May 17, 1960 S. K. CHAO ET AL 2,937,318

COUNTING TUBE READ OUT SYSTEM

Filed Oct. 27, 1958

FIG. 1

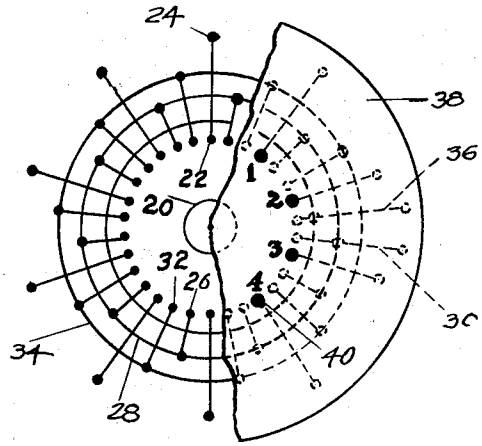
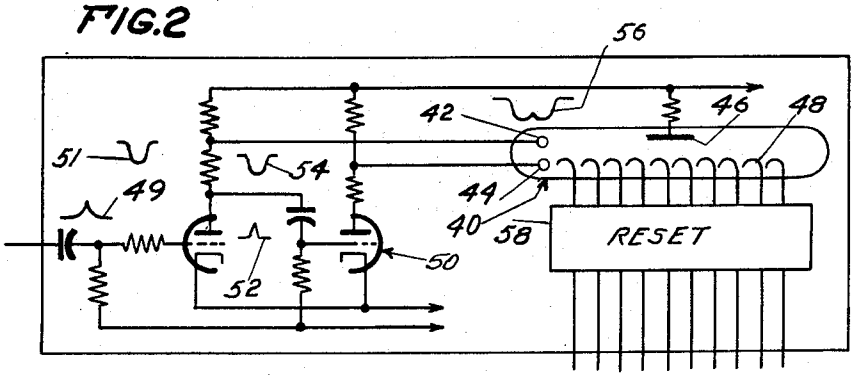


FIG. 2



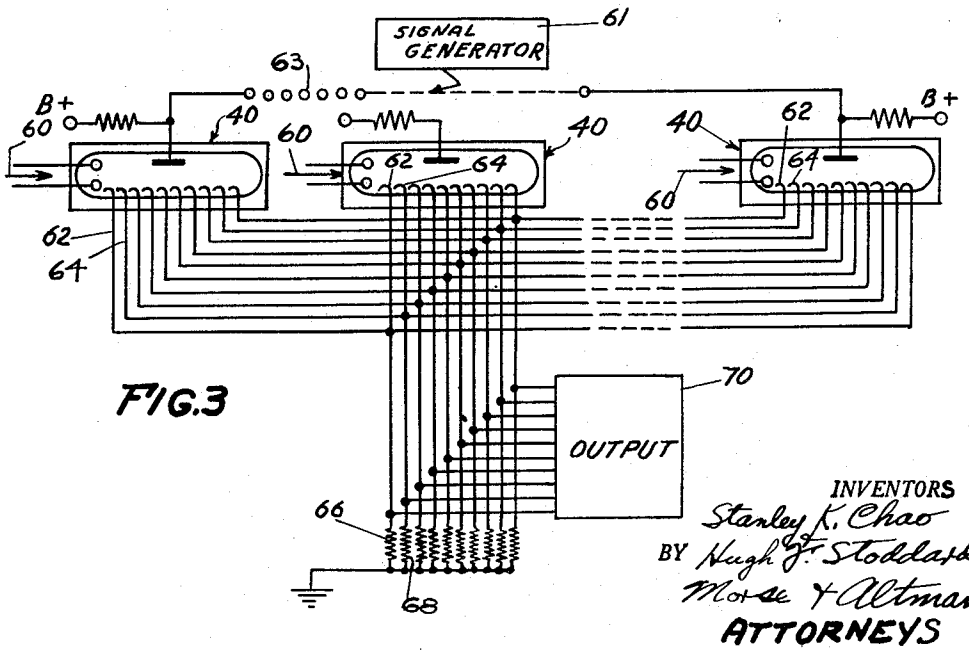


FIG. 3

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COUNTING TUBE READ OUT SYSTEM

