

Aug. 4, 1970

A. SOMLYODY

3,522,471

TRANSISTOR DRIVER CIRCUITS FOR CATHODE GLOW DISPLAY TUBES

Filed March 19, 1968

2 Sheets-Sheet 1

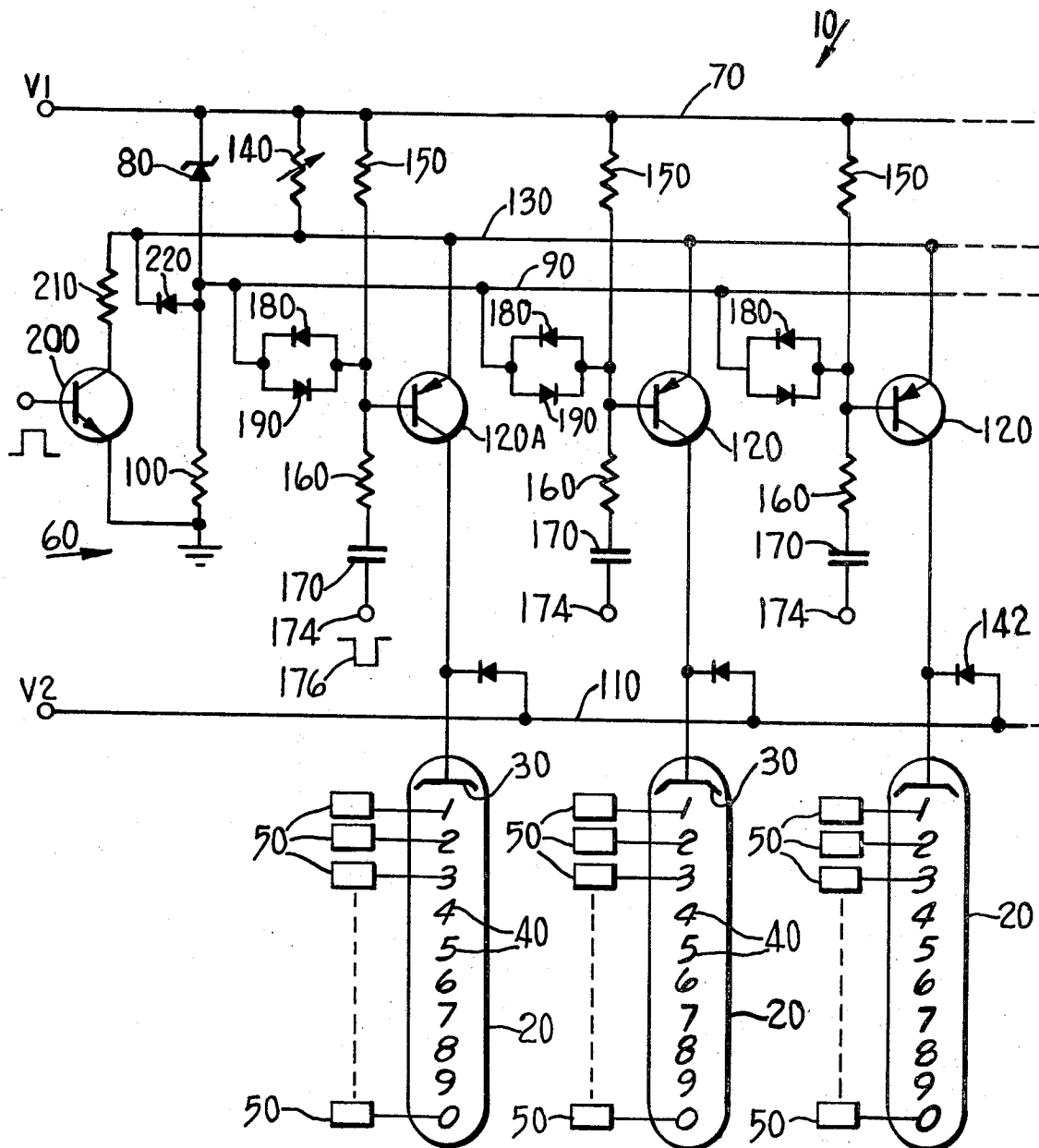


FIG. 1

INVENTOR.
ARPAD SOMLYODY
BY *Robert A. Green*

ATTORNEY

Aug. 4, 1970

A. SOMLYODY

3,522,471

TRANSISTOR DRIVER CIRCUITS FOR CATHODE GLOW DISPLAY TUBES

Filed March 19, 1968

2 Sheets-Sheet 2

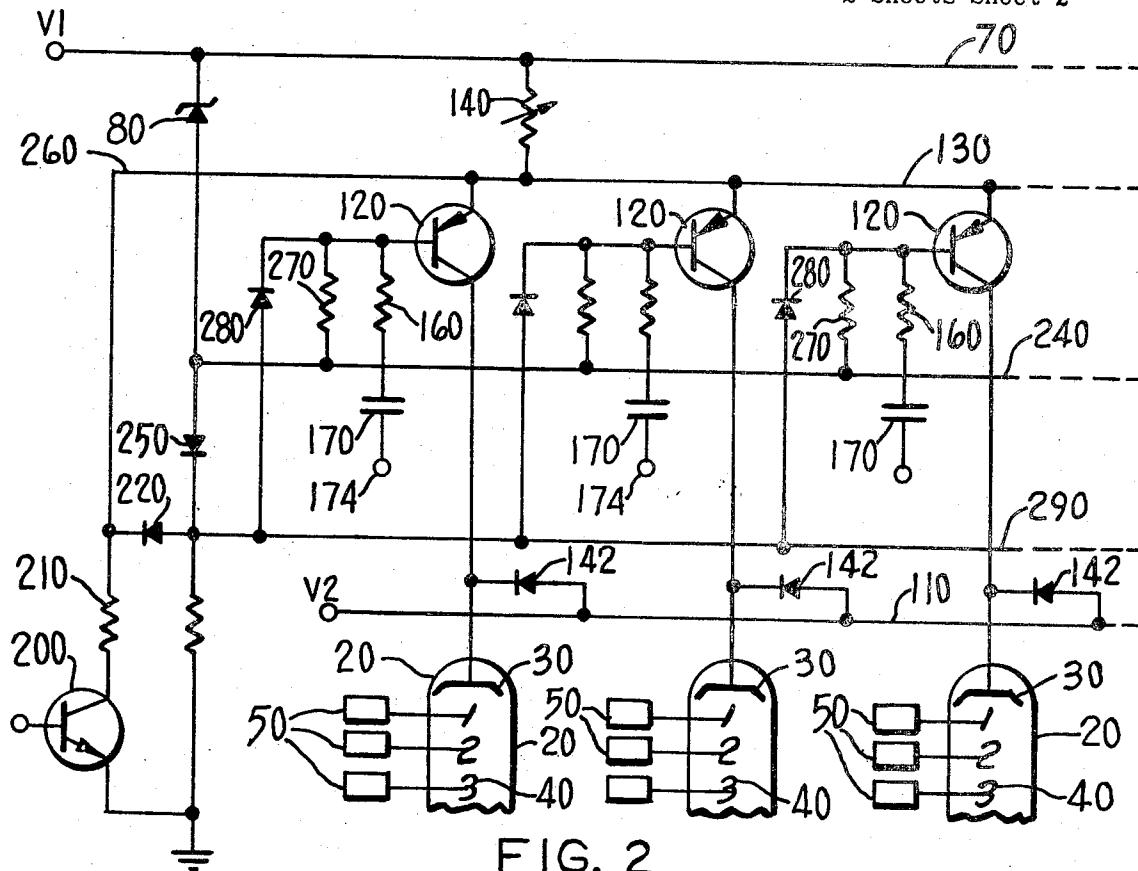


FIG. 2

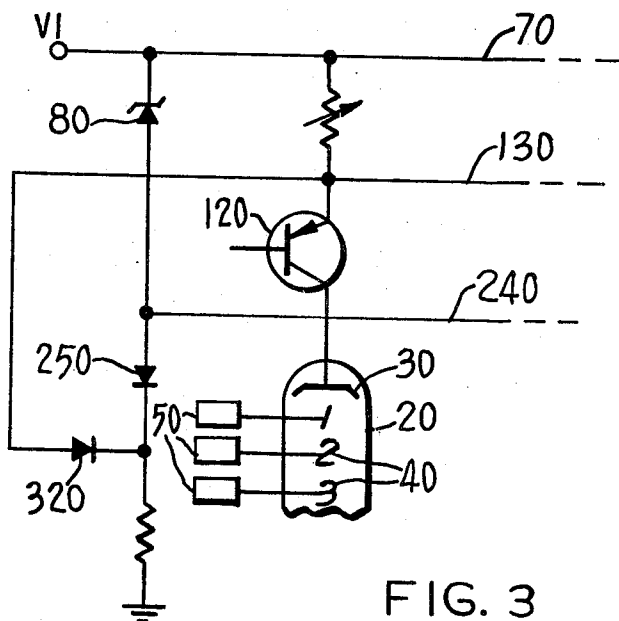


FIG. 3

INVENTOR.
ARPAD SOMLYODY
BY
Robert A. Green
ATTORNEY

1

3,522,471

TRANSISTOR DRIVER CIRCUITS FOR CATHODE GLOW DISPLAY TUBES

Arpad Somlyódy, Raritan, N.J., assignor to Burroughs Corporation, Detroit, Mich., a corporation of Michigan
Filed Mar. 19, 1968, Ser. No. 716,700
Int. Cl. H01j 17/38, 17/48

U.S. Cl. 315-84.6

5 Claims

ABSTRACT OF THE DISCLOSURE

