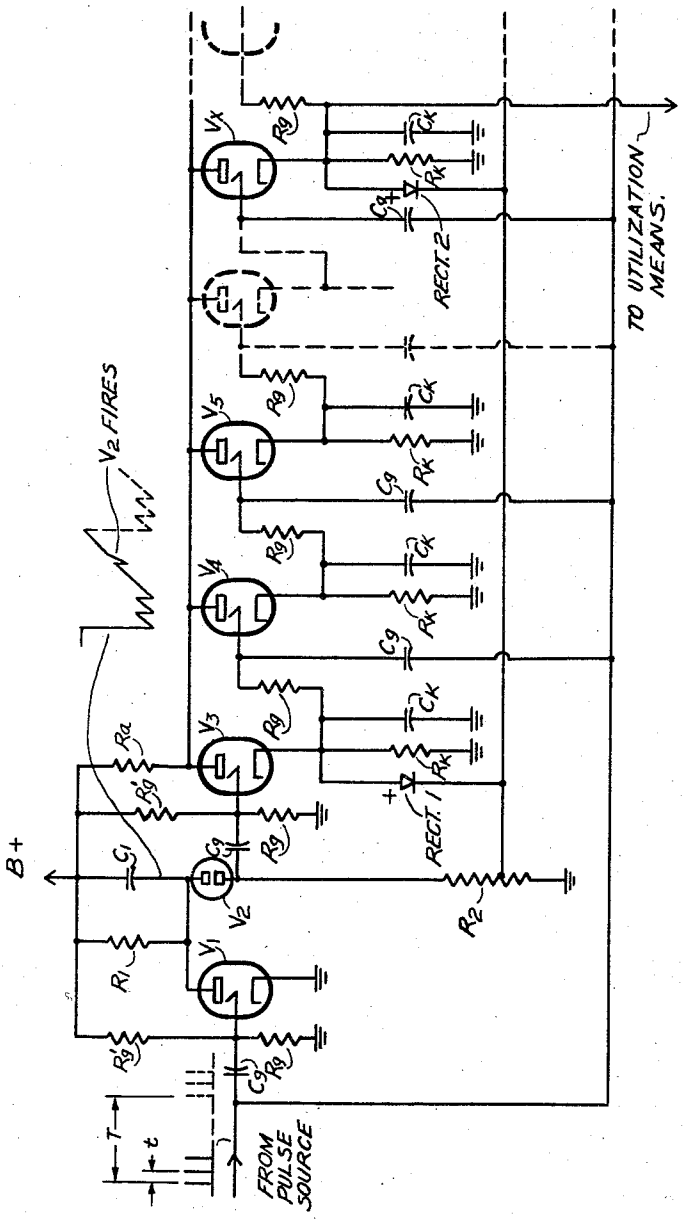
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PULSE CODE RESPONSIVE CIRCUIT CONTROL ARRANGEMENT

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PULSE CODE RESPONSIVE CIRCUIT CONTROL ARRANGEMENT

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The present invention is concerned with impulse counting circuits, and in particular to such circuits wherein an action is initiated thereby in response to a predetermined time distribution, or coding, of said impulses.

Representative of such systems are the selective calling systems used in telephony. It has been usual in the past to use electromechanical relays for such service, and whereas these known devices have given satisfactory performance in fixed station installations, they have certain drawbacks when applied to such services as mobile radiotelephony where their weight, bulk, susceptibility to shock and vibration, and operating power requirements are undesirable. Various all electronic systems have been devised to overcome the operational shortcomings of electromechanical relay systems, but it has been only with the advent of satisfactory miniature cold cathode trigger triode gas discharge tubes such electronic systems appear now to be commercially attractive. Such tubes require no heater supply, operate on a fraction of a milliampere of current, and are of very small size. Accordingly a large number of such tubes may be used to build up quite comprehensive counting or computing circuits without requiring much space or primary power.

The present invention, therefore, utilizes such trigger triodes, and seeks to provide for a well known trigger triode counter chain simplified circuitry whereby utilization means may be activated in response to a selected coding of trains of impulses applied to said counter.

