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ELECTRIC SYSTEM FOR INDICATING THE OCCURRENCE OF A PAIR OF SIGNALS

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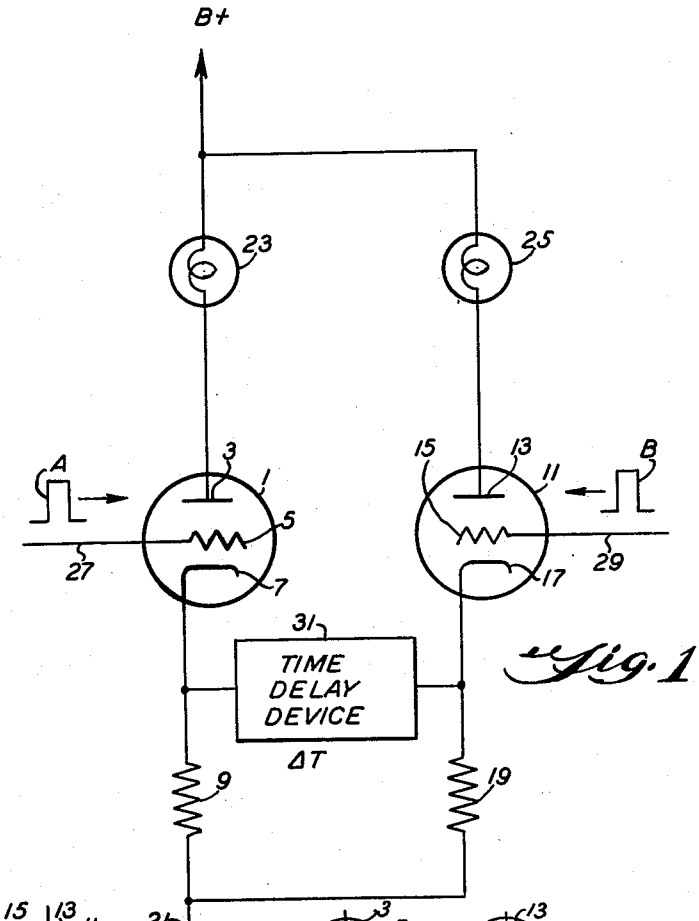


Fig. 1

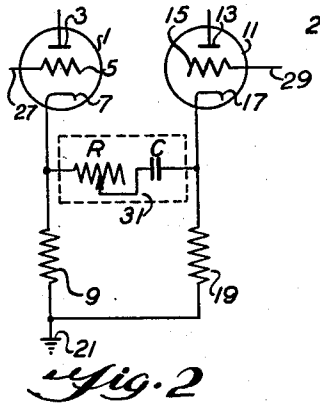


Fig. 2

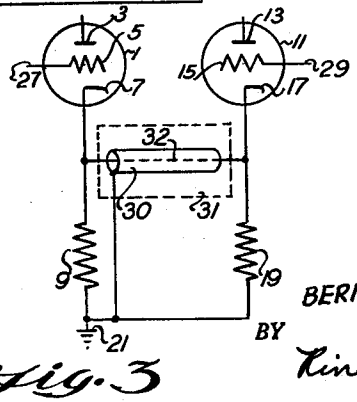


Fig. 3

INVENTOR.
BERNARD J. O'KEEFE
BY
Lines and Lines
ATTORNEYS

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ELECTRIC SYSTEM FOR INDICATING THE OCCURRENCE OF A PAIR OF SIGNALS

Bernard J. O'Keefe, Natick, Mass., assignor to Edgerton, Germeshausen and Grier, Inc., Boston, Mass., a corporation of Massachusetts

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10 Claims. (Cl. 340—248)

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The present invention relates to electric systems for indicating the occurrence of a pair of signals, and more particularly to electric systems for determining whether or not first and second signals occur within a predetermined time interval of duration greater than the duration of either signal.

