

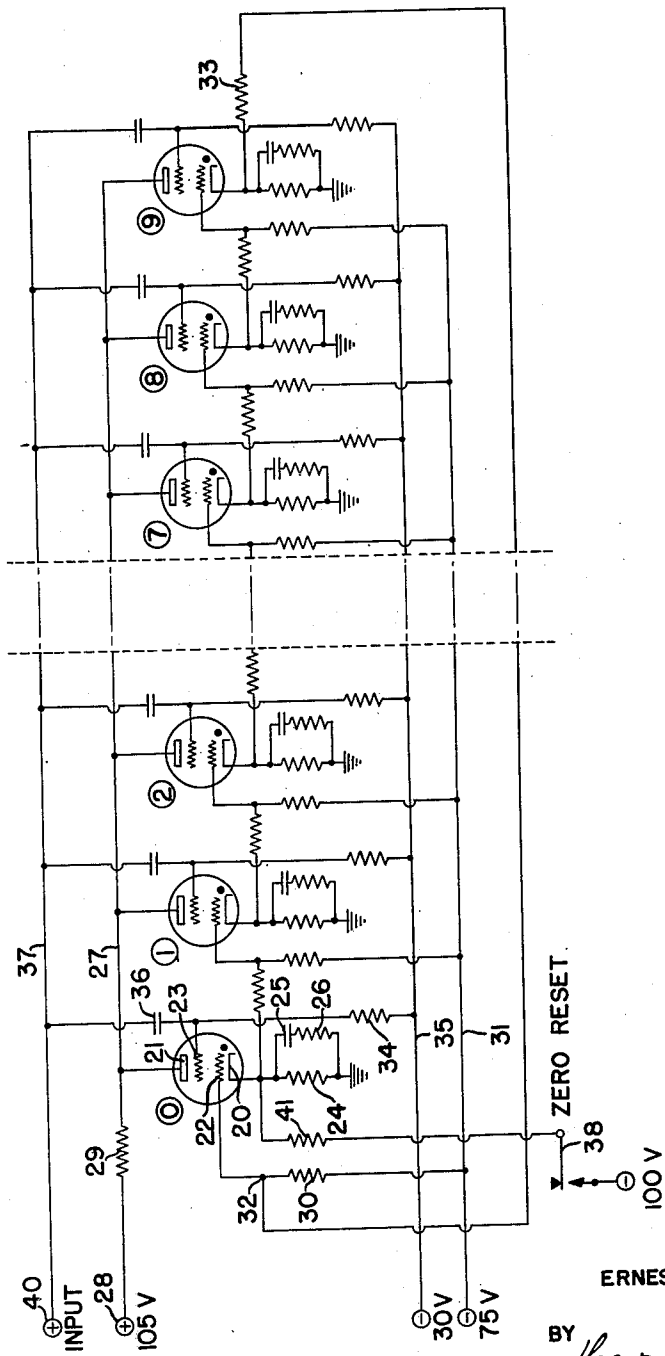
July 18, 1950

E. V. GULDEN

2,515,448

ELECTRONIC COUNTING RING

Filed Dec. 15, 1948



Inventor
ERNEST V. GULDEN

BY *Earl Beust*
Attorney

UNITED STATES PATENT OFFICE

2,515,448

ELECTRONIC COUNTING RING

Ernest V. Gulden, Oakwood, Ohio, assignor to
The National Cash Register Company, Dayton,
Ohio, a corporation of Maryland

Application December 15, 1948, Serial No. 65,428

5 Claims. (Cl. 315-323)

1

This invention relates to an electronic electric impulse counting ring, and more particularly pertains to one employing digit-representing gaseous discharge electron tubes of the type having at least an anode, a cathode, a control grid and an auxiliary grid, the control grid being used for priming a tube to be responsive, by firing and becoming conducting, when an electric impulse is received on its auxiliary grid.

This impulse counting ring is for use in counting electric impulse signals received at high speed. An early type of such a counting ring was devised by C. E. Wynn-Williams and disclosed in Proceedings of the Royal Society (London) 132,295 (1931), that ring employing gaseous discharge electron tubes of the triode type including an anode, a cathode and a control grid, signals and priming for successive tube operation both being impressed on the control grid.

This invention employs separate grids for the priming and signal-receiving functions and gives an advantage not obtainable in the heretofore known rings in that an unprimed tube cannot be fired by an unusually large pulse received on the signal-receiving grid. This is not true of rings which are primed and receive firing impulses on the same grid, and such rings may have erratic operation when excessively strong signals are received. The counting ring of this invention is capable of correct performance under such conditions.

It is, therefore, an object of this invention to provide a counter of electric impulses comprising a circuit employing digit-representing gaseous electron tubes having at least an anode, a cathode, a control electrode and an auxiliary electrode, so arranged in a circuit network that only a tube primed on its control electrode by a preceding conducting tube in the ring can be fired by an electric impulse impressed on the auxiliary electrode of said primed tube.

It is a further object of the invention to provide such a counting device in which all priming is done on the control electrodes from a preceding tube in the ring and all firing is done by the auxiliary electrodes on which the electric impulses are commonly received.

With these and other objects in view the invention includes other features of novelty, all coming within the scope of the claims and which will be described with reference to the drawing which is a diagrammatical representation of a decimal order of a numerical counting ring, part being broken away where the circuit is repetitive.

2

Referring to the drawing, tubes "0," "1," "2"—"7," "8" and "9" are the digit-representing elements of a decimal counting ring, said tubes each having, as shown in connection with the "0" tube, a cathode 20, an anode 21, a control grid 22 and an auxiliary grid 23.

Where the circuit elements are repetitive reference numbers are applied only to those elements associated with the "0" tube to avoid confusion.

