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CONTROL CIRCUIT FOR GASEOUS INDICATOR TUBES

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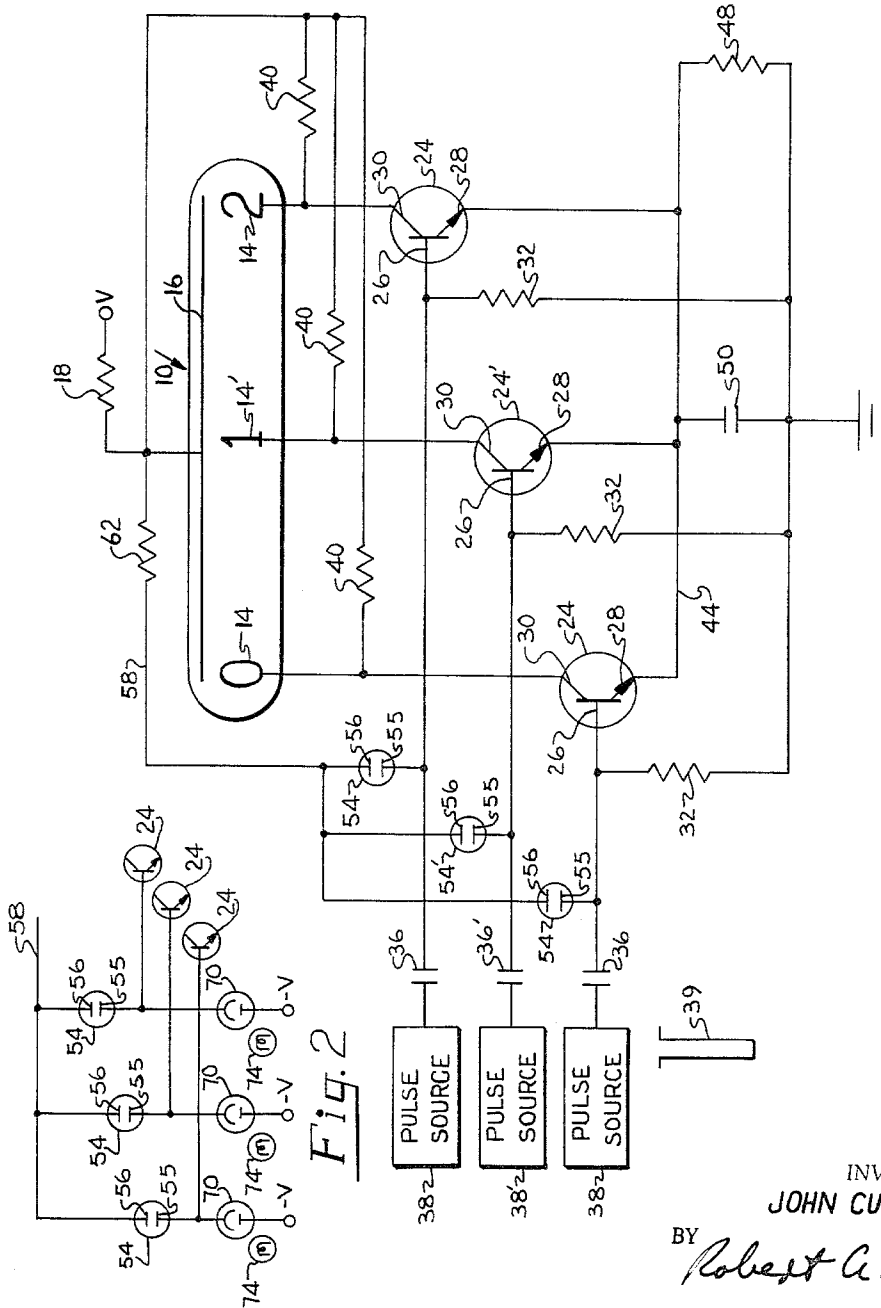


Fig. 1

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3,240,986 CONTROL CIRCUIT FOR GASEOUS INDICATOR TUBES

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This invention relates to transistor circuits for driving cold cathode gaseous indicator devices and, particularly, to circuits of this type which have a memory characteristic.

