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GLOW DISCHARGE TUBES AND CIRCUITS THEREFOR

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Fig.1

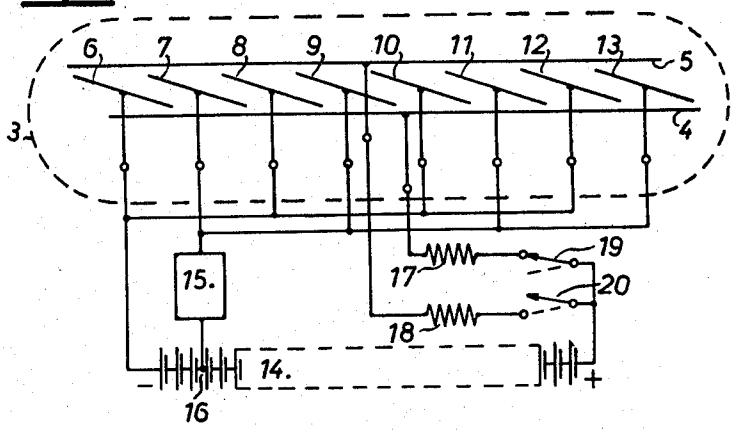
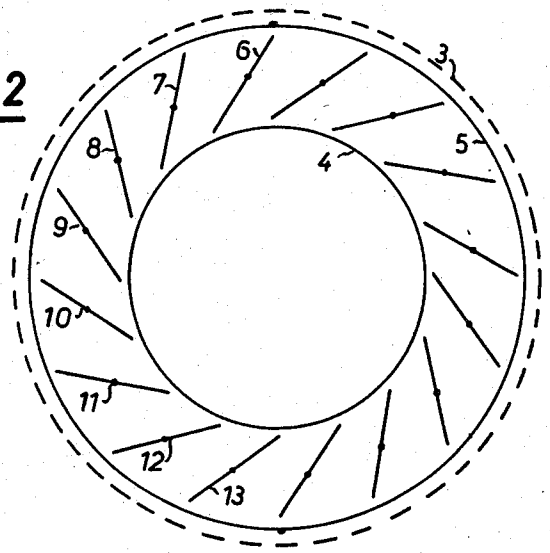


Fig.2



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GLOW DISCHARGE TUBES AND CIRCUITS THEREFOR

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This invention relates to glow discharge tubes and circuits therefor.

Objects of the invention are a glow discharge tube which has a number of cathodes arranged in a row and which is primarily used as a counting tube, the glow discharge jumping from one cathode to the next when electric voltage impulses are applied and withdrawn. The glow discharge tube according to the invention is characterized in that the aligned cathodes are arranged between two anodes in such a way that when one anode is energized the glow discharge jumps to a neighbouring cathode in one direction and, when the other anode is energized in the other direction. The two anodes are preferably parallel along the row of cold cathodes and each cold cathode is inclined between the anodes. The row of cold cathodes can be a closed circle, each of the anodes then also being annular or circular. The cathodes and anodes are preferably made of wire or sheet metal. Another object of the invention is an electronic impulse counter using a glow discharge tube of the kind outlined. One group of cathodes of the glow discharge tube is connected to the negative pole of a D.C. source and the anodes are selectively connectible to the positive pole thereof. The other group of the cathodes is connected through the source of the impulses to be counted to a tapping of the D.C. source, such that in the absence of an impulse the said other group of cathodes is positive with respect to the first mentioned group of cathodes but when an impulse arrives, the relative polarities of the two groups of cathodes are reversed.

These and other objects and the advantages of the invention will best be understood from the following description of specific embodiments when read in connection with the accompanying drawing in which:

Fig. 1 depicts a tube having a straight row of cold cathodes and shows the electric connections between a voltage source and an impulse generator as well as a switch arrangement for including one of the anodes at will, and

Fig. 2 is a plan view of a tube having two annular anodes and a plurality of cold cathodes arranged in a circle.

In the tube shown in Fig. 1, two parallel wire anodes **4** and **5** are located within a glass envelope **3**. A fairly large number of wire cathodes **6** to **13** are arranged between the anodes **4** and **5** and preferably lie in the plane of the anode wires **4** and **5** and inclined thereto. The row of cathodes **6** to **13** are divided into two groups, all even numbered cathodes being interconnected outside the tube and applied to the negative terminal of a D.C. source **14**. If it is desired to determine electrically at which of the even numbered cathodes the glow discharge is at any time occurring, each lead for the even numbered cathodes can incorporate an indicator such as a small ohmic resistance or the like. Such indicators are, however, omitted from Fig. 1 for the sake of clarity.

All the odd numbered cathodes are likewise connected

to each other and to one contact of an impulse source **15** the other contact of which is connected to a tap **16** of the D.C. source **14**. The impulse source **15** is to deliver electric voltage impulses which make the odd numbered cathodes temporarily negative with respect to the even numbered cathodes. Finally, each of the two anodes **4** and **5** is connected to the positive terminal of the D.C. source **14** through ohmic current-limiting resistances **17** and **18** respectively and switches **19** and **20** respectively. The anodes **4** and **5** as well as the cathodes **6** to **13** are preferably made of molybdenum wire and the gas filling for the glass envelope **3** can be a gaseous mixture at a pressure of about 50 millimetres of mercury column.