The disclosure is of a circuit for operating one or more cathode glow indicator tubes and includes a separate driver, a transistor, coupled between a power supply and the anode of each indicator tube to be operated. Various diodes are coupled to the transistor(s) for providing the necessary bias voltages, and a single common variable resistor provided in the emitter circuits of all of the transistors can be used to vary the current through each transistor as it operates its indicator tube. Means are also provided for holding off the transistors and their tubes as required during quiescent periods to prevent spurious cathode glow.

BACKGROUND OF THE INVENTION

The present invention relates to circuits for driving cathode glow indicator tubes of the type known as Nixie tubes, which are made by Burroughs Corporation. These tubes comprise a gas-filled envelope which contains an anode electrode and a plurality of cathode electrodes which are in the form of letters, numerals, or the like and which exhibit cathode glow when proper potentials are applied between them and the anode.

In recent years, Nixie tubes have been used in systems, such as calculators, which usually utilize a recirculating or sequentially addressed memory. The present invention provides more economical and efficient circuits for driving the indicator tubes in such applications, the circuits having an added advantage of being compatible with integrated circuits.

SUMMARY OF THE INVENTION

Briefly, circuits embodying the invention include one or more glow cathode indicator tubes and a separate active driver such as a transistor coupled to the anode of each indicator tube. These anode drivers cooperate with similar drivers coupled to the cathodes to operate the tubes. The circuits include means for turning on each anode driver and for holding off the drivers and their tubes during quiescent periods when it is necessary to prevent spurious cathode glow. These anode driver circuits are constant current sources, and they include means for varying the current in simple manner.

