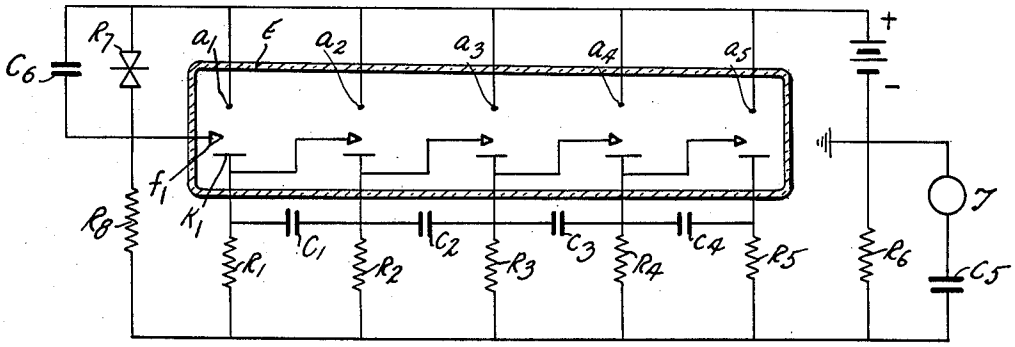
Jan. 10, 1956 W. SIX 2,730,658

CIRCUIT FOR COUNTING PULSES

Filed Aug. 16, 1952

FIG. 2.



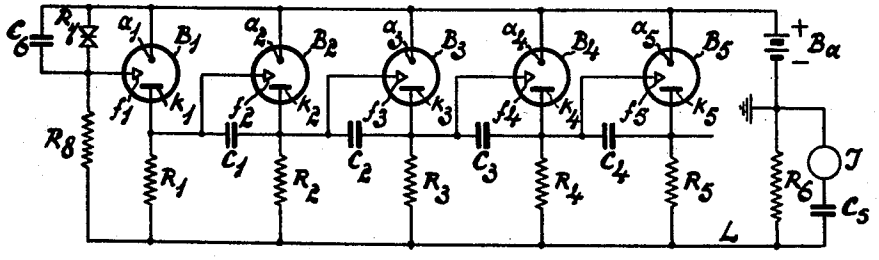


FIG. 1.

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CIRCUIT FOR COUNTING PULSES

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5 Claims. (Cl. 315—164)

This invention relates to circuits for counting pulses and more particularly to a pulse counting circuit comprising a plurality of gaseous discharge paths excited in succession by pulses, each path comprising a first and a second main electrode and an ignition electrode.

In circuits of this kind heretofore known, the anodes of the discharge paths are connected to a positive terminal of a source of supply, each cathode being connected by way of a resistor to a negative terminal of the source of supply. Furthermore, the cathodes are connected galvanically to the ignition electrode of a subsequent discharge path and connected capacitively to the cathode of this subsequent path. In such circuits the pulses to be counted are supplied by way of a condenser to the ignition electrode. Since an ignited gaseous discharge path constitutes a comparatively low resistance, the ignition electrodes must be connected by way of a resistor to the cathode of the preceding discharge path, in order to permit sufficient variation in the voltage of the ignition electrodes.

The object of the invention is to provide a pulse counting circuit in which the number of capacitive and resistive coupling elements may be about half of that in known circuits of the above-described type.

The circuit according to the invention has the characteristic that the source of pulses is connected in series with the source of supply.

The ignition electrodes may be connected directly to a main electrode of the preceding path, which is particularly advantageous if the discharge path is housed in a common envelope, since the said connection may be established at the interior thereof and specific supply wires to the ignition electrodes are not required.

In order that the invention may be more clearly understood, it will now be described more fully with reference to the accompanying drawing, in which Fig. 1 shows schematically one preferred embodiment of the invention, and Fig. 2 illustrates a modification of the embodiment shown in Fig. 1.

The anodes a_1 to a_5 of a series of gaseous discharge tubes B_1–B_5 are connected to the positive terminal of a battery B_a, the negative terminal of which is grounded. The battery voltage in this example is 140 volts. The cathodes k_1 to k_5 are connected by way of resistors R_1 to R_5 to a common conductor L, which is connected by way of a resistor R_6 to the negative terminal of battery B_a. The cathodes of successive tubes are interconnected by way of condensers C_1 to C_4. Furthermore, the cathodes are connected to ignition electrodes f_2 to f_5 of the succeeding tube. A voltage of 60 volts is supplied to the ignition electrode f_1 of the first tube B_1 by way of a voltage divider R_7—R_8.

The resistor R_7 is of the voltage-dependent type, such that its value varies in the opposite sense to the voltage applied. Such resistors may be manufactured, for example, from silicon carbide. The excitation voltage between the anode and the cathode of the tubes is about

160 volts and is higher than the battery voltage increased by the amplitude of the pulses to be counted. The pulses to be counted which are generated by the source of pulses 1, are supplied with negative polarity and an amplitude of 20 volts by way of a condenser C_5 to the conductor L and then transmitted by way of the resistors R_1 to R_5 to the cathodes of the tubes.

