Feb. 16, 1954 J. C. MANLEY 2,669,390

ELECTRONIC SIGNAL RESPONSIVE CIRCUIT
HAVING PRESETTABLE COUNT MEANS

Filed Dec. 22, 1950

3 Sheets-Sheet 1

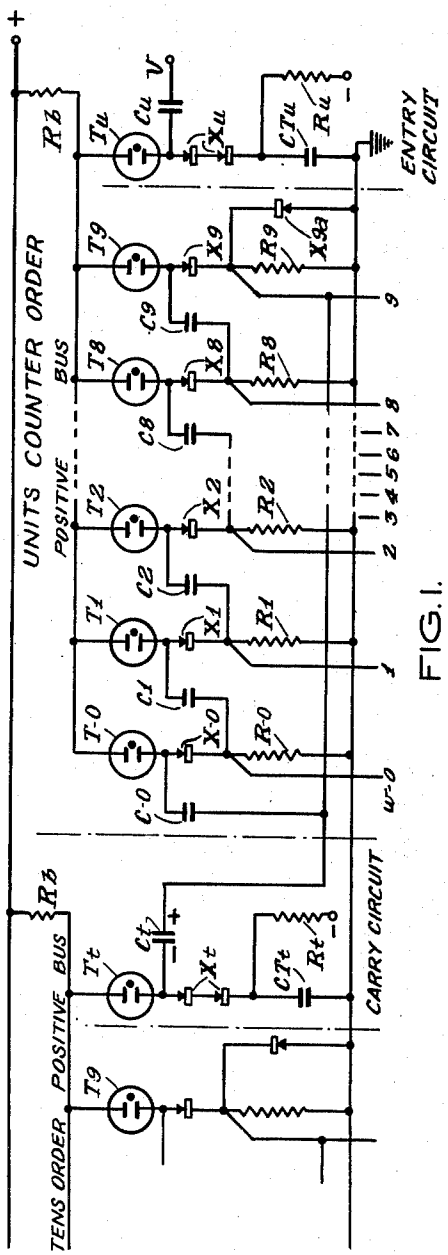


FIG. 1.

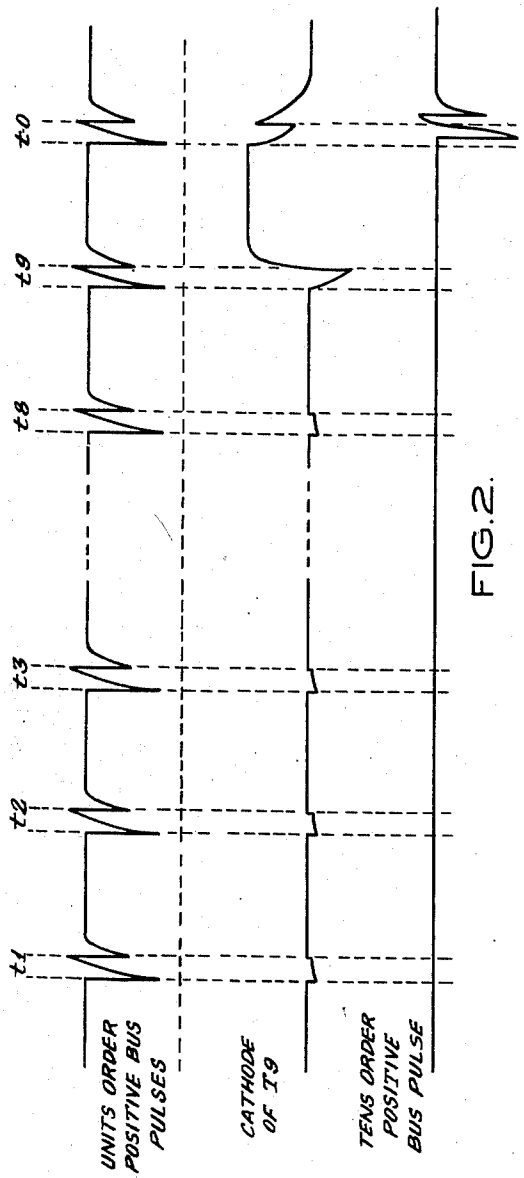


FIG. 2.

