

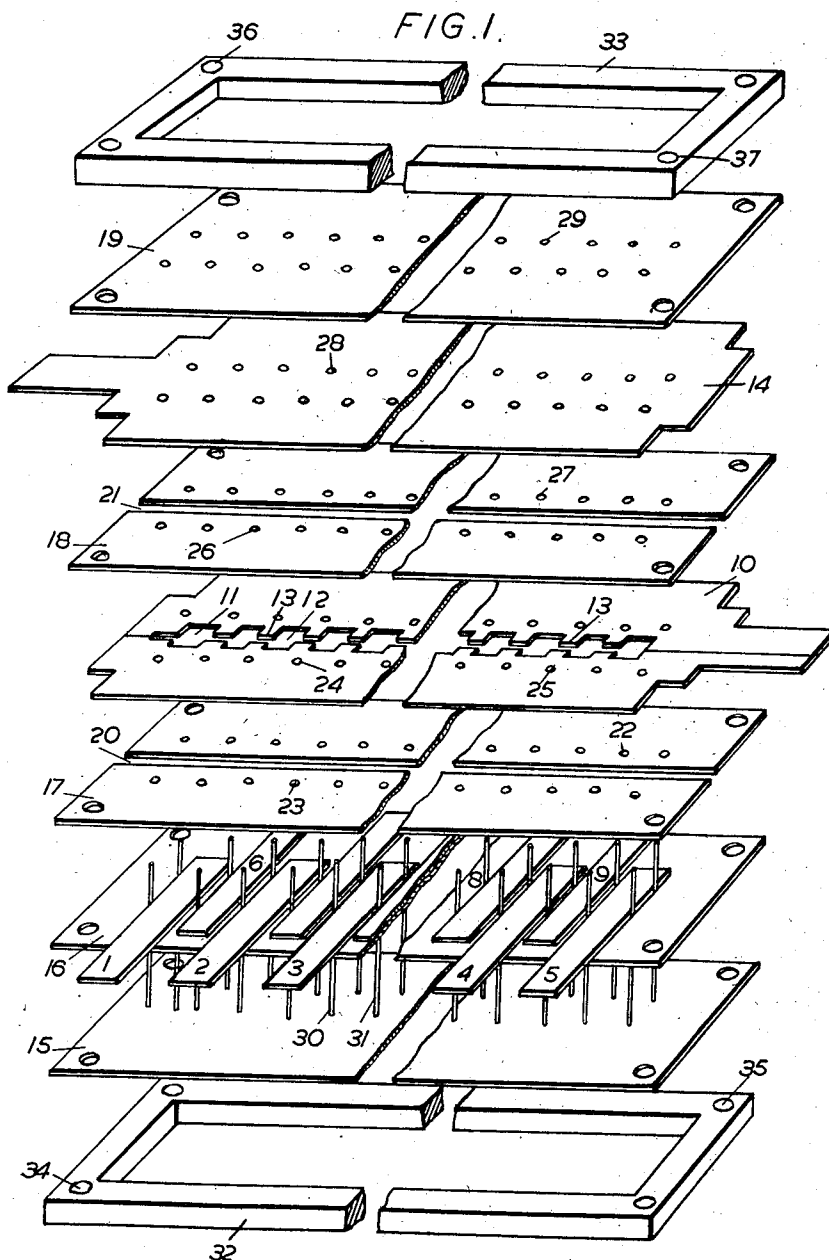
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E. TOURATON ET AL
ELECTRONIC DISCHARGE TUBE

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3 Sheets-Sheet 1



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FIG. 2.

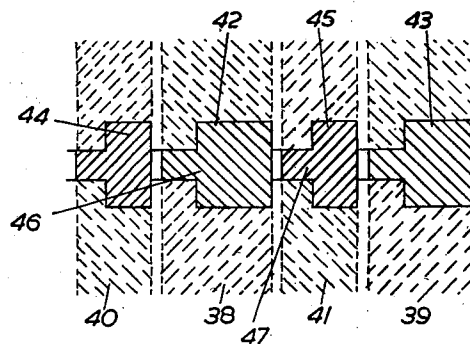
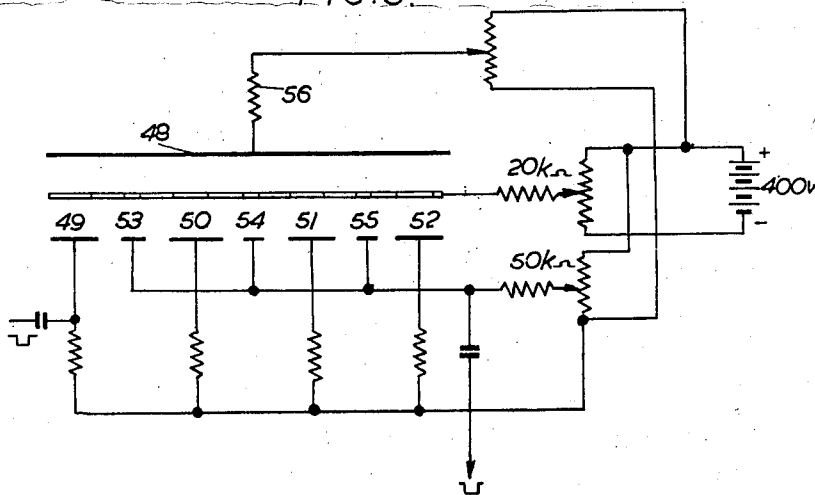