An object of the present invention is to provide a new and improved system for determining whether or not a pair of energy signals occur within a predetermined interval of time. In accordance with the invention, this is effected with the aid of a pair of normally non-conductive discharge devices to which the signals may be fed, the discharge devices being both rendered conductive only if both signals occur within the predetermined time interval.

A further object is to provide a system of the above-described character that may visually indicate the reception of such signals.

Other and further objects will be explained hereinafter and will be more particularly pointed out in the appended claims.

The invention will now be described in connection with the accompanying drawing:

Fig. 1 of which is a schematic circuit diagram of a preferred embodiment of the invention; and

Figs. 2 and 3 are similar fragmentary diagrams of modifications.

A pair of normally non-conductive discharge devices 1 and 11, such as, for example, gaseous-discharge tubes of the thyratron type, are shown provided with respective plates or anodes 3 and 13, control-grid electrodes 5 and 15, and cathodes 7 and 17. As will hereinafter be evident, other types of discharge devices including electron tubes may be utilized, though thyratron discharge devices are preferred. The cathodes 7 and 17 are connected through respective cathode loads 9 and 19 to a common terminal 21 that may be the negative terminal B— of the source of anode or plate voltage, not shown, for the devices 1 and 11. This terminal 21 may be grounded. The anodes 3 and 13 are connected through respective indicator apparatus, schematically illustrated as lamps 23 and 25, to the positive or B+ terminal of the source of the anode voltage, not shown. Connected between the cathode 7 and the cathode 17 is a time-delay device 31 adapted to delay the transfer of voltage appearing at either cathode to the other cathode a predetermined time interval ΔT. This time interval ΔT is selected to correspond to the time within which it is desired to know whether first and second signals A and B have been received by the respective devices 1 and 11. The signals A and B are shown for illustrative purposes as substantially rectangular voltage pulses of time duration less than the predetermined time interval ΔT. The voltage pulse A is received by and applied to the input circuit of the device 1 by way of the conductor 27 that connects with the control electrode 5, and by way of the ground terminal 21, connected to the cathode 7. The voltage pulse B is similarly received by and applied to the input circuit of the device 11 by way of a conductor 29 connected to the control electrode 15, and by way of the ground terminal 21, connected to the cathode 17. Both pulse signals A and B are of positive polarity and of sufficient amplitude normally to render the respective control electrodes 5 and 15 sufficiently positive with respect to their respective cathodes to render the respective discharge devices 1 and 11 conductive. If desired, of course, negative pulses A and B may be utilized if applied to render the cathode of the devices negative with respect to the control-grid electrodes.

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When the pulses A and B thus applied to the input circuits of the respective discharge devices 1 and 11 occur simultaneously or within the predetermined period of time ΔT, both devices will be rendered conductive and the indicator lamps 23 and 25 will both become illuminated as a result of the flow therethrough of output-circuit current from the B+ terminal, to the anodes 3 and 13, through the rendered-conductive devices 1 and 11, and to the B— terminal 21. If, on the other hand, one of the signals, say the signal B, occurs at a time different, such as later, from the time of occurrence of the signal A by an amount greater than the time interval ΔT, the signal A, first received in the input circuit of the device 1, will render the device 1 conductive and thus illuminate the indicator lamp 23. A positive rise in voltage at the cathode 7 of the device 1, resulting from the reception of the signal A and the consequent conduction of the device 1, will become transferred to the cathode 17 of the device 11 at a time ΔT after the reception of the signal A, as a result of the delay in transmission or transfer of this positive rise in voltage effected by the time-delay device 31. By the time the signal B has arrived at the control electrode 15 of the device 11, therefore, the device 11 will have become biased by this transferred voltage rise conveyed from the cathode 7 of the device 1 to the cathode 17 of the device 11 through the time-delay device 31. The time-