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3 Sheets-Sheet 2

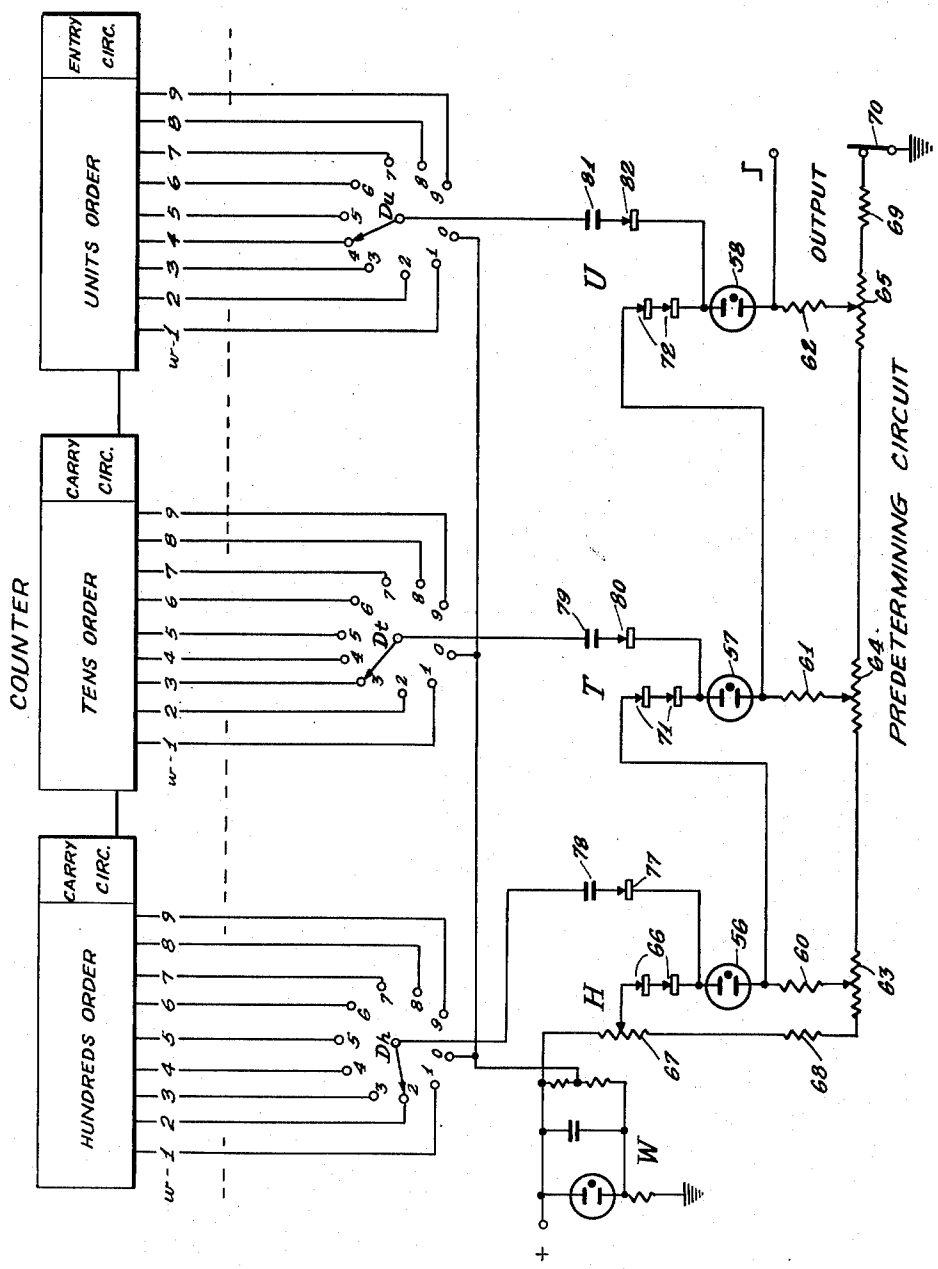


FIG. 3.