DESCRIPTION OF THE DRAWING

In the drawing:

FIG. 1 is a schematic circuit embodying the invention;

FIG. 2 is a schematic circuit of a modification of the invention; and

FIG. 3 is a schematic representation of a modification of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A circuit 10 embodying the invention includes a plurality of indicator or display tubes 20 of the type described above and represented schematically. Each tube includes an anode electrode 30 and cathode electrodes 40 which are shown as numerals and each of which is connected to a driver circuit represented by block 50. Each circuit 50 is essentially a switching circuit and in-

2

cludes a transistor for applying operating potential to a selected cathode, whereby the cathode glows when the corresponding proper potential is applied to the associated anode electrode.

The circuit 10 includes a driver circuit 60 for applying operating potential to each anode. Circuit 60 is a constant current source and includes a primary voltage supply V1 which is of the order of 200 volts and is coupled both to a bus 70 and through a Zener diode 80 to a bus 90 and through a resistor 100 to reference potential such as ground. A second power supply V2 of about +100 volts is coupled to a bus 110.

A separate driver or switching device such as a PNP transistor 120 is coupled to each anode electrode for driving a tube 20, and each such driver transistor has its emitter connected to a bus 130 which is connected in turn through a common variable resistor 140 to the bus 70. The collector of each driving transistor 120 is connected directly to the anode 30 of its tube and through diode 140 to the bus 110. The base of each transistor is connected through a resistor 150 to the bus 70 and through a resistor 160 and a capacitor 170 to a terminal 174, to which is coupled a source of negative pulses 176 for turning on the transistor. The base of each transistor 120 is also connected through parallel reverse-connected diodes 180 and 190 to the bus 90.

In the circuit 10, the potential of source V1 is +200 volts or more. This potential is chosen to maintain the transistors 120 just out of saturation when the worst case, highest tube voltage drop occurs. The Zener diode 80 establishes a small voltage, perhaps 10 volts, below the voltage of V1, and this small voltage, in conjunction with resistor 140, determines the emitter current for the transistor 120 which is turned on.

One of the transistors 120A is turned on by the application of a negative pulse 176 to the proper input terminal 174. If transistor 120A is turned on, the values of resistor 160 and capacitor 170 are chosen so as to maintain diode 190 in conduction for the full period that transistor 120A is to remain in the on condition. This causes the emitter of transistor 120A to be approximately at the potential of the anode of diode 80, and the V_{BE} drop of transistor 120A is balanced by the forward drop of diode 190.

At the time the transistor 120A is on, the other transistors 120 are held in the off condition by the resistors 150 in their base circuits which cause the diodes 180 in their base circuits to become forward-biased and thus maintain a small reverse bias on them.

The diodes 142 which connect the collectors of the constant current driver transistor 120 to the bus 110 prevent excessive voltages from appearing across these transistors. It is to be noted that the single variable resistor 140 can be used to vary the operating anode driver current in the circuit 10.

Under some circumstances, for example, during a quiescent period when one of the transistors 120 is not on and thus a potential is not provided to hold off the other transistors, it may be desirable to provide other means for holding off the transistors to prevent spurious cathode glow. This means may be an NPN transistor 200 which has its collector electrode connected through a resistor 210 to the bus 130, its emitter electrode connected to ground, and its base electrode connected to a source of positive turn-on pulses 212. Bus 130 is connected through a diode 220 to the path between diode 80 and resistor 100.

A modified anode driver circuit 10' is shown in FIG. 2. Circuit 10' includes some of the same elements as circuit 10, and these carry the same reference numerals where convenient. In circuit 10', the driver transistors 120 have

3

their emitters connected to common bus 130 and through common variable resistor 140 to the common supply bus 70 which is connected to the power supply V1. Power supply V1 is connected through Zener diode 80 to a bus 240 and through a diode 250 and resistor 100 to ground. The emitter bus is connected through a lead 260 to the cathode of diode 250 and through a resistor to the collector of transistor 200.

