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GAS-FILLED DISCHARGE TUBE CIRCUITS

Filed Feb. 8, 1951

FIG. 1.

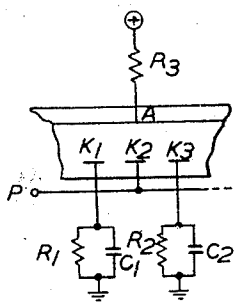


FIG. 2.

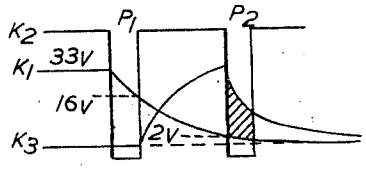


FIG. 3.

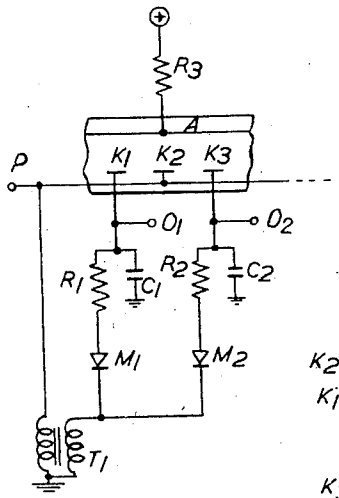
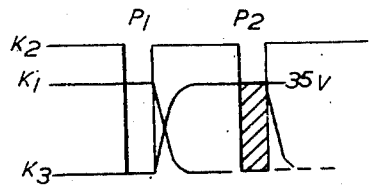


FIG. 4.



Inventors
DESMOND S. RIDLER
DONALD A. WEIR

By Percy P. Lantzy
Attorney

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GAS-FILLED DISCHARGE TUBE CIRCUITS

Desmond Sydney Ridler and Donald Adams Weir, London, England, assignors to International Standard Electric Corporation, New York, N. Y., a corporation of Delaware

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6 Claims. (Cl. 315—169)

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This invention relates to gas-filled multi-gap sequence discharge tube circuits.

In such tube circuits difficulty has been experienced in obtaining high speeds of operation. The object of the present invention is to overcome this difficulty.

The invention provides an electrical circuit comprising a gas-filled discharge tube having an array of anode/cathode gaps, means for applying pulses to said tube so that a single discharge is caused to travel in succession along said gaps and means for maintaining substantially constant the cathode potential of a discharging gap until the next gap in said array commences to conduct.

According to the invention there is also provided an electrical circuit comprising a gas-filled tube having a pair of discharge gaps, and means for applying pulses simultaneously to the circuits of said pair of gaps in such a way that a discharge at the first gap is transferred to the second of said pair and that the potential difference across said first gap is maintained substantially constant from the establishment of the discharge across said second gap to the cessation of the pulse application.

The invention further provides an electrical circuit comprising a gas-filled discharge tube having an array of main anode/cathode gaps and transfer gaps intermediate between adjacent pairs of main gaps, comprising a pulse supply, means for applying pulses across the transfer gaps so that a single discharge is caused to travel in sucession along the main gaps and means for maintaining the potential difference across a main gap substantially constant during the pulse application which effects the firing of the next main gap in succession.

The invention will now be described by reference to one embodiment thereof shown in the accompanying drawings in which:

Fig. 1 shows part of a multi-gap gas discharge tube circuit which has been previously described;

Fig. 2 shows waveforms obtained at different points in the tube circuit of Fig. 1 as pulses are applied to the tube;

Fig. 3 is a diagram of a tube circuit according to an embodiment of the invention; and

Fig. 4 shows the waveforms for the Fig. 3 circuit.

In Fig. 1 there is shown part of a gas-filled multi-gap discharge tube in which there is an anode A, cathodes K_1 and K_3 and a transfer electrode K_2. Each cathode is connected to ground over resistance-capacitance networks R_1/C_1, R_2/C_2 respectively. The transfer electrode K_2 is commoned with other similar electrodes, not shown, and connected to an inlet P to which negative-going pulses are applied. The anode A is connected to the positive high voltage supply over the anode resistance R_3. Such tubes and their operation in such circuits have been previously described. The operation will be briefly outlined with reference to the waveforms shown in Fig. 2.

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Consider the tube initially with a discharge occurring across the A/K_1 gap.