According to the invention there is provided a pulse code responsive circuit control arrangement comprising: a source of numerically coded groups of equally spaced positive pulses; a gas tube counter chain of the type comprising a serially connected train of grid triggered gas discharge tubes having a common voltage dropping anode resistor and galvanic tube priming connections between the grid of each tube and a load resistor in the cathode circuit of the preceding tube in said train of tubes, and means to couple said pulses in common by way of individual blocking capacitors to the grids of all said tubes in said train of tubes with the exception of the first tube in said train of tubes; a gas tube relaxation oscillator circuit comprising in serial connection from a positive to a negative supply rail a first capacitor shunted by a first resistor, a gas discharge tube, and a second resistor, the period of oscillation of said oscillator circuit being intermediate between the spacing of said pulses and the spacing of said groups of pulses; a grid triggered gas discharge tube the anode of which is connected to the junction of said capacitor and said gas tube and the grid of which is capacitively fed from said source of pulses; a capacitor coupling the grid of said first tube in said train of tubes to the junction of said gas tube and said second resistor; galvanic potential supplying connections between a tap on said second resistor and the cathodes of selected tubes in said train of tubes inclusive at least of said first tube in said train of tubes; and utilization means fed with potentials developed across selected ones of said cathode load resistors.

The invention will be more fully described with reference to the accompanying drawing which is a schematic representation of a preferred embodiment thereof.

In the drawing the tubes V_3, V_4, V_5 . . . V_x comprise a know trigger triode gas discharge tube counter chain, the action of which, briefly, is as follows:

Consider V_3 to be conducting. The potential developed across its cathode load resistor R_K will be applied as a priming voltage via the associated grid decoupling resistor R_g to the grid of V_4, raising the potential of this grid above that of the grids of the subsequent tubes in the chain, but below that potential necessary to fire tube V_4. Now let a positive pulse be applied in common via the blocking capacitors C_g to the grids of all the tubes in the chain. Assuming this applied pulse lies within appropriate limits of amplitude, tubes V_5 . . . V_x will not be affected, but V_4 will be fired. When V_4 is fired the rush of current through the common anode resistor R_a will result in the reduction of the voltage applied to the various tube plates below that necessary to maintain conduction in all tubes except that tube, V_4, which has its grid at or above firing potential. Tube V_3 will therefore be extinguished, and the glow discharge will transfer to tube V_4. The voltage developed across the cathode resistor of V_4 by the glow discharge current will prime the succeeding tube V_5. Thus, upon the application of a subsequent pulse to the grid line, the discharge will be stepped along to the following tube in the chain. The cathode load shunting capacitors C_k provide a smoothing action for incidental transients, and indication of a particular count may be obtained from the cathode load of the appropriate tube, shown here as V_x.

In a manner analogous to the usual counting relay systems, by resetting the above counter after each one of a train of equally spaced pulses, grouped according to a code, has been received, the number of tubes necessary to select the proper one of a large plurality of possible signals may be greatly reduced. In the present invention this re-cycling or re-setting function is performed by the tubes V_1 and V_2 with their associated circuitry.

R_1, C_1, V_2 and R_2 form a relaxation oscillation, V_2 being, preferably, a glow discharge diode. The period of this oscillatory circuit is intermediate the pulse separation period and the pulse group separation period (t and T, as indicated by the pulse input waveform shown in the drawing). Incoming pulses, in addition to being applied to the grid line of the counter chain, are applied also to the grid of V_1, said grid being appropriately biased by its grid resistors R_g and R_g'. The first pulse of the group, shown here as comprising three pulses, causes V_1 to discharge C_1, dropping the voltage applied to V_2 below its striking voltage. Between pulses C_1 charges through R_1 but is again discharged at the occurrence of the next pulse in the train before the voltage applied to V_2 rises to its striking potential. At the termination of the pulse train C_1 charges without hindrance until V_2 is struck, as shown by the waveform at V_1 plate, whereupon a positive pulse is applied to the grid of V_3. V_3 then fires, transferring the glow discharge of the counter chain to itself, priming V_4, and applying a positive potential via R_2 to the low potential electrode of V_2. A rectifier, Rect. 1, may be used for reasons subsequently to be set forth to provide a unidirectional path from the cathode of V_3 to R_2. Upon the application of this positive potential from the cathode of V_3 to V_2, the total available potential between the electrodes of V_2 is insufficient to support conduction, the circuit is rendered non-oscillatory, and the entire system is set in readiness for the counter to respond to the next train of pulses.