FIG. 3.



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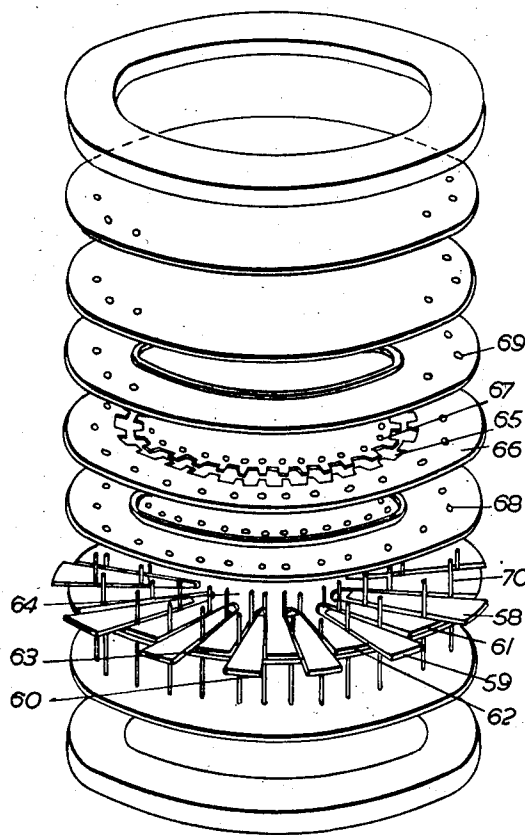
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FIG. 4.



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ELECTRONIC DISCHARGE TUBE

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The present invention relates to multi-electrode gas tubes such as those used for counting the electrical impulses, for example in automatic telephone systems or in electronic mathematical machine circuits.

In counting electrical impulse systems, there is generally used to perform the counting, the marking and the registering of the received impulses, a circuit comprising a plurality of vacuum tubes or gas tubes interconnected so that the arrival of an impulse causes the passing of the whole circuit from one stable state to another, each stable state being generally characterised by the firing of a certain number of tubes.

Multi electrode gas tubes are also utilised in which a discharge can fire and sustain itself between a common electrode, for example one anode, and an electrode of a plurality of identical electrodes such as cathodes, the said gas tube being associated with a circuit established so that each impulse transmitted with the circuit associated to the gas tube causes the transfer of the electrical discharge from one of the cathodes to another. In such tubes, the order in which the discharge passes from one cathode to another is characterized on the one hand, by the arrangement of the said cathodes and of the control electrodes of the tube, and on the other hand, by the circuits associated with the said gas tube.

The multi electrode gas tubes known in the art usually necessitate the use between the said gas tube and the impulse source, of a divider circuit which directs the impulse either towards one series of electrodes, or towards another series of electrodes, for example, according to whether the impulses are odd or even.

The present invention has for object a multi electrode gas tube in which the impulses, of suitable shape and amplitude, are applied to a group of identical electrodes which insures the transfer of the discharge from one electrode to another in a predetermined direction so as to simplify the circuit associated with the said tube.

According to one of the features of the invention a multi-electrode gas tube comprises in combination a plurality of identical cathodes, for example of a rectangular shape, arranged one after the other, a plurality of transfer electrodes, for example of a rectangular shape, each transfer electrode being located between two of the said cathodes, a common anode oppositely arranged to said cathodes and said transfer electrodes, an electrode or shielding plate in which have been provided rectangular apertures opposite to said cathodes and said transfer electrodes, the said

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apertures being joined by a slot, the distance between the said electrodes being established so that, when a sufficient positive voltage is applied between the said anode and the said cathode, a discharge establishes itself between the said anode and one of the cathodes; and so that, when a negative voltage is applied simultaneously to all the transfer electrodes the said electronic discharge is transferred to one of the cathodes adjacent to the said cathode from which the discharge has already started to fire, the direction in which the discharge is transferred being determined by the shape of the apertures which are provided in the said shielding plate.