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ELECTRONIC SIGNAL RESPONSIVE CIRCUIT
HAVING PRESETTABLE COUNT MEANS

Filed Dec. 22, 1950 3 Sheets-Sheet 3

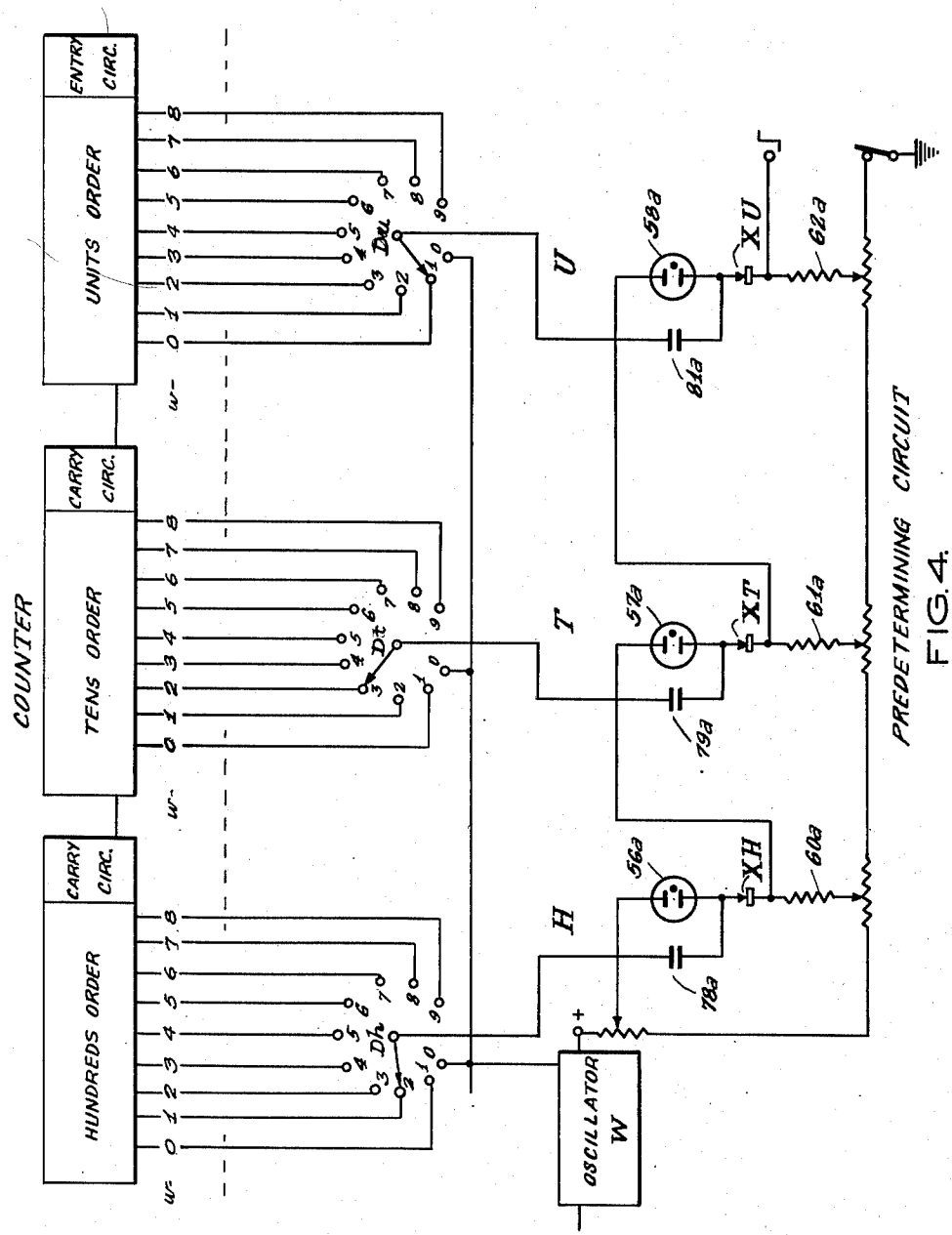


FIG. 4.

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UNITED STATES PATENT OFFICE

2,669,390

ELECTRONIC SIGNAL RESPONSIVE CIRCUIT HAVING PRESETTABLE COUNT MEANS

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Application December 22, 1950, Serial No. 202,336

15 Claims. (Cl. 235—132)

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This invention is directed to a novel circuit system of discharge tubes to produce an output signal or operate a work circuit in response to preselected or predetermined signals and particularly to such system which may be associated with a counter or data indexing means to respond to selected digit or data signals.

The system, which may be called a predetermining system, is particularly adapted for operation in conjunction with a plural order counter or plural order data indexing means to respond to successively produced digit or data signals representing a selected multi-place number or the like. The system may be used, for example, in conjunction with the impulse counter disclosed in an article "Neon Diode Ring Counter" in the January 1950 issue of "Electronics" or with an impulse counter composed of denominational orders of the kind disclosed in my application, Serial No. 191,306 filed October 20, 1950, now Patent No. 2,646,534.

An object of the invention is to provide a multistage predetermining circuit system composed of electric discharge tubes coupled in a novel manner to operate in sequence in response to electrical signals representing a preselected plural order number in a counter or representing plural order indicia in data indexing means.

More specifically, an object of the invention is to provide a predetermining circuit system composed of circuit stages coupled in series to voltage supply lines, so as to be sequentially conditioned for response to digit signals or the like.

Further, an object of the invention is to provide a predetermining system having successive stages, each of which includes a gaseous discharge tube which upon conduction causes priming potential to be applied across a gaseous discharge tube in the next stage to enable the latter tube to respond to and be made conductive by a digit signal or the like.

An object of the invention is to provide a predetermining system the stages of which are composed of gaseous discharge diodes, such as simple glow tubes, coupled for sequential response to voltage signals on separate signal input lines for the respective stages.

According to the invention, the stages of the predetermining system may be selectively associated with different orders of a counter or the like to be controlled by signals representative of the digits of a preselected number. The first stage has a gaseous discharge diode normally conditioned for response to a selected digit signal from the associated counter order. Upon firing of the diode in the first stage its output circuit

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applies conditioning potential to a diode in the next stage. The diode in this next stage is normally unable to respond to a digit signal but after being conditioned by the preceding stage it is ready to fire in response to a signal from the associated counter order. In turn, the firing of the diode in this next stage conditions a diode in a following stage to respond to a digit signal. The successive stages of the predetermining system are associated with the highest to lowest orders of the counter, respectively, so that by reason of the connections between the stages they will respond sequentially to signals representative of selected digits developed by the counter in descending order progression. Inasmuch as a higher order digit is developed in the counter as a result of a carry from a lower order, special provision must be made to operate a predetermining stage for which 0 has been selected. Accordingly, it is an object of the invention to provide means for replacing the counter orders in the production of selected 0 signals for the predetermining stages.

In one embodiment of the invention, each of the predetermining stages has a gaseous discharge diode which upon conduction applies voltage to the anode circuit of the diode in the next stage to condition it to respond to a digit signal applied to said anode circuit. In another embodiment, the tubes are conditioned as in the first embodiment but are responsive to digit signals applied to their cathode circuits.

