

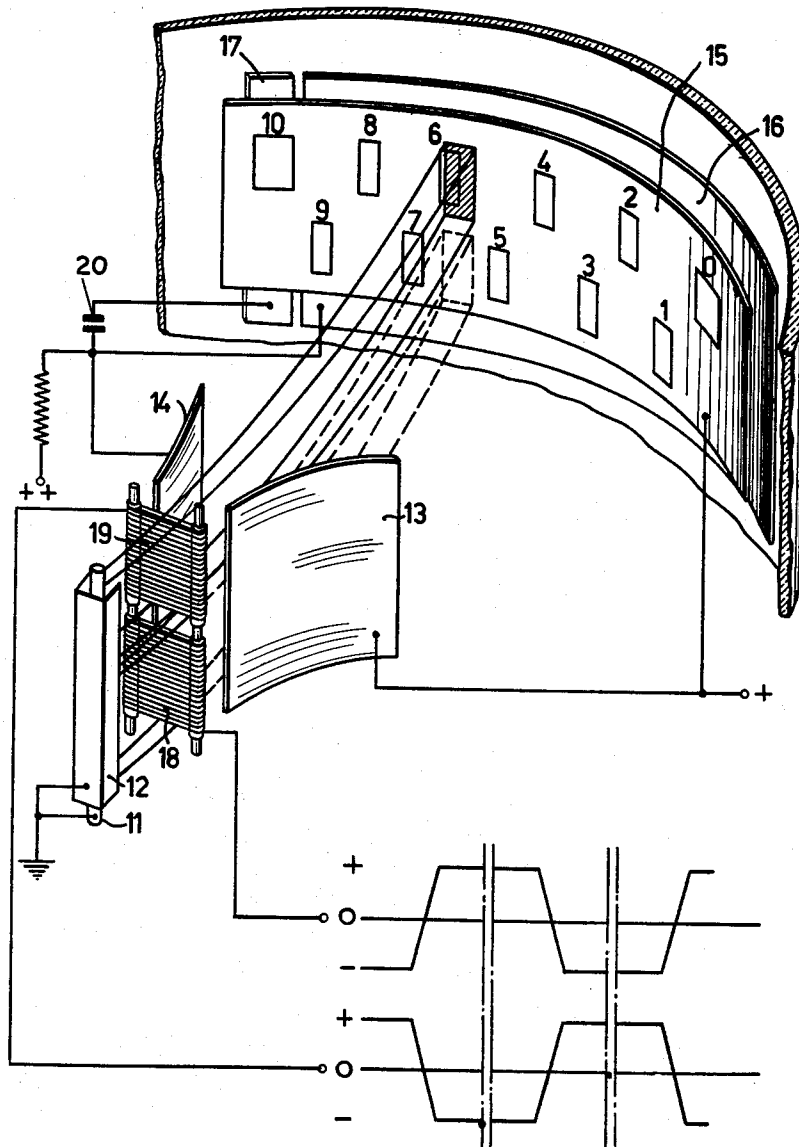
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PULSE-COUNTING DEVICE AND COUNTING TUBES FOR SUCH DEVICES

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**PULSE-COUNTING DEVICE AND COUNTING
TUBES FOR SUCH DEVICES**

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This invention relates to pulse-counting devices of the type comprising a counting tube having deflection electrodes and a collector or anode, wherein between the anode and the deflection electrodes there is arranged a masking electrode having a plurality of juxtaposed apertures corresponding to the figures to be indicated by the tube, it being possible for a directed stream of electrons to be held in the positions corresponding to these figures by means of distribution of the current between the masking electrode and the anode.

When the stream of electrons is deflected through the deflection range, the anode current alternately has a number of maximum and minimum values which correspond to the number of predetermined positions of the stream of electrons and which preferably monotonously vary with the angle of deflection of the electron current.

In counting tubes of known type, the streams of electrons is displaced from a given position to a subsequent position by means of a voltage pulse set up at one of the deflection plates. However, high requirements must be imposed upon this pulse with regard to its strength and duration and the slope of its flanks, since otherwise the risk is involved that the electron stream may either return to the same position or move on more than one position.

According to the invention, this is avoided if the directed stream of electrons is divided into two electron rays which may be deflected in common by the deflection plates and which may be either passed or suppressed by a control electrode independently of each other, the apertures in the masking electrode being provided in staggered position in two rows, each row being scanned by one of the electron rays, and that electron ray which partly passes through one of the apertures maintaining the whole electron stream in the position concerned, whereas the other electron ray is suppressed, while the electron stream is displaced to the subsequent position by suppression of the active ray and allowing the passage of the other electron ray. Since the anode is connected to one of the deflection plates, suppression of the active ray results in a decrease of the anode current, so that the anode voltage increases and the whole of the electron stream moves towards the next position. The other electron ray now passed, which initially wholly impinges on the masking electrode, since in this position no aperture is struck by this ray, comes due to the movement of the electron stream, into the aperture corresponding to the next position and thus partly strikes the anode, so that the voltage thereof decreases and the beam is maintained in this position. The counting-process is thus effected by change of the polarities of the control electrodes of the two electron rays instead of by direct supply of counting pulses to a deflection plate. According to the invention, the counting pulses are supplied to a bistable multivibrator connected to the two control electrodes.