According to another feature of the invention in such gas tubes, the electrodes are regularly arranged along a circle, the number of the cathodes being equal to the number of transfer electrodes so that the counting may be easily carried out in a constant manner.

According to another feature of the invention in such gas tubes the apertures made in the shielding plate are of a rectangular shape, the width of the said aperture being smaller than the width of the corresponding electrode, the said shielding plate being arranged with regard to the cathodes and transfer electrodes so that one of the sides of the said apertures is perpendicular to one of the sides, for example the right hand side of the corresponding electrode, all the said apertures provided in the shielding plate being joined to one another by a perpendicular slot to the said cathodes and the said transfer electrodes.

Other objects, features and advantages of the present invention will appear from reading the present description of an embodiment illustrated in the annexed drawings;

Figure 1 represents the different parts and electrodes constituting a gas tube incorporating features of the invention;

Figure 2 represents a part of the shielding plate electrode;

Figure 3 represents the operating circuit of the gas tube represented on Figure 1;

Figure 4 represents an alternative of the tube represented on Figure 1;

On Figure 1, there are shown in perspective a series of identical cathodes 1, 2, 3, 4 and 5 made of rectangular metallic plates for example nickel. These cathodes are arranged at regular intervals one behind the other. Between each two consecutive cathodes are arranged rectangular metallic electrodes, called transfer electrodes, such as 6, 7, 8 and 9. 10 is a metallic electrode

called a shielding plate; it is provided with apertures such as 11 and 12 communicating with one another by a slot 13. Anode 14 is constituted by a metallic plate. Mica plates such as 15, 16, 17, 18 and 19 are used to maintain the spacings between the different electrodes. Mica plates 17 and 18 are provided with a slot such as 20 or 21, opposite to slot 13 provided in the shielding plate. The mica plates, the shielding plate and the anode are provided with holes such as 22, 23, 24, 25, 26, 27, 28 and 29. Glass rods such as 30 and 31 fit in those holes and hold in position the different electrodes and the different mica plates. The assembly constituted of the various electrodes and the mica plates is held rigidly as a unit by means of end frames 32 and 33 which are joined together, for example by means of bolts or rivets, passing through the holes such as 34, 35, 36, 37.

On Figure 2, the shape of the apertures provided in the shielding plate has been represented. 38 and 39 represent two cathodes, 40 and 41 two transfer electrodes; apertures 42 and 43 provided in the shielding plate correspond respectively to cathodes 38 and 39 whilst apertures 44 and 45 correspond respectively to transfer electrodes 40 and 41. The aperture corresponding to a cathode, is larger than the aperture corresponding to the transfer electrode and each aperture is not symmetrically arranged with regard to the corresponding electrode. In the example represented on Figure 2, the aperture corresponding to an electrode is in registry with the right-hand portion of that electrode whereas the left-hand portion of the electrode is in registry with a slot such as 46 or 47.

The schematic of the circuits associated with the tube shown on Figure 1 is represented on Figure 3.

For simplification, a tube has been represented in Fig. 3 which only comprises four cathodes 48, 50, 51 and 52 and three transfer electrodes 53, 54 and 55. The potential difference between anode 48 and cathodes 49, 50, 51 and 52 is greater than the striking voltage corresponding to the anode-cathode gap. The transfer electrodes such as 53, 54 and 55 are maintained at a positive potential with regard to the cathodes. When the voltages are applied to the different electrodes of the tube a discharge is struck and is maintained between one of the cathodes and the anode. Since all the cathodes are identical, as well in shape as in position with respect to the anode, the discharge strikes at random between any one of the cathodes and the anode. The current passing between this cathode and the anode causes a voltage drop through resistance 56 and the anode potential lowers itself so that the difference in potential between the anode and any one of the cathodes becomes lower than the striking voltage.

The discharge between the cathode and the anode passes through an aperture such as 42 (Fig. 2) provided in shielding plate 10 (Fig. 1) and when the current passing through the tube and the dimensions of the different electrodes are suitably chosen, the glow is localised in the rectangular aperture of the shielding plate provided opposite to cathode 38 (Fig. 2). As shown in Figure 2, aperture 42 corresponding to cathode 38 is much nearer aperture 45 corresponding to transfer electrode 41 than it is to aperture 44 corresponding to transfer electrode 40. If a negative impulse of a sufficient amplitude is simultaneously applied to all transfer electrodes so that on the one hand, the difference in poten-

tial between the anode and any one of the transfer electrodes is higher than the striking voltage for the space between anode and transfer electrode and, on the other hand, the potential of the transfer electrode is lower than the potential of cathode 38, a discharge strikes between the transfer electrode 41 and the anode. The striking is set up and is determined by the glow existing between cathode 38 and the anode by the slot 47 provided in the shielding plate. The dimensioning of the electrodes and the value of the resistance 56 (Figure 3) being provided in such a way that no discharge may exist simultaneously between the anode and cathode, on the one hand, and between the anode and a transfer electrode, and on the other hand, the discharge ceases between cathode 38 and the anode. During the whole duration of the negative impulse the glow discharge is maintained between the transfer electrode 41 and the anode.