It is to be understood that the predetermining system may be used with other data indexing means than a counter. For instance, it may operate under control of signals on communication lines or signals produced by a keyboard.

Other objects of the invention will be made clear in the accompanying detailed description and claims, and be apparent from the drawings, in which:

Fig. 1 is a circuit diagram of elements of the counter chosen, for purposes of the disclosure, to control the predetermining system;

Fig. 2 shows pertinent wave forms produced in the counter;

Fig. 3 shows the first embodiment of the predetermining system in conjunction with a diagrammatic showing of three orders of the counter; and

Fig. 4 is a similar view relating to the second embodiment of the invention.

Before describing the predetermining system in detail, a brief description will be given of the counter. Referring to Fig. 1, each order, as shown for the units order, has ten glow discharge

diodes T–0 to T9. The anodes of T–0 to T9 are connected to a common positive bus which is returned to the positive terminal of a voltage source through a resistor R*b*. The cathodes of T–0 to T9 are, respectively, connected by rectifiers X–0 to X9 and resistors R–0 to R9 to ground. Coupling capacitors C–0 to C9 interconnect the diode circuits. Associated with each order is a triggering circuit. The units order triggering circuit includes a glow discharge diode T*u* having its anode connected to the positive bus and its cathode connected to ground by a rectifier set X*u* and a capacitor CT*u*. Negative priming potential is impressed on T*u* via a resistor R*u*. As illustrated, the triggering circuit will be operated by negative input pulses applied through a coupling capacitor C*u*.

The quiescent voltage on the positive bus is insufficient to fire any of the diodes T–0 to T9 but is sufficient to maintain a fired diode in ionized state. In the reset condition of the counter order, its 0 manifesting tube T–0 is conducting and capacitor C*l* is charged through the forward resistance of the rectifiers X–0 and X*l* and the resistor R*l*. Upon application of an input impulse to the triggering tube, the tube fires and causes an abrupt fall in the positive bus potential, sufficient to extinguish the conducting diode T–0. During the triggering interval, no one of the diodes T–0 to T9 is conducting. Capacitor C*l* discharges relatively slowly through R–0, R*l*, and the inverse resistance of rectifier X*l*. The high inverse resistance of the rectifier causes a very large proportion of the voltage across C*l* to appear between the cathode of T*l* and ground. Thus the cathode of T*l* becomes significantly negative with respect to ground. The voltage of the units bus recovers as capacitor CT*u* charges through units bus resistor R*b*, tube T*u*, rectifiers X*u* and resistor R*u*. Upon recovery of the bus voltage, a greater voltage appears across T*l* than across any of the other digit manifesting tubes and T*l* strikes, the bus voltage is again depressed, the triggering tube is extinguished and the bus voltage returns to its quiescent value. The counter order has thus been advanced one digit, from its 0 position to its 1 position. Succeeding triggering pulses cause the repetition of the counter step until T9 eventually becomes conducting.

Fig. 2 shows in the upper line the wave form of voltage on the positive bus of the units order during successive triggering intervals *t1* to *t0*. The second line of Fig. 2 shows the wave form of the cathode voltage of T9 during the counting steps. During the triggering interval *t9*, tube T8 is extinguished and capacitor C9 produces a significant drop in the cathode potential of T9. At the end of the interval T9, tube T9 strikes and the cathode potential rises abruptly while capacitors C–0 and a capacitor C*t* charge to the potential shown in the second line of Fig. 2 during the time between the triggering intervals *t9* and *t0*. The next input impulse causes the tube T9 to be extinguished during the interval *t0* and capacitor C–0 and C*t* to discharge through the inverse resistances of X–0 and X*t*, respectively. The cathodes of T–0 and T*t* become significantly negative with respect to ground; T–0 does not strike until the voltage of the units bus is allowed to recover but T*t*, the carry tube between the units and the tens orders, strikes almost immediately because it is primed close to its striking potential. When T*t* strikes, the voltage of the tens bus drops rapidly as shown in the bottom line of Fig. 2, and the conducting tube in the tens order is extinguished. The voltage of the tens bus recovers as CT*t* charges through the bus resistor R*b*, the tube T*t* and through X*t* and R*t*. The tube following the just extinguished tube in the tens order fires, for reasons now clear; the tens bus drops in potential and the tube T*t* is extinguished. The tens order has thus been advanced one count step as a result of a carry from the units order. Similarly, when the tens order steps from 9 to 0, a carry is effected to the hundreds order (see Figs. 3 and 4).