delay device 31 thus actually becomes operable to bias the cathode 17 at a time corresponding to the predetermined time interval ΔT after the rendering conductive of the discharge device 1. Even though the pulse B would normally render the device 11 conductive, therefore, this bias will prevent the rendering conductive of the device 11 irrespective of the application thereto of the signal B. Only the lamp 23, therefore, will be illuminated, demonstrating that the pulse A was received first, and that if the second pulse B did occur, it was received at a time later than the time interval ΔT after the reception of the pulse A. The same but reverse process will occur if the pulse B is received first and the pulse A is received at a time later than the time interval ΔT after the reception of the pulse B, the indication of such a situation being demonstrated by the illumination of only the lamp 25.

While the indicators 23 and 25 have been illustrated as lamps, such as incandescent lamps or neon or other gas indicators, it is to be understood that any other type of indicators including well-known metering devices may also be utilized. It is also to be understood that in place of the indicators 23 and 25 there may be substituted well-known voltage- or current-responsive members for automatically operating external control circuits, the operation of which is again determined by and indicative of whether or not the signals occur within the time interval ΔT.

The time-delay device 31 may comprise an electric network, such as, for example, the series-connected resistor-condenser RC network of Fig. 2, or any other similar electric time-delay device. Such networks are adapted to be variable, as by varying the value of the resistor R, thereby to vary the predetermined time interval ΔT as desired. The time-delay device 31, on the other hand, may be of a fixed nature comprising, as an illustration, a predetermined length of transmission line, such as coaxial line, Fig. 3, the inner conductor 32 of which is connected between the cathodes 7 and 17 and the outer conductor 30 of which may be grounded at 21. Delay circuits of this character, when utilized with thyratron-type discharge devices 1 and 11, are particularly useful for indicating the reception of voltage pulses differing in time of occurrence by time intervals ΔT of the order of fractions of microseconds.

Further modifications will occur to those skilled in the art and all such are considered to fall within the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. An electric system for determining whether or not first and second signals occur within a predetermined time interval of duration greater than the duration of either signal having, in combination, first and second normally non-conductive discharge devices, means for receiving the first and second signals and applying the same to the respective first and second discharge devices when received, the signals being of such a nature as normally to render the discharge devices conductive, and a time-delay device connected between the discharge devices and operable at a time corresponding to the said predetermined time interval after the moment of the rendering conductive of either discharge device by the application of the corresponding signal thereto for thereupon preventing the rendering conductive of the other discharge device irrespective of the application thereto of its corresponding signal.

2. An electric system for determining whether or not first and second signals occur within a predetermined time interval of duration greater than the duration of either signal having, in combination, first and second normally non-conductive discharge devices, means for receiving the first and second signals and applying the same to the respective first and second discharge devices when received, the signals being of such a nature as normally to render the discharge devices conductive, a time-delay device connected between the discharge devices and operable at a time corresponding to the said predetermined time interval after the moment of the rendering conductive of either discharge device by the application of the corresponding signal thereto for thereupon preventing the rendering conductive of the other discharge device irrespective of the application thereto of its corresponding signal, and means associated with each discharge device for indicating the conduction or non-conduction thereof.

3. An electric system for determining whether or not first and second voltage-pulse signals occur within a predetermined time interval of duration greater than the duration of either voltage-pulse signal having, in combination, first and second normally non-conductive discharge devices, means for receiving the first and second voltage-pulse signals and applying the same to the respective first and second discharge devices when received, the voltage-pulse signals being of such a nature as normally to render the discharge devices conductive, and a time-delay device connected between the discharge devices and operable at a time corresponding to the said predetermined time interval after the moment of the rendering conductive of either discharge device by the application of the corresponding voltage-pulse signal thereto for thereupon preventing the rendering conductive of the other discharge device irrespective of the application thereto of its corresponding voltage-pulse signal.