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5 Claims. (Cl. 315—84.6)

The present invention relates to counting tubes and, more particularly, to circuitry for reading digital information from counting tubes of the type comprising a common electrode (e.g. a central anode) and a plurality of sequence electrodes (e.g. a plurality of surrounding cathodes) within a discharge gas. The gas conducts or glows between the common electrodes and a selected sequence electrode when a predetermined voltage is applied. Under the control of guide electrodes, which restrict the discharge to a selected region in a given digital position that represents a given count, the glow moves from position to position in response to input signals. At a particular digital position, a glow generated by electron discharge between the common electrode and the selected sequence electrode, results in a voltage drop across an associated load resistor. A typical information storage system comprises one or more channels each including one or more counting tubes. In the past, the serial reading of information from such counting tubes has required a myriad of load impedances in correspondence with the myriad of sequence electrodes of the many counting tubes and in association with necessarily complex switching.

The object of the present invention is to secure an unprecedented simplification of read out circuitry of the foregoing type by applying a carrier signal to the common electrode (e.g. anode) of one or more counting tubes.

Since the counting tube essentially is characterized by constant voltage operation, the carrier signal will reappear at and serve to identify a selected sequence electrode (e.g. selected cathode). In consequence, sequence electrodes of different counting tubes may be connected to relatively few load impedances that serve several counting tubes at once and may be coupled to information sensing circuitry in a manner that obviates complex switching.

Other objects of the present invention will in part be obvious and will in part appear hereinafter.

For a complete understanding of the present invention, reference should be had to the following detailed disclosure, taken in connection with the accompanying drawings wherein:

Figure 1 illustrates an exemplary counting tube useful in accordance with the present invention;

Fig. 2 illustrates an exemplary circuit for driving the counting tube of Fig. 1 in response to input counting pulses; and

Fig. 3 illustrates a circuit for reading information from one or more counting tubes in accordance with the present invention.

The counting tubes of the illustrated embodiment of the present invention are multi-cathode glow tubes of the type shown in Fig. 1 and driven in Fig. 2. As shown in Fig. 1, each counting tube includes an anode **20**, ten cathodes **22** having independent leads **24**, ten first guides **26** all connected through a first guide ring **28** to a lead **30**, and ten second guides **32** all connected through a second guide ring **34** to a lead **36**. As shown, the cathodes, first

guides and second guides are interspersed in cyclic order and are disposed within a hermetic envelope containing an inert gas such as argon, neon, krypton, etc. Under the control of guides **26** and **32**, the gas conducts in one of ten restricted regions beneath a dial or bezel **38**. Bezel **38** provides translucent positions **40**, one of which at any given time is illuminated by a glow generated below it by discharge between anode **20** and a selected cathode **22**.

In a typical case, the first and second guides normally are held at plus 60 volts with respect to the cathodes. Initially a random discharge occurs between anode **20** and some cathode **22**. When a first negative pulse, for example, of 120 volts is applied to first guides **26**, the discharge region preferentially shifts in a clockwise direction to the adjacent position between anode **20** and the next clockwise first guide **26**. At this time, the discharge region does not shift in a counterclockwise direction first guide **26** because it is too remote from the region already ionized. Similarly, when a second negative pulse, for example, of 120 volts is applied to the second guides **32** at the moment the previous pulse is terminated, the discharge region preferentially shifts in a clockwise direction to the adjacent position between anode **20** and the next clockwise second guide **32**. Similarly, when the second negative pulse is terminated, the discharge region preferentially shifts in a clockwise direction to the adjacent position between anode **20** and the next clockwise cathode **22**. If the glow tube is reversible, the glow will step in counter-clockwise increments when the aforementioned pulses are applied first to second guide **32** and then to first guide **26**.