In the rest position of the circuit, the ignition electrodes f_2 to f_5 of the tubes B_2 to B_5 and the cathodes k_1 to k_5 of all tubes are at ground potential. With the first pulse, the potential of the conductor L and hence that of the cathodes and of the ignition electrodes f_2 to f_5 is decreased to −20 volts. The voltage of the ignition electrode f_1 of tube B_1 varies only slightly, this electrode being connected by way of a condenser C_6 to a point of constant potential.

The voltage between the ignition electrode f_1 and the cathode k_1 of tube B_1 then increases to 80 volts. The ignition voltage between the ignition electrode and the cathode of the tubes is 70 volts. Consequently, the tube B_1 is ignited by the first pulse.

Owing to the current now flowing through the resistors R_1 and R_6, the voltage of the cathode k_1 and of the conductor L increases to 80 volts respectively. A voltage of 60 volts is thus set up between the ignition electrode f_2 and the cathode k_2 of the tube B_2, which voltage is somewhat lower than the ignition voltage, whereas the corresponding voltage of the tubes B_3 to B_5 remains zero. As a result of the action of resistor R_7, the voltage of the ignition electrode f_1 of tube B_1 invariably has a potential of about 60 volts.

With the second pulse the voltage of conductor L and that of the cathodes of the tubes B_2 to B_5 is decreased to ground potential. The voltage of the ignition electrodes f_3 to f_5 follows that of the cathodes of the preceding tubes. The pulse is introduced in series with the main discharge path of tube B_1 and occurs between the anode a_1 and conductor L, so that the current traversing tube B_1 and resistor R_1 increases. However, the voltage between the anode a_1 and the cathode k_1 remains equal to the operating voltage, so that a voltage variation of 20 volts occurs at resistor R_1 and, consequently, the voltage between the ignition electrode f_2 and the cathode k_2 of tube B_2 becomes 80 volts. With the second pulse, tube B_2 will thus ignite. In this case the voltage of the cathode k_2 of this tube increases to 80 volts, a strong positive pulse being transmitted by way of condenser C_1 to the cathode k_1 of tube B_1, due to which tube B_1 extinguishes.

With the third pulse, the voltage of conductor L is again decreased to ground potential, causing ignition of tube B_3, of which the voltage of the ignition electrode f_3 is now 80 volts. Tube B_1 cannot ignite again, since with the third pulse the voltage between the ignition electrode f_1 and the cathode k_1 increases to only 60 volts. Due to the ignition of tube B_3, a strong positive pulse is transmitted by way of condenser C_2 to the cathode k_2 of tube B_2, so that the latter extinguishes. At the same time, the voltage of the ignition electrode f_4 of tube B_4 is increased to 80 volts, so that this tube comes into a preferred position for excitation by a subsequent pulse.

As previously pointed out, the ignition electrodes may be connected directly to a main electrode of the preceding path, which construction is particularly advantageous if the discharge paths are housed in a common envelope. Such a construction is shown in Fig. 2, wherein the discharge systems shown as individual tubes in Fig. 1, are contained within a single envelope in Fig. 2.

The circuit may be modified in different ways within the scope of the invention. Thus, the source of pulses may be connected to the other side of the battery B_a.

In the embodiment shown, the ignition electrodes are in the form of auxiliary anodes. However, as an alternative, the ignition electrodes may be auxiliary cathodes in which event the cathodes and the anodes and also the connections to the battery are required to be interchanged.

What I claim is:

1. Apparatus for counting pulses derived from a pulse source, comprising a series of gaseous discharge paths each provided with first and second main electrodes and an ignition electrode, and a circuit for igniting said paths in succession by said pulses, said circuit including a voltage supply having one terminal thereof connected to the first main electrode of each path, a series of resistors each connecting a respective second main electrode to the other terminal of said supply, means galvanically connecting each second main electrode to the ignition electrode of the succeeding path in the series, means capacitively connecting each second main electrode to the second main electrode of the succeeding path in the series, and means for interposing said pulse source in series with said voltage supply.

2. Apparatus, as set forth in claim 1, wherein said discharge paths are enclosed in a common envelope and wherein said galvanic connections between said ignition electrodes and said second main electrodes is within the interior of said envelope.

3. Apparatus for counting pulses produced by a pulse source, comprising a series of gaseous discharge paths each provided with cathode, anode and ignition electrodes, and a circuit for igniting said paths in succession in response

to said pulses, said circuit including a direct voltage supply having its positive terminal connected to the anode of each path, a series of resistors each connecting a respective cathode of said paths to the negative terminal of said supply, the cathode of each path in said series being directly connected to the ignition electrode of the succeeding path, a series of capacitors each connecting the cathode of a path to the cathode of a succeeding path in the series, and means interposing said pulse source in series with said voltage supply.

4. Apparatus, as set forth in claim 3, further including a voltage divider connected across the series connected supply and pulse source, said voltage divider being constituted by a fixed resistance in series with a voltage responsive resistance, the junction of said resistances being connected to the ignition electrode of the first path in said series.

5. Apparatus, as set forth in claim 4, further including a capacitance connected across said voltage responsive resistance, said voltage responsive resistance having a characteristic at which its value varies inversely as the applied voltage.

References Cited in the file of this patent

UNITED STATES PATENTS

2,373,134	Massonneau	Apr. 10, 1945
2,408,085	Meacham et al.	Sept. 24, 1946
2,454,782	De Rosa	Nov. 30, 1948
2,560,691	Hagen	July 17, 1951