4. An electric system for determining whether or not first and second signals occur within a predetermined time interval of duration greater than the duration of either signal having, in combination, first and second normally non-conductive discharge devices each having an anode, a cathode and a control electrode, means for receiving the first and second signals and applying the same between the control electrodes and cathodes of the respective discharge devices when received, the signals being of proper polarity and magnitude normally to render the discharge devices conductive, and a time-delay device connected between the cathodes and operable at a time corresponding to the said predetermined time interval after the moment of the rendering conductive of either discharge device by the application of the corresponding signal thereto for thereupon transferring the voltage appearing at the cathode of the rendered-conductive discharge device to the cathode of the other discharge device to bias the same with respect to the control electrode of the other discharge device in order thereafter to prevent the rendering conductive of the other discharge device irrespective of the application thereto of its corresponding signal.

5. An electric system for determining whether or not first and second signals occur within a predetermined time interval of duration greater

than the duration of either signal having, in combination, first and second normally non-conductive discharge devices each having an anode, a cathode and a control electrode, means for receiving the first and second signals and applying the same between the control electrodes and cathodes of the respective discharge devices when received, the signals being of proper polarity and magnitude normally to render the discharge devices conductive, a time-delay device connected between the cathodes and operable at a time corresponding to the said predetermined time interval after the moment of the rendering conductive of either discharge device by the application of the corresponding signal thereto for thereupon transferring the voltage appearing at the cathode of the rendered-conductive discharge device to the cathode of the other discharge device to bias the same with respect to the control electrode of the other discharge device in order thereafter to prevent the rendering conductive of the other discharge device irrespective of the application thereto of its corresponding signal, and means connected to the anode of each discharge device for indicating the conduction or non-conduction thereof.

6. An electric system for determining whether or not first and second signals occur within a predetermined time interval of duration greater than the duration of either signal having, in combination, first and second normally non-conductive gaseous discharge devices each having an anode, a cathode and a control electrode, means for receiving the first and second signals and applying the same between the control electrodes and cathodes of the respective gaseous discharge devices when received, the signals being of proper polarity and magnitude normally to render the gaseous discharge devices conductive, a time-delay device connected between the cathodes and operable at a time corresponding to the said predetermined time interval after the moment of the rendering conductive of either gaseous discharge device by the application of the corresponding signal thereto for thereupon transferring the voltage appearing at the cathode of the rendered-conductive gaseous discharge device to the cathode of the other gaseous discharge device to bias the same with respect to the control electrode of the other gaseous discharge device in order thereafter to prevent the rendering conductive of the other gaseous discharge device irrespective of the application thereto of its corresponding signal, and means connected to the anode of each gaseous discharge device for indicating the conduction or non-conduction thereof.

7. An electric system for determining whether or not first and second signals occur within a predetermined time interval of duration greater than the duration of either signal having, in combination, first and second normally non-conductive gaseous-discharge devices each having an anode, a cathode and a control electrode, a cathode load connected to each cathode, electrical connections to the anode and cathode through the cathode load of each gaseous-discharge device for applying anode-to-cathode voltage, means for receiving the first and second signals and applying the same between the control electrodes and cathodes through the cathode loads of the respective discharge devices when received, the signals being of proper polarity and magnitude normally to render the discharge devices conductive, a time-delay device connected between the cathodes and operable at a time corresponding to the said predetermined time interval after the moment of the rendering conductive of either gaseous-discharge device by the application of the corresponding signal thereto for thereupon transferring the voltage appearing across the cathode load of the rendered-conductive gaseous-discharge device to across the cathode load of the other gaseous-discharge device to bias the cathode of the other discharge device with respect to the corresponding control electrode in order thereafter to prevent the rendering conductive of the other gaseous-discharge device irrespective of the application thereto of its corresponding signal, and a lamp connected in the said electrical connections to the anode of each gaseous-discharge device for indicating the conduction or non-conduction thereof.