In addition to the re-setting action as above described, the invention provides for the possibility of employing more complex coding than the simple counter reset to

home position after each pulse group. Let a group of $x-3$ pulses be received. The final pulse will fire tube V_x and prime V_{x+1}. Now let the cathode of V_x be connected to R_2 as shown. The potential from this cathode applied to V_2 will disable the oscillatory circuit so that V_3 will not be fired, as before described, after the termination of the pulse train, but the discharge will remain on V_x. The next group of pulses will then start the system counting from V_x. Thus the system is provided with a memory. Any desired tubes in the counter chain can, of course, be connected in the manner shown for V_x. The use of the rectifiers Rect. 1, Rect. 2, will now be apparent, since it is obviously necessary to prevent the possibility of positive potentials applied to R_2 from being also applied as priming voltages to tubes other than the one desired.

In order to clearly set forth the basic aspects of the invention no discussion has been given of the extensive coding possibilities inherent in its use. Those skilled in this highly specialized art will realize, however, that the system of the invention provides in a very simple and economic manner means for greatly expanding the scope of present selective calling systems. Whereas the invention has been described with reference to the use of cold cathode trigger triode gas discharge tubes it will be evident that grid triggered gas discharge tubes of other types could be used also if so desired. It is also evident that while a gas diode type of relaxation oscillator is particularly suitable for use in the invention, other types of relaxation oscillators could be used without departing from the basic concept of the invention. It will further be realized that the invention is applicable also to such systems as counters, computers, and so forth. Hence the scope of the invention is not to be considered as being restricted to the specific embodiment set forth herein but is to be judged from the appended claims.

I claim:

1. A pulse code responsive circuit control arrangement comprising: a source of numerically coded groups of equally spaced positive pulses; a gas tube counter chain of the type comprising a serially connected train of grid triggered gas discharge tubes having a common voltage dropping anode resistor and galvanic tube priming connections between the grid of each tube and a load resistor in the cathode circuit of the preceding tube in said train of tubes, and means to couple said pulses in common by way of individual blocking capacitors to the grids of all said tubes in said train of tubes with the exception of the first tube in said train of tubes; a gas tube relaxation oscillator circuit comprising in serial connection from a positive to a negative supply rail a first capacitor shunted by a first resistor, a gas discharge tube, and a second resistor, the period of oscillation of said oscillator circuit being intermediate between the spacing of said pulses and the spacing of said groups of pulses; a grid triggered gas discharge tube the anode of which is connected to the junction of said capacitor and said gas tube and the grid of which is capacitively fed from said source of pulses; a capacitor coupling the grid of said first tube in said train of tubes to the junction of said gas tube and said second resistor; galvanic potential supplying connections between a tap on said second resistor and the cathodes of selected tubes in said train of tubes inclusive at least of said first tube in said train of tubes; and utilization means fed with potentials developed across selected ones of said cathode load resistors.

2. A system as claimed in claim 1 wherein said grid triggered gas discharge tubes are miniature cold cathode triggered triode gas discharge tubes.

3. A system as claimed in claim 1 wherein said gas tube relaxation oscillator employs a gas diode discharge tube.

4. A system as claimed in claim 1 wherein said galvanic potential supplying connections between said tap on said second resistors and the cathodes of said selected tubes include in each a unidirective current translating device.

5. A system as claimed in claim 1 wherein said counter is enabled to remember a given count by virtue of the use of a galvanic connection between the cathode of that tube registering said given count and said tap on said second resistor.

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