It is to be noted that when one digit manifesting tube is extinguished, a negative impulse is produced at the cathode of the next tube, following which the next tube strikes and a positive impulse appears at its cathode terminal, as indicated for tube T9 in Fig. 2, second line. Either the negative or positive impulses at the cathodes of the counting tubes in each order may be used to control the predetermining system. Fig. 3 shows the form of system controlled by positive impulse signals from the counting tube cathodes, while Fig. 4 shows the form of system controlled by negative impulses. The cathodes of the counting tubes in each order may be selectively connected to the input of a related stage of the predetermining system. As shown in Figs. 3 and 4, dial switches D*h*, D*t* and D*u* are used as selective connecting means between the counter orders and the stages of the predetermining system. Leads *w* from the cathodes of the counting tubes (also see Fig. 1) terminate at the digit spots of the dial switches. The arms of the switches are connected to the input circuits of the predetermining circuit stages. In the form of predetermining system using positive input signals, the wires *w1* to *w9* are connected to spots 1 to 9 (see Fig. 3). In the form of predetermining system using negative input signals, wires *w0* to *w8* are connected to spots 1 to 9, respectively. In each form, the 0 spots are connected to the output line of an oscillator W in order to take care of zeros in the predetermined number.

Referring now to Fig. 3, the stages H, T and U are connected to form a predetermining system in which stage H must operate first, under control of the hundreds counter order, stage T must operate next, under control of the tens counter order, and stage U must operate last, under control of the units counter order. When all the stages have operated, an output signal is produced at a chosen point of the last stage U. This output signal is an indication that the predetermining system has detected a preselected number and may be used to perform any desired work.

Stages H, T and U, respectively, include gaseous discharge diodes 56, 57 and 58. The cathodes of 56, 57 and 58 are, respectively, wired through resistors 60, 61 and 62 to the arms of potentiometers 63, 64 and 65. The anode of 56 is connected by rectifiers 66 to the arm of a potentiometer 67. Potentiometer 67 is in series with a resistor 68, potentiometers 63, 64 and 65, a resistor 69, and a switch 70, between the positive terminal of a voltage source and ground. The switch 70 is opened to reset the predetermining circuit to an unoperated status.

The cathode of 56 is connected by rectifiers 71 to the anode of 57, and the cathode of 57 is connected by rectifiers 72 to the anode of 58.

The anode of 56 is also connected through a rectifier 77 and a coupling capacitor 78 to the arm of dial switch D*h*. A coupling capacitor 79 and rectifier 80, in series, connect the anode of 57 to the arm of switch D*t*. The anode of 58 is similarly connected by a coupling capacitor 81 and a rectifier 82 to the arm of switch D*u*. The coupling capacitors 78, 79 and 81 are sufficiently small that negative wave forms are differentiated and, hence, positive impulses from the counter (and from the oscillator) are always available to trigger the predetermining tubes. The constants and elements are so chosen and the potentiometers so adjusted that the potential across tube 56 is maintained less than its striking voltage and is of such value that the tube will fire upon receiving a positive input signal. Until 56 fires, there is insufficient potential across tube 57 and it is not responsive to a positive input signal. The tube 57 is so biased that with 56 conducting and applying increased anode potential to 57, the latter will fire in response to a positive signal from the counter or from the oscillator. Similarly, the tube 58 is biased to respond to a positive input signal when increased anode potential is applied thereto through tubes 56 and 57 in conducting state.

As an example, assume the predetermining system is to detect the number 234 in the counter Switches D*h*, D*t* and D*u* are adjusted as shown in Fig. 3. With switch 70 closed, the voltage supply for the predetermining system impresses a priming voltage, fairly close to the striking voltage, across tube 56 and suitably biases the tubes 57 and 58. As the counter steps to number 200, the tube T2 in the hundreds order ignites and a positive impulse appears at its cathode terminal, as previously explained. This positive impulse is applied via wire *w*2 of the hundreds order, the switch D*h* in "2" position, the coupling capacitor 78 and the rectifier 77 to the anode of tube 56 of stage H. The potential across tube 56 will now exceed the firing potential and cause the tube to ignite. Current will flow essentially from the + side of the voltage supply, through the potentiometer 67, the rectifiers 66, in the forward direction, the tube 56, resistor 60, the potentiometers 63, 64 and 65, resistor 69, and closed switch 70, to ground. The voltage then appearing across resistor 60 is impressed on the anode of tube 57 and primes 57 fairly close to its striking voltage.

When the counter advances to the number 230, tube 57 is triggered by a positive pulse from the cathode of tube T3 in the tens counter, the pulse being applied through switch D*t*, coupling capacitor 79 and rectifier 80 to the anode of 57. The tube 57 strikes and current will flow essentially from the positive side of the voltage supply through the potentiometer 67, the rectifiers 66, the tube 56, the rectifiers 71, the tube 57, the resistor 61, potentiometers 64 and 65, resistor 69, and closed switch 70, to ground. The voltage now appearing across resistor 61 is impressed on the anode of tube 58 and is sufficient to condition the tube for striking in response to an input signal.

Upon the counter advancing four more steps, from 230 to 234, tube 58 is fired by a positive pulse from the tube T4 in the units order of the counter, the positive pulse being applied by switch D*u*, coupling capacitor 81 and rectifier 82 to the anode of 58. Current flows essentially from the positive side of the voltage supply through tubes 56 and 57 as previously described and from the cathode of tube 57 through rectifiers 72, tube 58, resistor 62, potentiometer 65, resistor 69, and switch 70, to ground. The output may be taken from the cathode of tube 58. Since the output voltage appears across resistor 62 and potentiometer 65, this potentiometer may be adjusted to conform to the demands of the load.