8. An electric system for determining whether or not first and second signals occur within a predetermined time interval of duration greater than the duration of either signal having, in combination, first and second normally non-conductive gaseous-discharge devices each having an anode, a cathode and a control electrode, a cathode load connected to each cathode, electrical connections to the anode and cathode through the cathode load of each gaseous-discharge device for applying anode-to-cathode voltage, means for receiving the first and second signals and applying the same between the control electrodes and cathodes through the cathode loads of the respective discharge devices when received, the signals being of proper polarity and magnitude normally to render the discharge devices conductive, a time-delay device comprising a time-constant-controlled electric network connected between the cathodes of the gaseous-discharge devices and having a time constant corresponding to the said predetermined time interval operable at a time corresponding to the said predetermined time interval after the moment of the rendering conductive of either gaseous-discharge device by the application of the corresponding signal thereto for thereupon transferring the voltage appearing across the cathode load of the rendered-conductive gaseous-discharge device to across the cathode load of the other gaseous-discharge device to bias the cathode of the other discharge device with respect to the corresponding control electrode in order thereafter to prevent the rendering conductive of the other gaseous-discharge device irrespective of the application thereto of its corresponding signal, and a lamp connected in the said electrical connections to the anode of each gaseous-discharge device for indicating the conduction or non-conduction thereof.

9. An electric system for determining whether or not first and second signals occur within a predetermined time interval of duration greater than the duration of either signal having, in combination, first and second normally non-conductive gaseous-discharge devices each having an anode, a cathode and a control electrode, a cathode load connected to each cathode, electrical connections to the anode and cathode through the cathode load of each gaseous-discharge device for applying anode-to-cathode voltage, means for receiving the first and second signals and applying the same between the control electrodes and cathodes through the cathode loads of the respective discharge devices when received, the signals being of proper polarity and magnitude normally to render the discharge

devices conductive, a time-delay device comprising a section of coaxial transmission line connected at its ends across the cathode loads and of length sufficient to delay the transmission of voltages from one end to the other by a time interval corresponding to the said predetermined time interval operable at a time corresponding to the said predetermined time interval after the moment of the rendering conductive of either gaseous-discharge device by the application of the corresponding signal thereto for thereupon transferring the voltage appearing across the cathode load of the rendered-conductive gaseous-discharge device to across the cathode load of the other gaseous-discharge device to bias the cathode of the other discharge device with respect to the corresponding control electrode in order thereafter to prevent the rendering conductive of the other gaseous-discharge device irrespective of the application thereto of its corresponding signal, and a lamp connected in the said electrical connections to the anode of each gaseous-discharge device for indicating the conduction or non-conduction thereof.

10. An electric system for determining whether or not first and second voltage-pulse signals occur within a predetermined time interval of duration greater than the duration of either voltage-pulse signal having, in combination, first and second normally non-conductive gaseous-discharge devices each having an anode, a cathode and a control electrode, a cathode load connected to each cathode, electrical connections to the anode and cathode through the cathode load of each gaseous-discharge device for applying

anode-to-cathode voltage, means for receiving the first and second voltage-pulse signals and applying the same between the control electrodes and cathodes through the cathode loads of the respective discharge devices when received, the voltage-pulse signals being of proper polarity and magnitude normally to render the discharge devices conductive, a time-delay device connected between the cathodes and operable at a time corresponding to the said predetermined time interval after the moment of the rendering conductive of either gaseous-discharge device by the application of the corresponding voltage-pulse signal thereto for thereupon transferring the voltage appearing across the cathode load of the rendered-conductive gaseous-discharge device to across the cathode load of the other gaseous-discharge device to bias the cathode of the other discharge device with respect to the corresponding control electrode in order thereafter to prevent the rendering conductive of the other gaseous-discharge device irrespective of the application thereto of its corresponding voltage-pulse signal, and a lamp connected in the said electrical connections to the anode of each gaseous-discharge device for indicating the conduction or non-conduction thereof.

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