The collector of each driver transistor 120 is connected to the anode of its indicator tube and through diodes 140 to bus 110. The base electrode of each driver transistor is connected through a resistor 160 and a capacitor 170 to input terminal 174. The base of each transistor 120 is also connected through resistor 270 to the bus 240 and through diode 280 to a bus 290 which is connected to the lead between diode 250 and resistor 100.

The PNP transistors 120, in conjunction with the Zener diode 80 and the common emitter resistor 140, form a multiposition constant current source. When a negative pulse 176 is applied to any one of the inputs 174, then the base of the corresponding transistor 120 is pulled negative to the point where the diode 280 goes into a clamp condition. This causes the emitter bus 130 to assume a potential approximately equal to that of the junction point 300 of diodes 280 and 220. The bases of the other transistors which have not received a turn-on pulse assume a potential approximately equal to the potential on bus 240, and therefore, all of these transistors are reverse-biased and do not turn on. As one of the transistors 120 is turned off, its base potential will increase slightly more positive, but this merely tends to turn this transistor off even more.

In both circuits 10 and 10', it can be seen that transistor 200 is used to operate, to turn off or blank, the indicator tubes. If transistor 200 is turned off and on at a relatively rapid rate, it can also be used to merely dim an indicator tube which is on.

Referring to FIG. 3, the transistor 200 and its associated circuitry shown in FIGS. 1 and 2 may be replaced by a connection from bus 130 through a diode 320 to the cathode of diode 250. This circuit serves to keep the emitter bus 130 from rising above the potential which is present on the lead between diodes 80 and 250. This insures that all driver transistors 120 are held off when necessary.

What is claimed is:

1. An information display circuit including
 - a plurality of indicator display tubes each having a plurality of cathode glow electrodes and an anode electrode,
 - a PNP transistor for each tube, each transistor having base, emitter, and collector electrodes,
 - a power supply coupled to a first bus,
 - said first bus being coupled through a variable resistor to a second bus to which all of the emitter electrodes of said transistors are connected,
 - said first bus also being coupled through a Zener diode

4

to a third bus to which each said base electrode is connected via an impedance, said third bus being connected to a potentiometer between said first bus and reference potential, said potentiometer comprising at least one resistance and at least one diode,

said Zener diode and said variable resistor together determining the emitter current for said transistors as each is turned on,

each said collector electrode being connected to the anode electrode of one of said tubes,

each said base electrode including circuit means for holding its transistor off when one other transistor is conducting,

auxiliary circuit means coupled to all of said transistors for holding them off when none is conducting,

signal means for turning on each of said transistors coupled to the base electrode of each transistor, and drive means connected to each cathode electrode of each said tube for operation in conjunction with each transistor to cause each tube to perform a display operation.

2. The circuit defined in claim 1 wherein each said signal means is coupled through a resistor and capacitor to the base electrode of its associated transistor.

3. The circuit defined in claim 1 and including an auxiliary semiconductor device connected between a point of reference potential and said second bus and thus to all of said emitter electrodes, said semiconductor device having an input electrode adapted to receive a turn-on signal whereby said semiconductor device turns on and applies hold-off potential to said second bus and to said transistors when none of said transistors has been turned on and is conducting.

4. The circuit defined in claim 1 wherein said auxiliary circuit means comprises a diode connected from a second point on said resistive path to said second bus for coupling hold-off potential thereto when none of said transistors is in the conductive state.

5. The circuit defined in claim 1 and including a clamping diode coupled between each said base electrode and said third bus and adapted thereby to limit the rise in potential of said third bus.

References Cited

UNITED STATES PATENTS

3,240,986	3/1966	Cullis	315—84.6 X
3,272,993	9/1966	Somlyody	235—92.6
3,329,949	7/1967	Colton et al.	315—334 X
3,340,524	9/1967	Rinaldi	340—324
3,343,032	9/1967	David et al.	315—84.6

ROBERT SEGAL, Primary Examiner

U.S. Cl. X.R.

315—8.6, 341; 340—324