These tubes preferably are of the type in which the control grid dominates, by its position, over a discharge between cathode and anode and wherein the auxiliary grid, as a subordinate control, may secondarily aid or prevent such a discharge by application of proper potentials thereto. Such tubes may be purchased from The General Electric Company under type designation GL-5663 or from Radio Corporation of America under type designation 2D21. In describing the circuit it will be assumed that the General Electric tube type GL-5663 is being used.

Each cathode is connected to ground through a resistor 24, of 20,000 ohms, shunted by a capacitor 25, of .005 microfarad, in series with a resistor 26 of 2500 ohms. Each anode is connected to conductor 27 supplied with potential of 105 volts positive from source 28 through resistor 29 of 5000 ohms. When any tube becomes conducting the discharge of the capacitor in its cathode supply circuit causes a drop in potential of conductor 27 because of resistance 29. This anode dip brings their potential to within about 32 volts of ground potential. Any previously conducting tube, having discharged its cathode capacitor, has assumed a potential of about 90 volts above ground potential, and will be held there by the cathode capacitor as conductor 27 dips in potential when another tube discharges. This will cause a cessation of current flow, momentarily, in the previously conducting tube permitting its grids to regain control, if properly biased. This extinguishing circuit arrangement forms no part of the novelty of this invention, but is disclosed and claimed in United States Letters Patent No. 2,401,657, issued on the application of Robert E. Mumma.

Each control grid 22 is connected through a resistance 30 of 1.5 megohms to negative 75 volt conductor 31 and is connected at point 32 to the cathode of the preceding tube of the ring through a resistor 33 of 1 megohm.

Each auxiliary grid 23 is connected through a resistance 34 to a negative 30 volt conductor 35 and is coupled through a capacitor 36 of 10 micro-

3

microfarads to a common input conductor 37 on which the impulses to be counted are impressed.

Means are provided to fire a selected tube preliminarily before signals are received or thereafter. This means is shown in connection with the "0" tube because counting rings are commonly reset to zero by firing the "0" tube. This may be accomplished by momentarily connecting the cathode of the "0" tube through a resistor 41 of 20,000 ohms and a switch 38 to a negative 100 volt source of supply. As the "0" tube becomes conducting any other then conducting tube is extinguished in the manner before described.

Signals, of around 30 volts as a safe minimum if of steep wave front, if applied to input terminal 40 will cause the counting ring to count by successive firing and extinguishing of the tubes, the last conducting tube representing, by its place in the ring, the sum of the signals entered.

The principal feature of this counting ring is that signals of unusually high potential will fire only the primed tube, which is supposed to be fired, and no other.

The values of circuit elements given are exemplary only and in no way are to be deemed to limit the principle of the invention as other sets of circuit values may easily be established, from those given, by one skilled in the art. The dominant control of the control grid electrode over the auxiliary grid electrode is of importance.

The ring described is capable of counting impulses impressed on it evenly at the rate of 10,000 per second and to perform in a correct manner even though large variation in pulse size is encountered. This provides a great safety factor inasmuch as in previously known gas tube counting rings, a signal of exceptionally high potential would not only fire a primed tube, but one or more others that were not primed.

As a positive potential signal is received on line 37 it is impressed on the auxiliary grid electrodes 23 of all the tubes of the ring. The normal potential bias on the control grids 22 of the tubes is sufficient to dominate in any tube but the one succeeding in the ring from the conducting tube. Thus, in the event the "0" tube is conducting its cathode will rise in potential to a point determined by the cathode-anode potential supply resistors. With the resistances shown this means a rise from about 1 volt negative to 76 volts positive. This changes the potential on the control grid of the "1" tube from a normal 30 volts negative to 2 volts positive, leaving only the auxiliary grid in control with a 30 volt negative potential. When this is reduced by a received input impulse to around 16 volts negative the "1" tube will become conducting, extinguishing the "0" tube. The same action continues around the ring.

While the device herein shown and described is admirably adapted to fulfill the objects primarily

4

stated, it is to be understood that it is not intended to confine the invention to the one form or embodiment herein disclosed, for it is susceptible of embodiment in various forms all coming within the scope of the claims which follow.

What is claimed is:

1. A counting device including a plurality of gaseous discharge electron tubes each having at least an anode, a cathode, a dominant control electrode and a subordinate control electrode; circuits connecting the tubes, cathode of one to dominant control electrode of another, in a succession; means supplying anode-cathode potential to the tubes sufficient to cause conduction therein; means supplying bias potential to the dominant control electrodes normally sufficient to prevent conduction in the tubes, said bias being relieved in a tube through the connection of its dominant control electrode to the cathode of a preceding tube and when the preceding tube is conducting; means capacitatively coupling each subordinate control electrode to a common input conductor; and means supplying bias potential to each subordinate control electrode sufficient to prevent conduction in a tube when the bias of its associated dominant control electrode has been relieved, except when a positive potential impulse signal is impressed thereon through said input conductor.

2. The device of claim 1 wherein the cathode-dominant control electrode connections form the succession of tubes into a ring.

3. The device of claim 1 in which the tubes are supplied with anode potential through a common resistor which causes the anodes of all tubes to fall in potential as a tube becomes conducting, permitting the dominant control electrode to resume control in any previously conducting tube.

4. The device of claim 1 in which the means coupling each of the subordinate control electrodes to the input conductor includes a capacitor.

5. The device of claim 1 in which means, including a negative potential source which may be selectively applied to a cathode of a tube, is provided to render a selected tube conducting.

ERNEST V. GULDEN.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
2,404,918	Overbeck (B)	July 30, 1946
2,442,872	Giansante	June 8, 1948

FOREIGN PATENTS

Number	Country	Date
557,172	Great Britain	Nov. 8, 1943