Nov. 21, 1950 J. L. H. JONKER 2,530,703

ELECTRIC DISCHARGE TUBE WITH SECONDARY EMISSION PREVENTION MEANS

Filed July 16, 1946

Fig. 2.

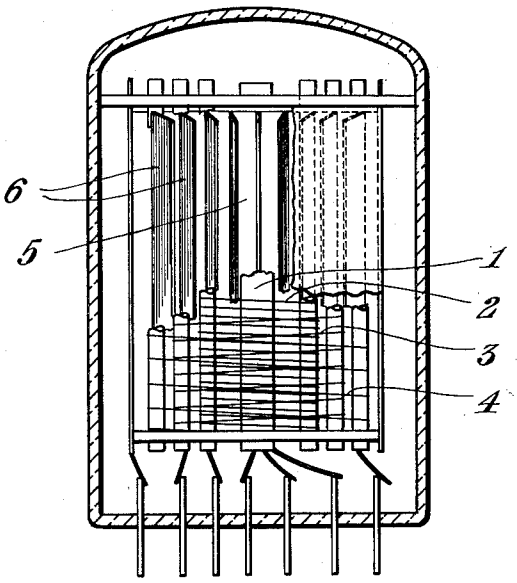


Fig. 1.

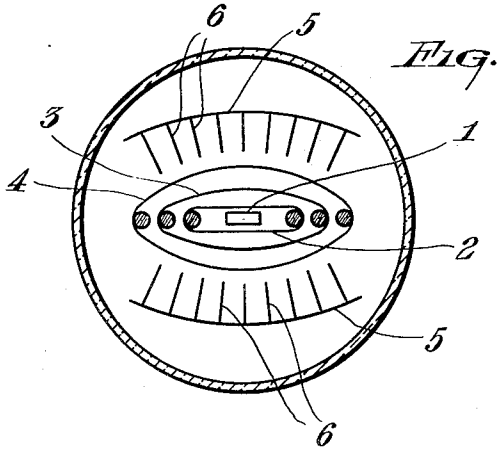
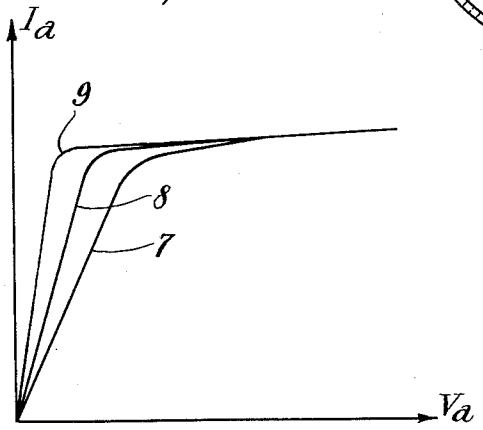


Fig. 3.



INVENTOR.
JAN LODEWIJK HENDRIK JONKER.
BY
ATTORNEY.

Patented Nov. 21, 1950 2,530,703

UNITED STATES PATENT OFFICE

2,530,703

ELECTRIC DISCHARGE TUBE WITH SECONDARY EMISSION PREVENTION MEANS

Johan Lodewijk Hendrik Jonker, Eindhoven, Netherlands, assignor to Hartford National Bank and Trust Company, Hartford, Conn., as trustee

Application July 16, 1946, Serial No. 684,031
In the Netherlands February 11, 1943

Section 1, Public Law 690, August 8, 1946
Patent expires February 11, 1963

4 Claims. (Cl. 250—176)

1

When in electric discharge tubes having control and screen grids, which are adapted for the amplification of electrical oscillations, the anode current and the anode voltage are plotted graphically, the anode voltage being plotted along the abscissa and the anode current along the ordinate of the system of coordinates, a curve is obtained which at first exhibits a fairly steep slope, followed by a bend and then extends substantially parallel with the abscissa. It is this horizontal part which is of importance for a satisfactory operation of the tube. In fact, when there are only a control grid and a screen grid a knee ensues in this part at a higher anode voltage, which is due to secondary emission. It is known that this drawback can be materially reduced by placing between the screen grid and anode a grid having a low potential, a so-called suppressor grid.

Also the point where the vertical part of the characteristic curve merges into the horizontal part, i. e. the bend, is of importance for the operation of the tube. The efforts directed to a high efficiency lead to the attempt of making this bend approach the ordinate as closely as possible. The location of this point largely depends on the deflections of the electrons by the grid wires and the space charge, and by choosing both of them as small as possible it can be achieved that this point approaches more closely to the ordinate.

It has been found that even when choosing the most favorable conditions the results are unsatisfactory and experiments have proved that this is, probably due to the appearance of swift reflected electrons, i. e. electrons which return at a speed of the order of magnitude of that of the primary electrons and consequently much more swiftly, for instance by a factor 3 or 5, than the secondary electrons.