Special provision must be made in order to obtain a predetermining output signal after any number which contains the digit 0. It may appear at first glance that if the predetermining circuit is to respond to the number 230, for example, the input signal to stage U may be derived from the 0 manifesting tube T–0 in the units order. However, when the counter receives the 230th impulse to be counted, the units counter order first switches from 9 to 0 and following this, the tens order switches from 2 to 3 as a result of a carry from the units order. Thus, the tube 58 in stage U is not primed until after the units order tube T–0 has fired and produced the positive pulse at its cathode terminal. Unless provision is made to offset this condition, the predetermining system will not complete its operation until the units order has again completed a counting cycle of ten steps and has produced another carry to the tens order; namely, after 240 impulses have been applied to the counter. This same difficulty arises with any number containing the digit 0. For correct operation, the signals which operate the predetermining tubes must be delivered first from the hundreds order, then from the tens order, and finally from the units order. In the case of 0 digits in the selected, predetermined number, the correct sequence is provided artificially by obtaining the 0 digit signals for the predetermining system from an oscillator. The simple relaxation oscillator W shown in Fig. 3 may be used. The frequency of oscillation is considerably higher than the maximum counting speed so that the delay in the production of the predetermining output signal is minimized when this signal is required after numbers such as 100, 200, 110, 230, and so on.

It is to be noted that rectifiers 77, 80 and 82 prevent reaction of the predetermining circuit upon the counter circuit. When, for instance, predetermining tube 56 fires, the rise in its cathode potential is blocked by rectifier 80 from having any ill effect on the tens counter order.

With regard to rectifiers 66, 71 and 72, they restrict the incoming positive signals from the counter orders to the associated predetermining tubes and also prevent appearance of negative impulses at the cathodes of predetermining tubes when the counting tubes preceding the selected tubes are extinguished. Such negative impulses might be effective to prematurely ignite predetermining tubes. For example, considering the example shown in Fig. 3 where the tens order counting tube T3 has been selected, each time the preceding tube T2 is extinguished a negative priming pulse is produced, in the manner previously explained, at the cathode of tube T3. In the absence of the rectifiers 71, a similar negative impulse may be produced at the cathode of predetermining tube 56 and tend to cause the tube 56 to strike. Thus, each time the tens counter order stepped from digit position 2 to digit position 3, the hundreds order predetermining tube 56 would tend to strike, if the rectifiers 71 were not present. Similarly, rectifiers 72 prevent appearance of undesirable negative impulses at the cathode of predetermining tube 57

each time the units counter steps to the selected units order digit position.

Fig. 4 shows an embodiment of the predetermining system utilizing negative signals from the counter. The coupling circuits between the counter orders and the predetermining stages are similar to the coupling circuits between counting tubes and between one counter order and the next. For this embodiment, the leads *w*0 to *w*8 from each counter order are connected to the spots 1 to 9 of the related dial switch D*h*, D*t* or D*u*. The 0 spots are connected, as before, to an oscillator W for providing digit 0 signals to the predetermining circuit, for the reasons explained in connection with the embodiment shown in Fig. 3. The connections of the predetermining tubes **56***a*, **57***a* and **58***a* to the voltage supply and to each other are similar to the connections in the preceding embodiment except that rectifiers such as **66**, **71**, and **72** of the preceding embodiment are not included and are not necessary and, further, rectifiers XH, XT and XU are inserted, for reasons which will become clear, between the cathodes of the predetermining tubes and the cathode resistors **60***a*, **61***a*, and **62***a*.

In further explanation, consider the example indicated in Fig. 4 where the predetermined or preselected number is 231. The junction between the rectifier X–0 of the 0 manifesting stage in the units order (see Fig. 1) and the resistor R–0 is connected by wire *w*0 to the 1 spot of dial switch D*u*. The arm of switch D*u* is connected by coupling capacitor **81***a* to the junction of the cathode lead of tube **58***a* and the rectifier XU. It is seen that the coupling between the 0 manifesting stage of the units order and the predetermining stage U is similar to the coupling between the 0 manifesting stage of the units order and the next 1 manifesting stage of the units order. Similar coupling is provided between the 2 stage of the tens counter order and the predetermining stage T and between the 1 stage of the hundreds counter order and the predetermining stage H.

Following up this example, the 199th triggering impulse applied to the counter causes the tube T1 in the hundreds order to be fired. While this tube T1 conducts, the coupling capacitor C2 to the next tube T2 and the coupling capacitor **78***a* connected, with the assumed setting of switch D*h*, between said tube T1 and the predetermining tube **56***a* are charged substantially to a potential such as indicated between *t*9 and *t*0 in the second line of Fig. 2. The 200th triggering impulse causes the tube T1 in the hundreds order to be extinguished, whereupon the cathodes of the next tube T2 and of the predetermining tube **56***a* assume a negative potential with respect to ground due to the discharge of coupling capacitors C2 and **78***a* through the inverse resistances of the rectifier X2 (hundreds counter order) and the rectifier XH (predetermining stage H), respectively. The hundreds order counter tube T2 will strike upon recovery of the hundreds order bus potential, in the manner previously described. The predetermining tube **56***a* strikes almost immediately because it is primed close to the striking potential. With tube **56***a* conducting, the voltage across its cathode resistor **60***a* is applied to the anode of predetermining tube **57***a* and primes it close to its striking potential.