The present invention is particularly adapted for use with a type of indicator device which includes a plurality of cathode glow electrodes and an anode arrangement mounted in a gas-filled envelope. When a suitable electrical potential is applied between a cathode and the anode, the cathode exhibits cathode glow; that is, a sheath of gas surrounding the cathode glows. Circuits are known for turning on each of the cathodes of a tube of the type described above and, generally, these circuits include a separate transistor suitably coupled to each of the cathode glow electrodes. Such circuits are generally satisfactory except for the fact that, in general, they do not have memory; that is, a cathode cannot be turned on by a first specially applied potential and then be maintained on by normal circuit potentials after the applied potential is removed.

The objects of the present invention are concerned with the provision of an improved driver circuit for an electronic cold cathode, gaseous indicator device, the circuit having a memory characteristic.

Briefly, the circuit of the invention includes a multiple cathode gaseous indicator device which has each of its indicator glow cathodes connected to a separate transistor. Each transistor is adapted to turn one cathode on and off by controlling the potentials applied thereto. In addition, a separate neon glow lamp is provided coupled to each of the transistors. The neon glow lamps are so connected that, when an input pulse is applied to a glow lamp and its transistor, the pulse causes the neon lamp to glow and the transistor to be turned on, whereby the associated indicator cathode is caused to glow. When the input pulse is removed, the potentials carried by the neon glow lamp are sufficient to sustain its glow and to maintain the transistor turned on so that the associated cathode continues to glow. A second input pulse applied to another transistor operates to turn off the first neon glow lamp and its associated transistor and to extinguish the first glow cathode, while causing a second neon lamp to glow, a second transistor to be turned on, and a second indicator cathode to glow.

The invention is described in greater detail by reference to the drawing in which:

FIG. 1 is a schematic representation of a circuit embodying the invention; and

FIG. 2 is a schematic representation of a circuit embodying a modification of the invention.

Referring to FIG. 1, numeral 10 designates a cold cathode gaseous indicator device such as a type 6844A cold cathode gaseous glow tube. The tube contains a gas such as neon and a plurality of cathode glow electrodes 14 which may be in the form of numerals, letters, or the like, three of which are shown. The tube 10 also includes an anode electrode 16 which is connected through a suitable current-limiting resistor 18 to a source of positive D.C. potential V. In the particular circuit arrangement shown and described, V is about 170 volts.

Each cathode electrode 14 is connected to a transistor driver comprising an N-P-N transistor 24 which includes a base electrode 26, an emitter electrode 28, and a collector electrode 30. In each transistor, the base elec-

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trode 26 is connected through a resistor 32 to a source of reference potential such as ground. Each base electrode is also coupled through a capacitor 36 to its own input pulse source 38 of negative, generally rectangular waves or pulses 39. The collector electrode 30 of each transistor is connected to one of the cathode glow electrodes 14 of the tube 10 and through a resistor 40 to anode 16. The emitter electrode 28 is connected to a bus 44 which is connected, through a resistor 48 paralleled by capacitor 50, to ground.

According to the invention, a separate neon glow lamp 54 is connected by its cathode 55 to the base electrode 26 of each transistor 24 and by its anode 56 to a bus 58 which is coupled through a resistor 62 to the anode 16 of indicator tube 10. In the circuit operation described below, the neon lamps 54 are assumed to be type NE68 lamps.

In operation of the invention, the transistors 24 are adapted to control the operation of the glow cathodes 14 of tube 10, that is, each transistor is adapted, when conducting, to cause a cathode electrode to glow and, when not conducting, to prevent a cathode from glowing. When a transistor is in the conducting state, its collector electrode and the glow cathode connected thereto are at about ground potential. Thus, a favorable potential is present between the anode and a cathode in tube 10 to support cathode glow. When a transistor is turned off, its collector and associated glow cathode are at a relatively high positive potential at which cathode glow cannot be initiated.