This drawback may be met by making use of an electric discharge tube according to the present invention, in which tube a suppressor grid is placed between a screen grid and the anode, and the anode is equipped with partitions normal to the surface thereof.

It was known per se to provide an anode with partitions. This expedient has been suggested to suppress the secondary emission from the anode. In fact, there are circumstances in which the knee in the horizontal part of the anode current/anode voltage characteristic in the proximity of the screen grid voltage can be eliminated for the greater part by making use of these partitions, but as a rule this knee can be avoided only when making use of a suppressor grid. Now the remarkable fact occurs that this suppressor

2

grid does not suppress all of the returning electrons, particularly those electrons returning rapidly and at a low anode voltage, i. e. in the vicinity of the bend of the curve where the number of swift reflected electrons, according to measurements made by applicant, are not completely suppressed. Though the use of partitions is not sufficient to counteract effectively the secondary emission of the anode, this expedient proves to be sufficient for collecting a large part of the swift reflected electrons, so that the use of a discharge tube according to the invention, in which a suppressor grid is combined with partitions extending normally to the anode surface, permits both drawbacks that may be associated with the anode current/anode voltage characteristic to be materially reduced. The action of the suppresor grid by which, as has been found from elaborate researches on the part of applicant, the swift returning electrons are suppressed to an insufficient degree is complemented by the action of the partitions which alone yield an insufficient suppression of the secondary electrons. Thus, this combination cures two drawbacks which at first sight are not related with each other. The result is now that on the one hand the knee in the horizontal part of the said characteristic is removed and on the other hand the bend of this characteristic approaches very close to the axis of the ordinate.

The partitions normal to the anode surface are preferably given a fairly great height, i. e. the height of the partitions should be about twice the distance between these partitions.

In order that the invention may be clearly understood and readily carried into effect it will now be described more fully with reference to the accompanying drawing in which:

Fig. 1 is a horizontal cross-sectional view of a discharge tube according to the invention,

Fig. 2 is a vertical cross-sectional view of the tube of Fig. 1 and

Fig. 3 is a graph showing the anode voltage-anode current characteristic of the tube of the invention as compared to prior art discharge tubes.

In Figs. 1 and 2 of the drawing the reference numeral 1 designates the cathode, 2 a control grid, 3 a screen grid, 4 a suppressor grid and 5 the anode of the electrode system in a discharge tube according to the invention. As shown in the drawing partitions 6 are provided normally to the anode surface, which partitions extend in the space between anode and suppressor grid. By combining these partitions with the suppressor

grid the secondary emission is counteracted to such a degree that there is no knee in the horizontal part of the anode voltage/anode current characteristic and in addition the bend of this curve approaches very closely to the axis of the ordinate of the coordinate system. In Fig. 3 the curve 7 shows the anode voltage-anode current characteristic of a tube having only an anode with partitions, the curve 8 shows the characteristic of a pentode tube and the curve 9 shows the characteristic of the tube of the invention.

What I claim is:

1. An electric discharge tube comprising an evacuated envelope and within said envelope a cathode, a control grid surrounding said cathode, a screen grid surrounding said control grid, a suppressor grid surrounding said screen grid, and an anode surrounding said suppressor grid, said anode comprising partition portions extending toward said suppressor grid.

2. An electric discharge tube comprising an evacuated envelope and within said envelope a cathode, a control grid surrounding said cathode, a screen grid surrounding said control grid, a suppressor grid surrounding said screen grid, and an anode surrounding said suppressor grid, said anode comprising partition portions extending toward said suppressor grid, said partition portions having a depth about twice as great as the distance therebetween.

3. An electric discharge device comprising an evacuated envelope, and within said envelope a cathode, a control grid surrounding and concentric with said cathode, a screen grid surrounding and concentric with said control grid, a suppressor grid surrounding and concentric with said screen grid, and an anode having a wall portion surrounding and concentric with said suppressor grid and having partition members extending from said wall portion radially toward said suppressor grid.

4. An electric discharge device comprising an evacuated envelope, and within said envelope a cathode, a control grid surrounding and concentric with said cathode, a screen grid surrounding and concentric with said control grid, a suppressor grid surrounding and concentric with said screen grid, and an anode having a wall portion surrounding and concentric with said suppressor grid and having partition members extending from said wall portion radially toward said suppressor grid, said partition members having a radial depth about twice the distance of separation therebetween.

JOHAN LODEWIJK HENDRIK JONKER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,058,878	Holst et al.	Oct. 27, 1936

FOREIGN PATENTS

Number	Country	Date
404,672	Great Britain	Jan. 19, 1934