It is clear now that when the 230th input impulse is applied to the counter, the capacitor **79***a* discharges a negative impulse at the cathode of tube **57***a* causing it to ignite. With **57***a* conducting, tube **58***a* is primed, and upon application of the 231st triggering impulse to the counter, capacitor **81***a* will discharge a negative impulse on the cathode of tube **58***a* and cause it to strike.

Any suitable constants and tubes may be used which will produce satisfactory operation of the circuit system according to the principles outlined. For example, satisfactory operation has been obtained with the voltage at the positive terminal of the circuit at approximately 180 volts with resistors **60**, **61**, **62** each having a value of 300,000 ohms and resistors **63**, **65**, **67** each having a value of 20,000 ohms. Capacitors **78**, **79**, **81** each have a value of .0005 microfarad; resistor **64** a value of 5,600 ohms, resistor **68** a value of 18,000 ohms and resistor **69** a value of 15,000 ohms. The rectifiers may be germanium crystal diodes. With the constants specified, the tubes may be of the NE96 type which fire at approximately 135 volts and operate at approximately 70 volts. The zero signal oscillator may also have an NE96 diode with a cathode resistor of 3 megohms and a capacitor having a value of .0005 microfarad.

It should be borne in mind that in describing the invention, only the preferred embodiments were explained and shown in detail, and that many variations in the details of the circuit may be made without departing from the spirit of the invention. It is therefore intended to be limited only as indicated by the scope of the following claims.

What I claim is:

1. A circuit network controllable by a plurality of signal sources for producing signals in various possible sequences, comprising a voltage supply, a succession of gaseous discharge tubes, separate signal input circuits for so respectively connecting the signal sources and the tubes, each said source to a different tube, as to be capable of non-simultaneously transmitting signals from the sources to the related tubes, biasing connections between the voltage supply and the tubes for initially biasing only the first tube to fire upon application thereto of a signal by its input circuit the remaining tubes being unaffected by signals on their input circuits, means serially connecting the anode-cathode circuits of the tubes including an output connection from each preceding tube to the next tube effective upon firing of the preceding tube to condition the next tube to fire upon application of a signal thereto by its input circuit, whereby the tubes are conditioned in predetermined sequence and fire in said sequence in response to signals produced in a corresponding sequence on their respective input circuits by said signal sources.

2. A circuit network controllable by a plurality of signal sources, comprising a voltage supply, a succession of gaseous discharge tubes, separate signal input circuits for so respectively connecting the sources to the tubes as to be capable of non-simultaneously transmitting signals from the sources to the related tubes, biasing connections between the voltage supply and the tubes for initially biasing only the first tube to fire upon application of a signal thereto by its input circuit, the remaining tubes being unaffected by signals on their input circuits, an output circuit for each tube including an impedance across which increased voltage is produced upon firing of the tube, and a connection from the output circuit of each preceding tube to the anode-cathode cir-

cuit of the next tube effective upon firing of the preceding tube to apply the increased voltage across the related impedance to the anode-cathode circuit of the next tube to condition it to fire in response to a signal on its input circuit, whereby the tubes are compelled to fire in a given sequence in response to signals on their respective input circuits.

3. A circuit network controllable by a plurality of signals from different sources, comprising a voltage supply, a series of gaseous discharge diodes, separate signal input circuits for so respectively connecting the diodes to the different signal sources as to be capable of non-simultaneously transmitting signals from the respective sources to the related tubes, biasing connections between the voltage supply and the diodes to initially bias only the first diode to fire upon application of a signal thereto by its input circuit, the remaining diodes being unaffected by signals on their input circuits, impedance means in series with each diode and across which a voltage increase is produced upon firing of the diode, and a connection from a terminal of the impedance means, associated with each preceding diode, to the next diode to apply the voltage increase produced across the impedance means, upon firing of the preceding diode, to the next diode to condition the latter to fire upon application of a signal thereto by its input circuit, whereby the diodes are compelled to fire in prescribed sequence in response to signals on their input circuits.

4. A circuit network to produce an output signal in response to a plurality of input signals from different sources, comprising a group of gaseous discharge diodes, a separate positive signal input circuit connected from a different source to the anode of each diode, a source of potential, and means including connections to the source of potential and series connections from cathode of one diode to anode of the next diode for rendering the diodes effective for sequential ignition in response to positive signals on their respective input circuits so as to produce the output signal upon ignition of the last diode of the group.

5. A circuit network to produce an output signal in response to a plurality of negative input signals from different sources, comprising a group of gaseous discharge diodes, a separate negative signal input circuit connected from a different source to the cathode of each diode, a source of potential, and means including connections to the source of potential and series connections from the cathode of one diode to the anode of the next diode for rendering the diodes effective for sequential ignition in response to negative signals applied by their respective input circuits, so as to produce the output signal upon ignition of the last diode of the group.