When the negative impulse applied to transfer electrodes ceases, the potential difference between the transfer electrode 41 and the anode becomes lower than the maintaining potential, the discharge ceases and the potential of the anode reaches again the high voltage potential. The voltage between the cathodes and the anode becomes then greater than the striking potential because of the position of the apertures provided in the shielding plate, the glow is transferred from aperture 45 corresponding to transfer electrode 41, to aperture 43 corresponding to cathode 39 through the slot 50.

At each negative impulse transmitted to the transfer electrodes, the glow passes from one cathode to the next cathode in a direction determined by the position of the apertures provided in the shielding plate. On Figure 3, it may be seen that, in the example considered, if the first impulse has caused a discharge between cathode 48 and anode 48, this discharge is transferred to cathode 52 after the fourth negative impulse transmitted to the transfer electrodes so as to perform continuously the counting, the circuit must be reset to normal by applying a negative impulse to cathode 52 which in certain embodiments may present certain drawbacks.

Figure 4 represents another embodiment of a counting tube such as the one represented on Figures 1, 2 and 3. In the tube represented on Figure 1, the cathodes and the transfer electrodes, of a rectangular shape are arranged one behind the other. In the example represented on Figure 4 cathodes such as 58, 59 and 60, of a trapezoidal shape, are regularly arranged along a circle. The transfer electrodes are constituted by teeth such as 61, 62 and 63 provided along the circumference of a circle 64. The apertures such as 65 provided in the shielding plate 66 are of a trapezoidal shape; they are arranged along a circle opposite to the cathodes and the transfer electrodes. The electrodes are provided with holes such as 67, 68 and 69 in which fit the glass rods such as 70 so as to maintain the different electrodes in position. The operation of the tube is in all points identical to the operation of the tube represented on Figure 1, however as the cathodes are regularly arranged along a circle, if for example ten cathodes are provided, the meter will automatically be reset to zero after reception of the tenth impulse which enables to simplify the control circuits of the tube.

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 is claimed:

1. A gaseous discharge tube selectively responsive to the receipt of a series of successive impulses, comprising in combination, an enclosing envelope containing a filling of an ionizable gaseous medium, a plurality of discrete cathodes arranged in successive equally spaced array, an anode common to all said cathodes and equally spaced therefrom, a plurality of glow discharge transfer electrodes also arranged in successive array there being one such transfer electrode located between each pair of adjacent cathodes, a conductive shielding electrode located between said cathodes and said anode, said shielding electrode having a series of windows each aligned with a corresponding cathode to permit the passage of electrons between the corresponding cathode and said anode, each of said windows being constituted of two sections one of which is larger than the other and with the larger section registering with only a part of the area of the corresponding cathode the smaller section of each window being located closer to a preceding cathode than to a succeeding cathode to cause the glow discharge to be shifted in a predetermined direction to successive cathodes in response to successive impulses impressed on said transfer electrodes.

2. A gaseous discharge tube according to claim 1, in which all said cathodes are connected electrically to a common connection for applying a negative potential thereto, and all said transfer electrodes are electrically connected for applying negative impulses thereto.

3. A gaseous discharge tube according to

claim 1, in which the large section of each of said windows in the shielding electrode is in alignment with only a corresponding portion of the associated cathode, said larger window section being located closer to the next succeeding cathode than to the next preceding cathode.

4. A gaseous discharge tube selectively responsive to the receipt of a series of successive impulses such as impulses to be counted, comprising in combination, an enclosing envelope containing a filling of an ionizable gas, a series of successive spaced cathodes, an anode common to said cathodes and equally spaced therefrom, a series of successive glow discharge transfer electrodes each located symmetrically between a corresponding adjacent pair of cathodes, a conductive shielding electrode having a series of windows each in alignment with a respective cathode and a respective transfer electrode, each window having a large area section and a smaller area section, each large area section serving to maintain a discharge between the anode and the respective cathode or the respective transfer electrode, and the smaller window sections serving to control the movement of the discharge from one cathode to the next succeeding cathode in a fixed direction in response to successive impulses applied to said transfer electrodes.

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