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GLOW TUBE COUNTING CIRCUIT

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Fig. 1

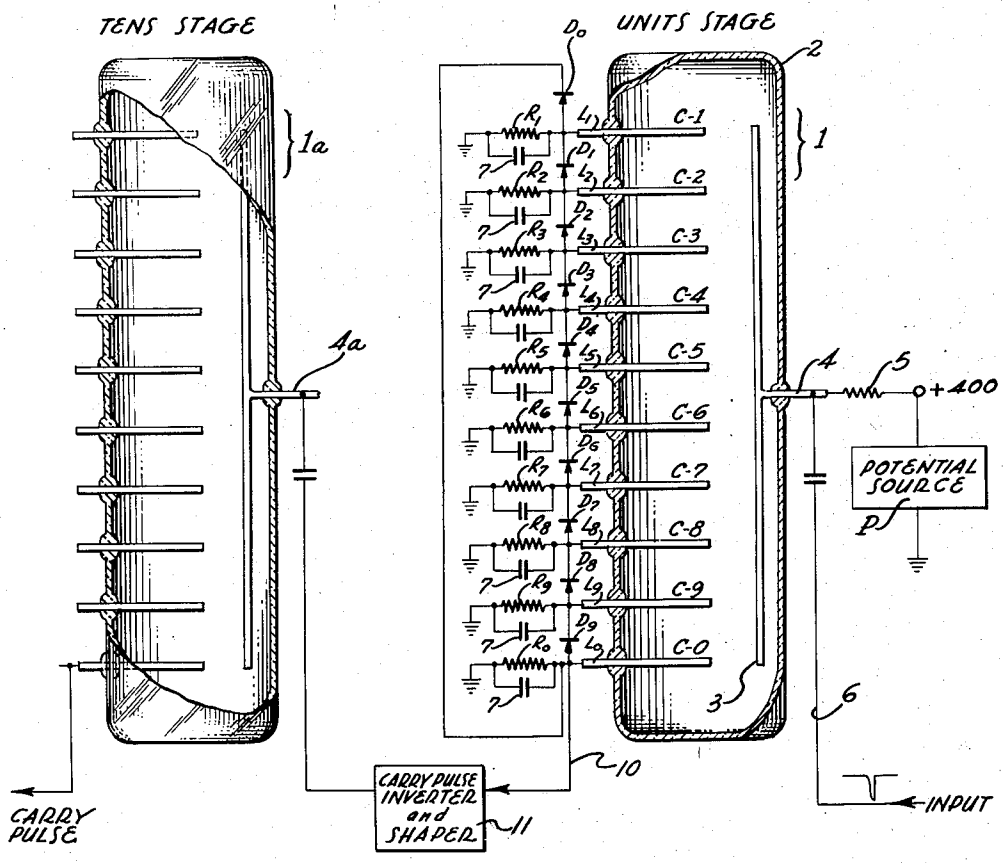
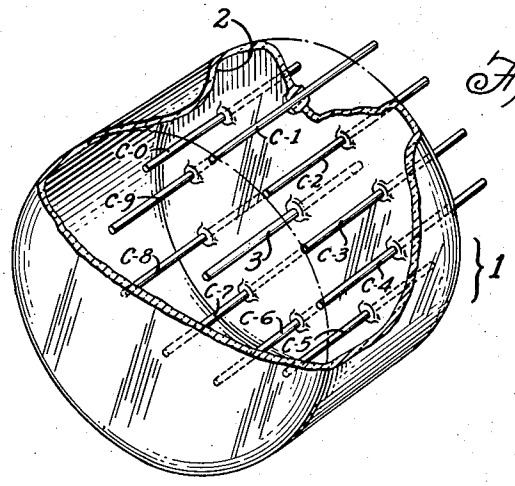


Fig. 2



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GLOW TUBE COUNTING CIRCUIT

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1

My invention relates to visual indicators and more particularly to a visual indicator of the polycathode glow tube type together with a ring circuit for sequentially glowing the cathodes in the tube.

Among the objects of my invention are:

To provide a simple counting tube and circuit;

To provide a polycathode counting tube requiring no additional tube matrix for use as a counter;

To provide a circuit means energizing one cathode after another of a polycathode glow tube, under the control of a train of input pulses,

And to provide a polycathode glow tube and circuit suitable for use as a decade counter.

Briefly, the present invention includes the use of an envelope containing a plurality of glow tube cathodes and an anode immersed in a gas at glow discharge pressure. The glow is progressed from one cathode to another by connecting each cathode to ground through a cathode resistor bridged by a capacity, and by connecting the anode to a source of positive potential through an anode resistor, the negative pole of said source being grounded. Each cathode is connected to the next by a rectifier, so that when any one cathode is glowing, a negative pulse on the anode will extinguish this glow and transfer the glow to the next cathode in the rectifier ring having the lowest cathode voltage thereon. When ten cathodes are used, a single tube becomes a single decade counting stage, and a plurality of such tubes can be interconnected by a carry pulse line so that numbers of any order of magnitude desired can be counted when pulses are applied to the anode of the first stage tube, for example.

Other objects and advantages of the present invention will be apparent from the following description of the drawings in which:

Figure 1 is a diagrammatic sectional view of a vertical type polycathode decade stage counting tube and circuit illustrating the present invention in a preferred form.

Figure 2 is a diagrammatic perspective view of a ring type polycathode tube that can also be used in the circuit shown in Figure 1.

Referring first to Figure 1, a polycathode tube 1 comprises an envelope 2 containing ten cathodes C–1 to C–0 inclusive, positioned side by side along the tube. A bar type anode 3 also extends along the tube, and is provided with an exterior anode lead 4. The cathodes C–1 to C–0 inclusive are respectively provided with exterior leads L_1 to L_0 inclusive. The envelope is filled with an ionizable gas at glow discharge pressure such as, for example, helium at 100 m. m. Hg pressure.