Assuming, for example, that a glow discharge occurs between the cathode **10** and the anode **4** so that the entire surface of the cathode **10** is covered with a glow light, the right-hand end of the adjacent cathode **9** then projects into the discharge space of the said glow discharge. The left-hand end of the other adjacent cathode **11**, on the other hand, is completely remote from the discharge space of the glow discharge taking place between the cathode **10** and the anode **4**. If, now, the impulse source **15** delivers a negative voltage pulse, then the odd numbered cathodes become more negative than the even numbered cathodes and the glow discharge accordingly jumps from the cathode **10** to the cathode **9** because the latter is already located in the discharge space. As soon as the voltage pulse has disappeared, the even numbered cathodes are again more negative than the odd numbered cathodes. For the reasons already mentioned, the glow discharge thereupon jumps from the cathode **9** to the cathode **8**. After a further voltage pulse from the impulse source **15**, the glow discharge jumps from the cathode **8** to the cathode **7** and then to the cathode **6** in the same way. Each of the negative voltage pulses delivered by the impulse source **15** causes the glow discharge to be displaced from an even numbered cathode to the next lower even numbered cathode i.e. in Fig. 1 the discharge is displaced in a direction from right to left.

If, on the other hand, the anode **4** is disconnected and the anode **5** is included, then the glow discharge which originally occurs on the cathode **10** is displaced via the cathode **11** to the cathode **12** as soon as the impulse source **15** delivers a negative voltage impulse. The direction of counting then takes place in a reverse manner i.e. from left to right in Fig. 1. Thus, the desired direction of counting can be chosen merely by including one of the two anodes **4** or **5**, so that, inter alia, additions or subtractions can be carried out very easily by means of the counting tube as described.

There may be any desired number of cold cathodes. For a decimal counting tube, twenty cold cathodes will be required which are connected in groups within or outside the glass envelope **3**, as shown in Fig. 1.

For continuous counting, the row of cold cathodes is arranged in a circle as usual and as illustrated in plan in Fig. 2. The two anodes **4** and **5** are made of wire or sheet metal bent into a circle and arranged concentrically. An even number of cold cathodes **6**, **7**, **8**, **9** . . . are arranged between the two circular anodes **4** and **5**, each of these cathodes consisting of wire or sheet metal which is inclined to the radial direction. For the sake of clarity, the electrode supports for the anodes and cathodes are only indicated diagrammatically but not shown in detail. If the anode **4** is switched into the circuit, then the direction of counting is clockwise. With the anode **5** included, the direction is anti-clockwise.

Instead of concentric circular anodes, coaxially arranged circular anodes could be used between which there are arranged in a circular row cathodes which are in-

clined to the circumferential direction. In this and similar modifications of the valve according to the invention, it is likewise possible by suitably shaping the electrode to ensure that counting takes place in one direction when one of the anodes is switched in and in the other direction when the other anode is switched in. These and other modifications which may occur to those familiar with the art fall within the spirit and scope of the invention as set forth in the following claims.

I claim:

1. A glow discharge tube comprising a gas filled envelope, a pair of parallel spaced linear anodes in said envelope, a plurality of equally-spaced cold cathodes intermediate and spaced from said pair of anodes and coplanar therewith, each of said cathodes consisting solely of a linear wire section, said cathodes extending between said anodes and being angularly arranged at equal angles of inclination to one of said anodes, said cathodes being spaced relative to each other to cause each cathode intermediate two other cathodes to extend at one end intermediate the space between one anode and the adjacent cathode on one side thereof and at the other end intermediate the space between the other anode and the adjacent cathode on the other side thereof, first circuit means connecting alternate cathodes together as one group, second circuit means connecting the remaining cathodes together as a second group, means for operatively energizing either one of said anodes, and means for applying impulses to one of said groups of cathodes whereby the glow discharge on a given cathode will jump to the adjacent cathode in one direction longitudinally of the anodes when one of said anodes is operatively energized and the glow discharge will jump to the adjacent cathode in the other direction longitudinally of the anodes when the other of said anodes is energized.

2. A glow discharge tube comprising a gas-filled envelope, a pair of spaced concentrically-arranged circular anodes in said envelope, a plurality of equally-spaced coplanar cold cathodes intermediate and spaced from said pair of anodes, said cathodes each consisting of a substantially straight element, said cathodes extending between said anodes and being obliquely arranged at equal angles of inclination relative to radii of the circular anodes, said cathodes being spaced relative to each other to cause each cathode intermediate two other cathodes to extend at one end intermediate the space between one

anode and the adjacent cathode on one side thereof and at the other end intermediate the space between the other anode and the adjacent cathode on the other side thereof, first circuit means connecting alternate cathodes together as one group, second circuit means connecting the remaining cathodes together as a second group, means for operatively energizing either one of said anodes, and means for applying impulses to one of said groups of cathodes whereby glow discharge on a given cathode will jump to the adjacent cathode in one direction longitudinally of the anodes when one of said anodes is operatively energized and the glow discharge will jump to the adjacent cathode in the other direction longitudinally of the anodes when the other of said anodes is energized.

3. A glow discharge tube comprising a gas-filled envelope, a pair of parallel spaced anodes in said envelope, a plurality of equally-spaced cold cathodes intermediate said pair of anodes, said cathodes each consisting solely of a substantially straight element, said cathodes extending between said anodes and being obliquely arranged at equal angles of inclination with respect to one of said anodes, said cathodes being spaced relative to each other to cause each cathode intermediate two other cathodes to extend at one end intermediate the space between one anode and the adjacent cathode on one side thereof and at the other end intermediate the space between the other anode and the adjacent cathode on the other side thereof, first circuit means connecting alternate cathodes together as one group, second circuit means connecting the remaining cathodes together as a second group, means for operatively energizing either one of said anodes, and means for applying impulses to one of said groups of cathodes whereby the glow discharge on a given cathode will jump to the adjacent cathode in one direction longitudinally of the anodes when one of said anodes is operatively energized and the glow discharge will jump to the adjacent cathode in the other direction longitudinally of the anodes when the other of said anodes is energized.

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