Counting pulse P_1 is applied to the transfer cathode K_2 causing the gap A/K_2 to break down and consequently to increase the voltage drop across anode load resistance R_3, which acts to reduce the voltage across gap A/K_1 below the required maintenance value thereby extinguishing said last named gap. Condenser C_1 starts to discharge through R_1. If the counting rate is high, say, 10 kc./s. with a pulse width of 25 microseconds and R_1 and C_1 have such typical values as 12,000 ohms and .003 microfarad, then the potential on K_1 will have decayed to 50% of its original value on the trailing edge of the pulse and to 6% on the leading edge of the next pulse. When the pulse P_1 disappears, the potential on K_2 rises immediately, the discharge across A/K_2 is extinguished and the discharge passes to the A/K_3 gap due to the ionisation coupling of each gap with the other, and the potential of K_3 thereafter rising as condenser C_2 is charged up. However the potential of K_3 only reaches 95% of its maximum value. The effect of this short time constant resistance-capacity network required for high speeds is therefore

(*a*) to increase the possibility of a retreat of the discharge from K_2 to K_1 due to the reduction in the charge on C_1, which results in meagre tolerances.

(*b*) to reduce the available output voltage by about half, since the output is normally taken while the counting pulse is on. This disadvantage is indicated by the shaded portion of Fig. 2.

For these reasons operation at frequencies above 10 kc./s. has not proved to be entirely satisfactory.

In the new circuit arrangement incorporating this invention, the decay of potential of a cathode does not take place until the pulse is removed. This results in a large reduction of the time constant of the cathode resistance capacity network and use of the same tube is possible at much higher speeds.

Fig. 3 shows the improved circuit. Transformer T_1 inverts the counting pulse and causes

rectifiers M_1 and M_2 to be blocked until the inverted pulse decays in transformer T_1 so that no discharge of condenser C_1 may take place during the pulse application and the full potential difference between K_1 and K_3 can be used for the output (see Fig. 4) the output being taken over terminals such as O_1 and O_2. Output arrangements may be provided for one or more cathodes. The previously conducting cathode, say K_1, is, as before, held at an elevated potential during the pulse. This provides sufficient extinguishing time for the A/K_1 gap. Thus the time constant circuit R_1 C_1 can be very short and have a minimum value which is determined by the time taken to establish the discharge on K_3 after withdrawal of the pulse. It will be seen from Fig. 4 that P_1 and P_2 can be moved much closer together before interference takes place between the rise and decay waveforms.

It should be noted that the output from T_1 can be replaced by a suitable positive-going pulse supply in-phase with the pulses applied to the point P, if this be more convenient.

While the principles of the invention have been described above in connection with specific embodiments and particular modifications thereof, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of the invention.

What we claim is:

1. An electrical circuit comprising a gas-filled discharge tube having electrode means defining a pair of main gaps and a transfer gap intermediate said main gaps, a source of pulses, means for applying pulses from said source across said transfer gap, a separate storage circuit having a predetermined time constant associated with each of said main gaps to store potential passed through said gaps, means disposed between said source and said storage circuits and under control of pulses from said source for delaying the discharge of the potential stored in said storage circuits, whereby the stored potential is maintained within said storage circuits independent of the time constants thereof, until the next main gap in said array commences to conduct.

2. An electrical circuit as claimed in claim 1, wherein said delaying means comprises a pair of uni-directional devices, each serially connected between one of said storage circuits and said pulse source and poled so as to be blocked from conducting the potential in said storage circuits by the application of a pulse from said source, thereby causing maintenance of said stored potential in said storage circuits.

3. An electrical circuit as claimed in claim 1, wherein said discharge delaying means comprises a two-terminal rectifier element, means for developing pulses of identical phase but of opposite polarity of the pulses from said source, said element having one terminal coupled to said storage circuit and having another terminal coupled to said last-mentioned means, said rectifier element adapted to remain blocked during the period of application of pulses to said gap.

4. An elecrical circuit as claimed in claim 1, further comprising means for deriving an output from at least one of said main gaps from which a substantially constant amplitude pulse output is obtained during said pulse application which effects the firing of the next main gap in succession.

5. An electrical circuit comprising a gas-filled discharge tube having electrode means defining an array of main gaps and transfer gaps, each of said transfer gaps intermediate different pairs of said main gaps, a source of pulses, means for applying pulses from said source across said transfer gaps so that a single discharge is caused to travel in succession along said main gaps, a plurality of separate storage circuits, each having a predetermined time constant and each serially connected with a different one of said main gaps and adapted to store potential passed through said gaps, a plurality of two-terminal rectifier elements, each serially connected between said pulse source and a different one of said storage circuits and poled so as to remain blocked during the period of application of pulses to the gap with which each of said storage circuits and connected rectifier elements are associated.

6. An electrical circuit as claimed in claim 3, wherein said means for developing pulses of identical phase but of opposite polarity comprises a transformer serially coupled between said source and said element, said transformer adapted to invert pulses received from said source.

DESMOND SYDNEY RIDLER.
DONALD ADAMS WEIR.

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