2

The anode 3 of the tube 1 is connected to a source of positive potential P through an anode resistor 5, and a pulse input line 6 is connected directly to anode lead 4. This line carries negative pulses to be counted.

Cathode leads L_1 to L_0 inclusive are connected to ground through respective cathode resistors R_1 to R_0 inclusive, and each cathode resistor is bypassed by a by-pass condenser 7.

Each cathode is connected to the next cathode by respective rectifiers D_1 to D_0, inclusive, which may be of the germanium type, for example. All rectifiers are connected to provide a ring connection around all cathodes, conducting current in the same direction. The circuit as shown will progress a cathode glow from one cathode to the next in order upon receipt of a negative pulse on the anode through input line 6 and no additional matrix of tubes is required for such action.

Assume that there is a glow discharge between anode 3 and cathode C–3, for example. Assume also that the anode supply voltage is 400 volts, and that the drop through the anode resistor 5 when the tube is conducting is 200 volts, thereby making the voltage at anode 3,200 volts. Likewise, assume that the voltage drop through the cathode resistor R_3 in the energized cathode circuit is such that it makes the voltage at cathode C–3, 100 volts above ground. Part of the current flowing from cathode C–3 passes through diode D–2 and through the resistor R_2 in the cathode circuit of cathode C–2. The current flowing through the resistor R_2 in the cathode circuit of cathode C–2 causes the voltage at cathode C–2 to be at 90 volts. Some of the current from cathode C–3 flows into diode D_1 and diode D_0 etc., and thus through the resistors R_1 and R_0 in the cathode circuits of cathode C–1 and cathode C–0 to cause the voltage at cathode C–1 and cathode C–0 to be 80 and 70 volts, respectively. This voltage division by the diodes D and cathode resistors R continues around the ring so that the voltage on cathode C–4 is 10 volts. When a negative pulse is applied to anode 3 through input line 6, this pulse causes an interruption in the glow discharge between anode 3 and cathode C–3, and immediately the voltage at anode 3 starts to rise towards the supply voltage of 400 volts. The cathode condensers 7 maintain the voltages on the cathodes. The ion cloud in the vicinity of cathode C–3 will tend to aid the restoring of a glow discharge between the anode and any of the cathodes in the vicinity. However, the next higher cathode C–4 has the lowest possible voltage of any of the cathodes in the vicinity, hence the rising

voltage on anode 3 quickly brings the voltage from anode 3 to cathode C–4 to the point at which a glow discharge is struck between anode 3 and cathode C–4. Once this is done, the voltage at anode 3 drops to 200 volts, the voltages on the condensers 7, quickly assume their new proper values, and the circuit is again capable of being pulsed with a negative pulse on the anode 3 through input line 6. Successive negative pulses applied thereby to the anode 3 will cause the glow discharge to progress successively from cathode to cathode in order.

A carry pulse line 10 may be attached to cathode C–0 for example, passed through a pulse inverter and shaper 11 and then attached to the anode lead 4*a* of a second stage tube 1*a* connected as above described for tube 1. In this way, numbers of any order of magnitude desired can be counted.

The tube shown in Figure 1 is used for visual indication of a number by viewing the vertical position of a glowing cathode in the tube. However, the same circuit is adapted for use with a polycathode glow tube such as shown in Figure 2 where the cathodes C–1 to C–0 inclusive are circularly positioned around a central anode 3. In this case, the position of the glowing cathode in the cathode ring gives the number information to the viewers.

From the above description it will be apparent that there is thus provided a device of the character described possessing the particular features of advantage before enumerated as desirable, but which obviously is susceptible of modification in its form, proportions, detail construction and arrangement of parts without departing from the principle involved or sacrificing any of its advantages.

While in order to comply with the statute, the invention has been described in language more or less specific as to structural features, it is to be understood that the invention is not limited to the specific features shown, but that the means and construction herein disclosed comprise the preferred form of putting the invention into effect, and the invention is therefore claimed in any of its forms or modifications within the legitimate and valid scope of the appended claims.

What is claimed is:

1. A counting circuit comprising an envelope containing an anode, a plurality of spaced cathodes, and a filling of ionizable gas at glow discharge pressure, an anode resistor connected to said anode and to the positive pole of a potential source, a cathode resistor connected to each of said cathodes and to the negative pole of said source, a capacity across each of said cathode resistors, unidirectional conducting means connected between each of said cathodes in a serial order and conducting current in the same direction, and a pulse input connection to said anode.

2. A counting circuit for a polycathode glow tube having an anode, comprising cathode resistance means connected to each of said cathodes and to a common line, a potential source having the positive pole thereof connected to said anode, with the negative pole thereof connected to said common line, current limiting means in series with said source and said anode and common line, unidirectional conducting means between each of the cathodes of said tube in an order to form a ring connection therebetween conducting current in the same direction, and an input line connected to said anode.

3. A counting circuit for a polycathode glow tube having an anode, comprising anode resistance means connected to said anode and to the positive pole of a potential source, cathode resistance means connected to each of said cathodes and to the negative pole of said source, unidirectional conducting means between each of said cathodes in an order to form a ring connection therebetween conducting current in the same direction, and means for applying a pulse to said anode.

4. A counting circuit for a polycathode glow tube having an anode, comprising anode resistance means connected to said anode and to the positive pole of a potential source, cathode resistance means connected to each of said cathodes and to the negative pole of said source, unidirectional conducting means between each of said cathodes in an order to form a ring connection therebetween conducting current in the same direction, and means for applying a pulse to said anode.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,375,830	Spencer	May 15, 1945
2,505,006	Reeves	Apr. 25, 1950