In order that the invention may be readily carried into effect, it will now be described in detail, by way of example, with reference to the accompanying drawing showing diagrammatically a counting tube for a device according to the invention.

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In the figure, reference numeral 11 indicates the cathode which is surrounded, on three sides, by a screen 12, resulting in a directed ribbon-like beam of electrons which may be deflected by deflection electrodes 13 and 14 over a mask 15 having apertures 0 to 10. Arranged behind the mask 15 is a collector or anode 16, while behind the aperture 10 there is an electrode 17 which provides for the fly-back of the electron beam.

According to the invention, the apertures 0 to 9 are provided in staggered position in two rows, the electron beam being divided into two electron rays by means of grids 18 and 19. The grids 18 and 19 are insulated relative to one another and each of them can either pass or suppress one electron ray. The ray which is controlled by grid 18 co-acts with the apertures 1, 3, 5, 7, 9 and the other ray, which is controlled by grid 19, co-acts with the apertures 0, 2, 4, 6, 8, 10. Each of the two rays may hold the beam in a predetermined position by distribution of the current between mask 15 and anode 16. The grids may be made alternately positive and negative due to their being connected to a bistable multivibrator. Each counting pulse supplied to the vibrator just brings about a change of the grid potentials. The potentials at the grids are always of opposite polarities. In the position shown, grid 18 is negative so that the lower beam is suppressed, whereas grid 19 is positive and hence passes the upper beam which partly strikes the mask 15 and partly impinges, through aperture 6, upon the anode 16, holding the beam in this position. If, now, a counting pulse is supplied to the multivibrator, grid 19 becomes negative so that the upper beam is suppressed, whereas grid 18 becomes positive and passes the lower beam. The latter then wholly impinges on the masking electrode 15, as indicated by the dotted partition. Since the anode 16 now does not convey current, its voltage increases and hence also that of deflection electrode 14, the beam being moved to the left until it enters the aperture 7 and, after having partly passed through it, impinges on the anode 16. Consequently, the potential thereof decreases and the beam is held in position 7 until a subsequent counting pulse brings about a change of the grid potentials and makes the beam move to position 8, etc. When the beam reaches position 10, it is immediately restored to position 0 by means of a negative pulse from electrode 17 which is applied to electrode 14 via capacitor 20 and due to the tube geometry is sufficient to drive the beam to the right toward electrode 13.

Although the electron rays in this case form parts of a ribbon-like beam of electrons, it is alternatively possible to utilise two beams of circular cross-sections. However, in this case, it would be simpler to use a single beam and direct it in known manner by means of deflection alternatively towards the upper of the lower row of apertures. However, a limitation is then set to the current strength of the beam. Deflection of beams of elongated rectangular cross-section in the direction of the longitudinal dimensions of this cross-section is not well possible, however, so that in this case one has recourse to the above-mentioned control of the beams. Although the embodiment described is more complicated than that with one beam of circular cross-section, the use of beams of rectangular cross-section permit working with comparatively high current strength, which is beneficial to the reliability in operation of the device.

Although one determined embodiment has been described, it is possible to practice, as is well-known, to arrange one or more further screen grids or corrector grids in the tube between the deflection plates and the masking electrode.

What is claimed is:

1. A pulse-counting device comprising an electron dis-

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charge tube including an anode electrode, a pair of deflection electrodes, a masking electrode having a plurality of staggered apertures in alternate rows between the anode electrode and the deflection electrodes, and means to generate two electron beams which impinge upon the anode through the alternate rows of apertures in the masking electrode, means to alternately suppress said electron beams, and means coupling said anode to one of said deflection electrodes to move said electron beams step-wise across said masking electrode when one of said beams is suppressed whereby the other beam is intercepted by the anode through one of the apertures therein and held there until said latter beam is suppressed, said latter means further including means coupled to the other deflection electrode for returning the electron beams to an initial deflection position, after a given number of pulses are counted, when one of said beams intercepts the anode through an aperture in said masking electrode.

2. A device for counting pulses as claimed in claim 1

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in which the means for suppressing one of said electron beams while allowing the other to impinge upon the anode includes a bistable multi-vibrator coupled to said means for generating and controlling the two electron beams.

3. A device for counting pulses as claimed in claim 1 in which the means for generating two electron beams includes a cathode and a pair of spaced control electrodes between the cathode and the deflection electrodes.

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