6. A circuit network to produce an output signal in response to a plurality of input signals from different sources, comprising a series of electron tubes, each including at least an anode and a cathode, a separate signal input circuit connected from a different source to each tube, a source of potential, and means including connections to the source of potential and series connections from cathode of each tube to anode of the next tube for rendering the tubes sequentially conductive in response to signals on their respective input circuits so as to produce the output signal upon the last tube in the series becoming conductive.

7. A circuit network as in claim 6, wherein said input circuits include rectifiers poled to prevent reaction of the circuit network upon the signal sources.

8. A circuit network as in claim 6, said series connections between the tubes including rectifiers poled to isolate each tube from all the signal input circuits except its own signal input circuit.

9. A circuit network controllable by a plurality of signals, comprising a voltage supply, a series of signal receiving tube circuits, each including a gaseous discharge diode and a resistor in series, impedance connections between the voltage supply, and the tube circuits including potentiometers in series between opposite sides of the voltage supply, each potentiometer connected to the terminus of the resistor in a different one of the tube circuits, for biasing the first diode to fire upon receiving a signal and biasing the succeeding diodes to disregard signals, and means serially connecting the diodes including a connection from the opposite terminus of the resistor of a preceding tube circuit to the next tube circuit to apply priming potential to the diode in the next tube circuit for conditioning it to fire upon receiving a signal, whereby the diodes are fired in sequence in response to signals received thereby.

10. A predetermining circuit network to detect a desired number in a plural order number register, said predetermining circuit network including a series of gaseous discharge tubes each including anode and cathode electrodes, a separate input signal circuit connected to each tube and selectively connectable to an order of the register to apply a digit manifesting voltage signal to the tube upon said order advancing to a selected digit position, a source of potential, bias connections between the source of potential and the tubes, and series connections between the anode-cathode path of each tube and the anode-cathode path of the next tube, said bias and series connections priming the tubes for sequential operation in response to signals applied by their respective input signal circuits.

11. A predetermining circuit network as in claim 10, said bias connections including potentiometers in series between the opposite terminals of the source of potential and individual connections between the potentiometers and the tubes.

12. A predetermining circuit system to detect a desired number in a plural order impulse counter producing distinctive digit manifesting voltage signals in each order, said system comprising a direct voltage supply, a series of discharge tube circuits of which each includes a rectifier, a resistor and a gas discharge tube between the rectifier and resistor, means to apply potentials to the tube circuits to render the tubes therein responsive to applied digit signals, said means including potentiometers in series between opposite sides of the voltage supply and respectively tapped by the resistors in the different tube circuits, said means further including a connection from one side of the voltage supply through the rectifier in the first tube circuit to the tube therein and a connection from the anode-cathode path of each tube to the anode-cathode path of the next tube through the connected rectifier, and means including capacitors for selectively coupling the tube circuits to the counter orders to apply digit signals representing a desired number to the tube circuits.

13. A predetermining system operable in response to signals from different sources, comprising a voltage supply, a series of gaseous discharge diodes, connections between the voltage supply and the diodes for initially priming the first diode to respond to an input signal and the remaining diodes to disregard input signals, a separate input signal circuit for each diode including a rectifier connected between the cathode of the diode and one side of the voltage supply and further including a coupling capacitor connected to the rectifier and selectively connectible to one of the signal sources to be charged through the forward resistance of the rectifier prior to the production of a signal by said source and to be discharged through the inverse resistance of the rectifier upon the production of a signal by said source, whereupon the input circuit develops a negative signal at the cathode of the diode, such negative signal in the first diode being effective to fire it, and connections from the first diode to the next and so on for priming each succeeding diode to fire in response to the negative signal applied thereto by its input circuit.

14. A predetermining system to detect a desired number in denominationally ordered counter circuits, comprising a voltage supply, a series of gaseous discharge diodes, connections between the voltage supply and the diodes for initially priming the first diode to respond to an input signal and the remaining diodes to disregard input signals, a separate input signal circuit for each diode, each input circuit including a capacitor and a rectifier connected to the cathode of a diode and selectively connectible to an ordered counter circuit to complete a charging circuit for the capacitor through the forward resistance of the rectifier upon the counter circuit stepping to the digit position preceding a desired digit position and to cause the capacitor to discharge through the inverse resistance of the rectifier upon the counter circuit stepping to the desired digit position, said capacitor discharge in the signal input circuit of the first diode increasing the potential across this diode to the firing value, and connections between the first diode and the next diode and so on to apply priming potential to each succeeding diode upon firing of the preceding diode.

15. A circuit network to produce an output signal in response to a plurality of input signals from different sources on different signal lines, comprising a source of potential, a series of gaseous discharge diodes each to receive an input signal from a different one of said lines, means for initially conditioning only the first diode to strike in response to an applied input signal, and coupling circuits between each diode and the next for connecting the anode cathode path of each succeeding diode through the preceding diode or diodes to the source of potential so as to be conditioned to strike in response to an applied signal, whereby the diodes will operate sequentially in response to separate signals.

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