In the circuit of FIG. 1, the circuit elements and voltages are selected so that, when a transistor 24 is cut off, its base electrode 26 is at ground potential, its emitter 28 is at a few volts positive, and its collector electrode 30 is at about 40 volts positive. Initially, when all circuit connections are made, more than 150 volts are applied across the neon glow lamps and one lamp, at random depending on internal resistance, turns on. Current flow through this one neon lamp raises the potential of the base electrode of the associated transistor sufficiently so that the transistor turns on and its collector electrode approaches ground potential. The glow cathode 14 connected to this collector thus exhibits cathode glow. When it is desired to cause one of the other cathode electrodes 14' to glow, a negative wave 39 of about 30 volts is coupled from source 38' through capacitor 36' both to the base electrode 26' of the selected transistor 24' and to the cathode of the associated neon glow lamp 54'. The wave 39 thus causes approximately 90 volts to be applied across the selected neon lamp 54', and this causes the lamp to glow. Since an NE68 neon lamp is designed to support about 60 volts between its electrodes, the anode of lamp 54' which has just turned on, is lowered to about 30 volts positive. Since bus 58 is also thus lowered to +30 volts for approximately the duration of the input pulse, the previously lighted neon lamp will be extinguished. When the wave 39 terminates, the base electrode 26' of transistor 24' rises in potential sufficiently, due to current flow through neon lamp 54', for transistor 24' to be turned on. As described above, the associated cathode electrode 14', connected to the collector thereof, is reduced to approximately ground potential and exhibits cathode glow. This condition is a stable condition and is maintained until a second input wave 39 is applied to a second one of the neon lamps 54 and to a second one of the transistors 24. The application of the second wave causes the second neon lamp to glow and turns off neon lamp 54'. As the second wave is terminated, the second transistor is turned on and the cathode electrode connected thereto is also turned on. This represents another stable state and is maintained until still another input wave 39 is applied.

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In another modification of the invention, the circuit shown in FIG. 1 is modified so that it can be operated by means of input pulses of light or other radiant energy, rather than by means of electrical signals. Thus, the modification of the invention illustrated in FIG. 2 includes all of the elements of the circuit of FIG. 1 except that the sources of input pulses 38 and capacitors 36 are not required. Instead, a photodiode 70 is connected between the cathode of each neon lamp 54 and a negative D.C. power source of about 30 volts. In addition, a separate source of input trigger radiation 74 is provided in operative relation with each of the photosensitive elements.

The circuit of FIG. 2 operates in the same way as the circuit of FIG. 1 except that, when a flash of radiation from a source 74 is applied to one of the photosensitive elements, its resistance is reduced to a low level and the cathode of the neon lamp 54 to which it is connected is lowered to about -30 volts. The associated neon lamp is thus turned on, and this in turn, as described above, turns on the corresponding transistor and causes one of the cathodes to glow. Each successive input pulse of radiation, in the same way, causes one of the glow cathodes to be turned on and a previously glowing cathode to be turned off.

In the circuits described above, the particular potentials mentioned are those which operated successfully with type NE68 neon lamps. However, other circuit components and potentials could be employed in accordance with the principles of the invention.

What is claimed is:

1. An electronic display circuit comprising
 - a cold cathode gaseous indicator tube including an anode electrode and a plurality of cathode electrodes in the form of characters, each of which can be caused to glow by the application of a suitable potential between it and said anode,
 - a plurality of amplifier switches each having an input electrode and an output electrode,
 - the output electrode of each amplifier being coupled to one cathode electrode for applying glow-producing potential thereto,
 - a first separate current flow path being constituted by the circuit extending through each cathode electrode and its associated amplifier,
 - the input electrode of each amplifier being coupled to a source of input pulses,
 - a plurality of gaseous voltage regulator devices having two electrodes, each connected between said anode and one amplifier, a second separate current flow path being constituted by the circuit through each voltage regulator device,
 - each of said first current flow paths having a common point with one of said second current flow paths,

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the circuit connections being such that the input pulses from said source control the turning on and off of said voltage regulator devices, and the turning on of a specific voltage regulator device controls the state of the amplifier in the first path with which the second path containing said specific voltage regulator device has a common point.

2. The circuit defined in claim 1 wherein said amplifier switches comprise NPN transistors, each having its collector electrode as its output and its base electrode as its input.

3. An electronic display circuit comprising

- a cold cathode gaseous indicator device including an anode and a plurality of indicator glow cathodes,
- a plurality of transistors each having an input electrode and an output electrode,

the output electrode of each transistor being coupled to one glow cathode for applying viewing potential thereto,

a first separate current flow path being constituted by the circuit extending from said anode through each cathode and the associated transistor,

the input electrode of each transistor being coupled to a source of input pulses,

a plurality of two-electrode gaseous voltage regulator devices, each connected between said anode of said indicator device and the input electrode of one transistor, a separate current flow path being constituted by the circuit through each voltage regulator device, a power source coupled across said indicator device and said transistors of sufficient magnitude to cause cathode glow, the transistors controlling the application of glow potential to said cathodes and thus controlling cathode glow,

one electrode of each regulator device being connected to said power source as well as to said anode,

the circuit connections being such that the input pulses control the turning on and off of said voltage regulator devices, and the turning on of a voltage regulator device controls the state of the transistor in the first path with which it has a common point.

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