An exemplary drive circuit for generating the first and second pulses referred to above is shown in Fig. 2 as comprising a counting tube **40** having first guides and second guides shown at **42** and **44**, respectively. First and second guides **42** and **44** normally are held at a positive voltage so that discharge can occur only between the anode **46** and a cathode **48**. Upon receiving a positive input pulse **49**, half of double triode **50** produces a negative rectangular pulse **51**, which is applied directly to first guides **42**. This pulse also is differentiated to produce a positive pulse **52**. Pulse **52**, when applied to the second half of double triode **50**, produces a negative rectangular pulse **54**, which is applied directly to second guides **44**. Thus, one input counting pulse **49** produces two negative guide pulses **50** and **54**, overlapped as indicated at **56** to shift the discharge region from one cathode to the next. Cathodes **48** are connected to output load resistors in a manner to be discussed below. At the end of a particular count, the counting tube is reset to zero by a circuit **58**, which operates to raise the potential on all cathodes but the zero cathode and, therefore, to force the glow to return to that position.

A circuit embodying a plurality of counting tubes of the foregoing type in accordance with the present invention is illustrated schematically in Fig. 4. This circuit comprises one hundred counting tubes **40**. Counting pulses are applied to tubes **40** by input circuits **60**. Digital information in tubes **40** is read out serially by applying a carrier signal from a signal generator **61** through a single pole-100 throw switch **63** seqeuentially to the anodes of tubes **40**. As a practical matter, the carrier frequency should range between 0.5 kc. and 500 kc. The corresponding cathodes of counting tubes **40** are connected directly together, i.e. cathodes **62** are connected together, cathodes **64** are connected together, etc. Each group of corresponding cathodes is returned to ground through a common lead resistor, e.g. cathodes **62** through resistor **66**, cathodes **64** through resistor **68**, etc. Since counting tubes **40** essentially are characterized by constant voltage operation, the carrier signal from signal

generator **61** reappears across the load resistors and is applied to an output circuit **70** as a representation of information from a selected counting tube **40**.

Since certain changes may be made in the above described system without departing from the scope of the invention herein involved, it is intended that all matter contained in the above description shall be interpreted in an illustrative and not in a limiting sense.

What is claimed is:

1. A system for reading digital information from counting tubes, said counting tubes each comprising a common electrode and a plurality of sequence electrodes within a discharge gas, one each of the groups of corresponding sequence electrodes being connected together and to one each of a plurality of load resistors, carrier frequency generating means operatively connected to the anodes of said counting tubes, and output means for receiving carrier signals generated across said load resistors.

2. A system for reading digital information from a plurality of counting tubes, one each of said counting tubes comprising, within a discharge gas, an anode, a plurality of cathodes, a plurality of first guides electrically connected together and a plurality of second guides electrically connected together, said cathodes, first guides and second guides being so interspersed that one each of said cathodes follows one each of said second guides, one each of said second guides follows one each of said first guides and one each of said first guides follow one each of said cathodes, one each of the groups of corresponding cathodes being connected together and to one each of a plurality of load resistors, carrier signal generator means, switch means for connecting said carrier signal generating means sequentially to the anodes of said counting tubes, and output means for receiving carrier signals generated across said load resistors.

3. The system of claim 2 wherein, in each of said counting tubes, the cathodes, the first guides and the second guides encircle the anode.

4. A system for reading digital information from a plurality of counting tubes, one each of said counting tubes comprising, within a discharge gas, an anode, a plurality of cathodes and guide means for restricting electron discharge between said anode and a cathode to a given region, one each of the groups of corresponding cathodes being connected together and to one each of a plurality of load resistors and switch means for connecting said carrier signal generating means to the anodes of said counting tubes said carrier signal being a frequency ranging from 0.5 kc. to 500 kc.

5. A system for reading digital information from at least one counting tube, said counting tube comprising a common electrode and a plurality of sequence electrodes within a discharge gas, said sequence electrodes being connected to load resistors, carrier signal generating means operatively connected to the anode of said counting tube, and output means for receiving carrier signals generated across said load resistors, said carrier signals being radio frequencies ranging from 0.5 kc. to 500 kc.

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