of cathode K and is applied to grid F via resistor R5. Similarly when switch S4 is closed (S3 open) a partial voltage taken off between resistors R3 and R4 is applied to grid F via resistor R6.

Instead of the particular voltage switching arrangement shown in FIG. 1, it is also possible to connect the anode A to ground as shown in FIG. 2 and to connect the direct voltage source VI between the voltage source V2, in the same polarity therewith, and ground. In this case, however, the insulation requirements for the switching devices S1, S2 and other circuitry connected to the cathode are higher.

The above description of the invention was based on the assumption that the display on the screen is to be shown only in two colors which is often sufficient for alphanumerical and graphic displays. If more than two colors are to be used, i.e., the anode-cathode voltage of the tube R is to be settable for more than two different values, this can be accomplished as shown in FIG. 2 by providing at least one further voltage source V3 which is different from V2 and which can be connected to terminal 1, in the manner described for the voltage V2, by closing a switch S' so that it is thus "added" to the voltage V1.

It will be understood that the above description of the present invention is susceptible to various modifications, changes and adaptations, and the same are intended to be comprehended within the meaning and range of equivalents of the appended claims.

I claim:

1. A circuit arrangement for producing an electron acceleration high voltage in an electron beam picture tube comprising:

a. an electron beam picture tube of the type having a phsophor layer on the screen portion thereof which produces different colors depending on the speed of the impinging electron beam, and a single cathode;

b. first means connecting the anode of said picture tube to a constant d.c. potential;

c. second means connected to said cathode of said picture tube for selectively applying different d.c. potentials to said cathode so as to cause different values of electron acceleration high voltage, and hence different speeds for the electrons, corresponding to said different colors within said picture tube; and

d. third means connected to said cathode and responsive to the d.c. potential applied thereto for simultaneously switching the d.c. potentials applied to the grids of said picture tube.

2. The circuit arrangement defined in claim 1 wherein said means for selectively applying different d.c. potentials to said cathode comprises first switch means connected between said cathode and ground, and a series circuit including a second switch means

and a d.c. high voltage source, said series circuit being connected in parallel with said first switch means.

3. The circuit arrangement defined in claim 1 wherein said anode is connected to a source of constant high d.c. voltage.

4. The circuit arrangement defined in claim 2 wherein said anode of the picture tube is connected to ground and wherein a constant d.c. high voltage source is connected in series with said first and second switch means.

5. The circuit arrangement defined in claim 1 wherein said third means includes a first transformer whose secondary winding is connected to the output of said second means connected to said cathode, said secondary winding of said first transformer furnishing the operating voltages for the grids of said picture tube; and wherein the output voltage generated in a further transformer, which also furnishes the cathode heating voltage, is applied to the primary winding of said first transformer.

6. A circuit arrangement as defined in claim 5 wherein the cathode heating voltage and the primary voltage of the said first transformer are taken from the same secondary winding of said further transformer which secondary winding is also connected to the output of said second means connected to said cathode; and wherein a high frequency generator is connected to the primary circuit of said further transformer.

7. A circuit arrangement as defined in claim 5 wherein said output of said second means is connected to the center tap of the secondary winding of said first transformer, and wherein said third means further includes means for rectifying the output voltage from said secondary winding.

8. A circuit arrangement as defined in claim 5 wherein a video amplifier for controlling the beam intensity control grid of said picture tube is connected to the output of said first transformer; and wherein said video amplifier is controlled by a photo-electric element by means of illumination intensity modulation.

9. In a circuit arrangement including an electron beam color picture tube of the type having a phosphor layer on the screen portion thereof which produces different colors depending on the speed of the impinging electron beam, and means for selectively applying different values of electron acceleration high d.c. voltage, which values correspond to the desired colors, between the cathode and the anode of the picture tube to cause different speeds for the electrons within the picture tube, the improvement wherein said means for selectively applying different values of electron acceleration high d.c. voltage includes controllable switch means connected to said cathode of said color picture tube for selectively applying different d.c. potentials, whose values selectively determine said different values of electron acceleration high d.c. voltage, to said cathode; and further comprising means responsive to said selectively applied different d.c. potentials for simultaneously switching the potentials applied to the grids of said picture tube.

10. The circuit arrangement defined in claim 1 wherein said third means includes a first transformer having a primary winding and a center tapped secondary winding with said center tap connected to said cathode, a pair of oppositely poled rectifiers, each of which is connected in series with a respective end of said secondary winding, means for applying an a.c. signal to said primary winding, and circuit means for feeding the rectified output voltages of said first transformer to the intensity control, preacceleration and focusing grids of said picture tube.

11. The circuit arrangement defined in claim 10 wherein said means for applying an a.c. signal includes a second transformer having its input connected to a high frequency a.c. generator and its output connected to said primary winding of said first transformer and to the heating filament for said cathode of said picture tube.

12. The circuit arrangement defined in claim 9 wherein said means for simultaneously switching the potentials applied to the grids includes a first transformer having a primary winding and a center tapped secondary winding with said center tap connected to said cathode, a pair of oppositely poled rectifiers, each of which is connected in series with a respective end of said secondary winding, means for applying an a.c. signal to said primary winding, and circuit means for feeding the rectified output voltages of said first transformer to the intensity control, preacceleration and focusing grids of said picture tube.

13. The circuit arrangement defined in claim 12 wherein said means for applying an a.c. signal includes a second transformer having its input connected to a high frequency a.c. generator and its output connected to said primary winding of said first transformer and to the heating filament for said cathode of said picture tube.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,863,097

DATED : January 28th, 1975

INVENTOR(S) : Hans-Jürgen Labudda

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading of the patent, under [73] Assignee, change "Patent-Verwattungs" to --Patent-Verwaltungs--.

Column 1, after line 26, insert --A character writing electron beam picture tube of this type is described, for example, in the prospectus of the firm Sylvania, Seneca Falls, N.Y., "I & M Cathode Ray Tubes, Multicolor Display Tube SC-4852P22G/P22R", dated April 24, 1968.--

Column 2, lines 29 and 30, change "VI" to --Vl-- (both occurrences).

Column 3, line 2, change "approriate" to --appropriate--; line 40, change "reuslt" to --result--.

Column 4, line 4, change "similiar" to --similar--; line 19, change "VI" to --Vl--; line 47, change "phsophor" to --phosphor--.

Signed and Sealed this

ninth Day of *September 1975*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks