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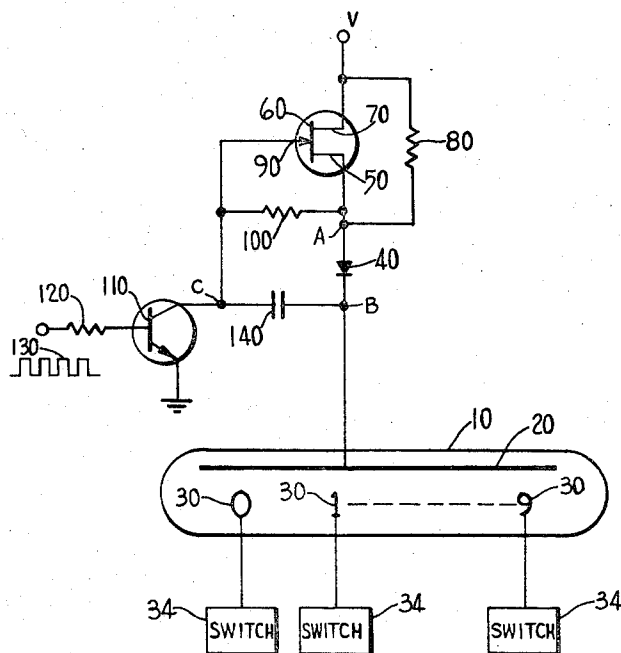
- [54] OPTIONAL HIGH VOLTAGE BOOSTER CIRCUIT
FOR INDICATOR TUBE
2 Claims, 1 Drawing Fig.**
- [52] U.S. Cl.**..... **315/169 R,**
315/169 T, 315/224, 315/233, 315/245, 315/260,
315/287, 315/337
- [51] Int. Cl.**..... **H01j 61/66,**
H02m 7/52
- [50] Field of Search**..... 315/101,
169, 260, 337, 209, 224, 227, 233, 240, 245, 260,
287, 84.5, 84.6; 307/263, 109, 110

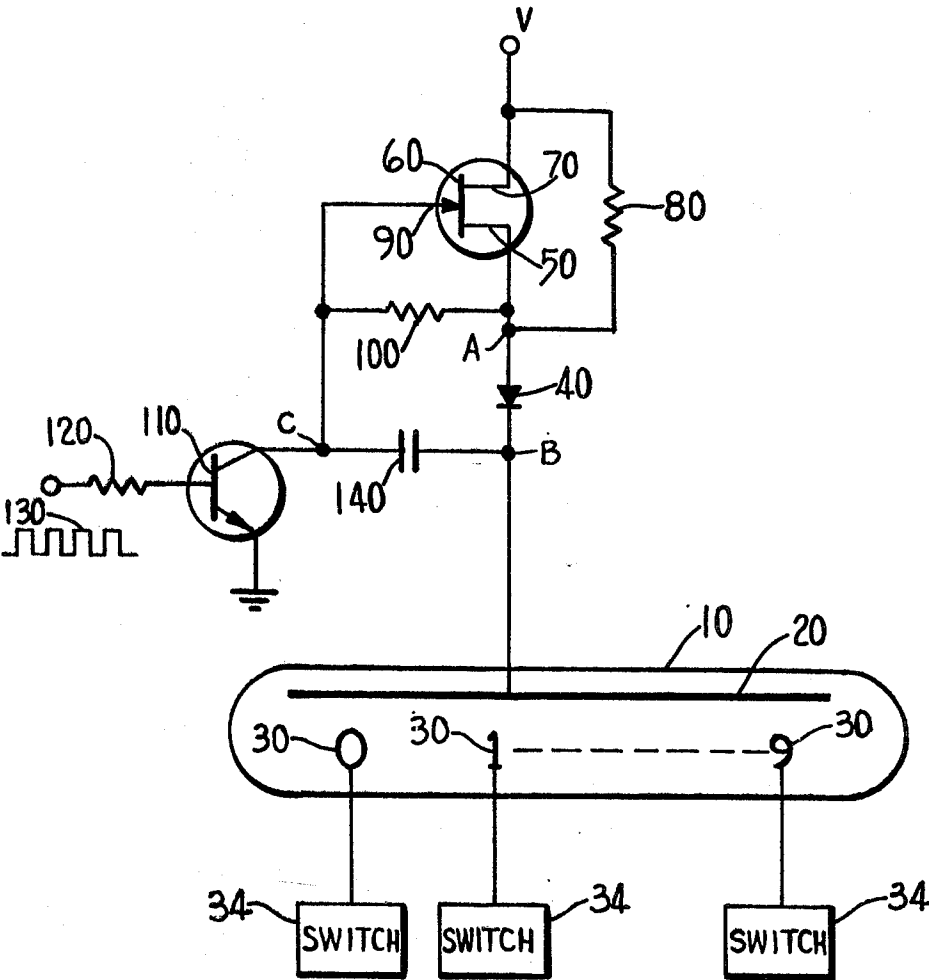
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ABSTRACT: The disclosure is of a circuit for driving an indicator tube of the type including an anode and a plurality of glow cathode electrodes. The circuit includes a normal anode power supply and an auxiliary circuit for increasing the voltage supplied to the anode of the tube by a fractional amount of the voltage supplied by the normal power supply during periods when the normal power supply is insufficient to fire the tube.





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OPTIONAL HIGH VOLTAGE BOOSTER CIRCUIT FOR INDICATOR TUBE

BACKGROUND OF THE INVENTION

In typical operation of an indicator tube of the type described above, when the usual operating potential is applied to the anode electrode and a selected cathode electrode, the cathode exhibits cathode glow and becomes clearly visible. However, under some circumstances, it has been found that application of the normal potentials cannot cause the tube to fire. It has been found that this nonfiring condition occurs, for example, when a tube is operated at a higher-than-normal temperature.

SUMMARY OF THE INVENTION

In order to overcome the foregoing problem, an anode driving circuit utilizes a capacitor that is charged to a predetermined level determined by a pair of resistors acting as a voltage divider. This capacitor is thereafter automatically connected to the anode power supply so the voltage on the capacitor is aiding the power supply voltage when the tube is nonconducting. A boosted supply voltage that is just sufficient to fire the tube when hot, yet not so great as to stress it, is applied to the tube by choosing the requisite relative values of the two resistors forming the voltage divider.

DESCRIPTION OF THE DRAWING

In the drawing, the single FIGURE is a schematic representation of a circuit embodying the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The circuit of the invention is particularly adapted for use with cathode glow indicator tubes of the type known as Pat. No. tubes. This type of tube 10 is shown schematically in the drawing and includes a gas-filled envelope which contains an anode electrode 20 and usually ten cathode electrodes 30 including the numerals "0" to "9." Each cathode electrode is coupled to a switch or driver circuit 34 which is used to select the cathode to be displayed. These driver circuits are well known in the art and may comprise switching transistors that are turned on or off as required to fire the appropriate cathode. One type of driver circuit for this purpose is described in patent 3,227,922.

According to the invention, the anode electrode 20 is connected to the anode of diode 40, which has its cathode connected to the source 50 of a field effect transistor 60. The drain 70 of the transistor 60 is connected to a positive DC power source V which, in a typical circuit, is of the order of 200 volts. A resistor 80 is connected between the drain 70 and the source 50, and the gate 90 of the transistor 60 is connected both through a resistor 100 to the junction of its source and the anode of diode 40 and to the collector of an NPN transistor 110 which has its emitter connected to ground and its base connected through a suitable input impedance 120 to any well-known source of positive pulses 130. A capacitor 140 is connected between the collector of the transistor 110 and the cathode of diode 40.

The circuit shown is one which is used to overcome the problem described above, and it can also be used for dimming or blanking the tube 10 by controlling the frequency of pulses 130 so that the duty cycle of the current flow through the tube is decreased. Circuitry to control pulses 130 is well known in the art and is not seen as requiring explanation here. In operation, the circuit responds to pulses 130 in the following

manner. As the positive pulses 130 are fed into the base of the transistor 110, each pulse turns on the transistor 110, and this turns off transistor 60 to block current flow to the anode 20 of tube 10. Normally, this sequence of operations occurs at such a rate and for such a short time that, if a cathode is glowing in the tube, its glow appears to be continuous and the periodic blanking is not visible. If the repetition rate of pulses 130 is increased significantly so that the tube is blanked more frequently, then a glowing cathode can be dimmed.

The circuit solves the problem described above where the tube 10 does not operate with the normal voltage applied to it as follows.

Each input pulse 130 turns on transistor 110, sets its collector at about ground and thus turns off transistor 60. Resistors 80 and 100 comprise a voltage divider. When transistor 10 turns on and its collector is grounded, point A, which is the intersection of the cathode of diode 40, the source 50 of field effect transistor 60 and the junction of resistors 80 and 100, will have a potential determined by the resistance values of resistors 80 and 100. Assuming this potential to be about 100 volts, capacitor 140 charges to about 100 volts through diode 40. Thus, there is +100 volts at point A and at point B, the intersection of one side of capacitor 140, anode 20 and the anode of diode 40. This potential may be insufficient, however, to fire tube 10. When the transistor 110 turns off, point C, which is the intersection of gate 90 of field effect transistor 60, the other side of capacitor 140 and the collector of transistor 110, and point A rise toward 200 volts, and, therefore, the gate of transistor 60 approaches turn-on potential. When transistor 60 turns on, it becomes a low impedance path so that point C is now connected to about +200 volts through resistor 100 and point A. If tube 10 is nonconducting, point C effectively has a potential of +200 volts that is summed with the +100 volts across the capacitor 140 so that a maximum of about +300 volts is placed at point B and at the anode 20 of the indicator tube, thus causing the indicator tube to fire.

I claim:

1. A circuit for firing a gas discharge device having at least one pair of electrodes comprising:

a first current path including a first electronic switch connected to one electrode of said pair of electrodes through a unidirectional device for connecting a positive potential source to said one electrode;

a second current path including a second electronic switch connected to said one electrode through a capacitor for connecting a ground potential source to said one electrode;

a first resistor shunting said first switch in said first current path;

a second resistor connected between the first electronic switch and the unidirectional device in said first current path and between the capacitor and second electronic switch in said second current path; and

means interacting with said second resistor for causing the first electronic switch to close when said second electronic switch is opened and open when said second electronic switch is closed, whereby said capacitor is charged to a fraction of the potential of said potential source when said first electronic switch is open and said second switch is closed and is connected to the positive potential source in a series aiding relationship when said second switch is open and said first switch is closed and said discharge device is nonconducting.

2. The circuit of claim 1 wherein said first and second electronic switches comprise first and second transistors and wherein said means comprises a current path from said second current path between the capacitor and second switch to the gate of said first transistor.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,600,631 Dated August 17, 1971

Inventor(s) Arthur F. Cake

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

The title should be --VOLTAGE BOOSTER CIRCUIT FOR INDICATOR TUBE--. Column 1, lines 37 & 38 delete "Pat. No." and substitute therefor --NIXIE--. Column 2, line 44 change "electrode" to --electronic--; and line 65 after "transistors" insert --the first transistor having a drain, source and gate, and the second transistor having a collector, a base and an emitter,--.

Signed and sealed this 21st day of March 1972.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents