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THERMIONIC VACUUM TUBE

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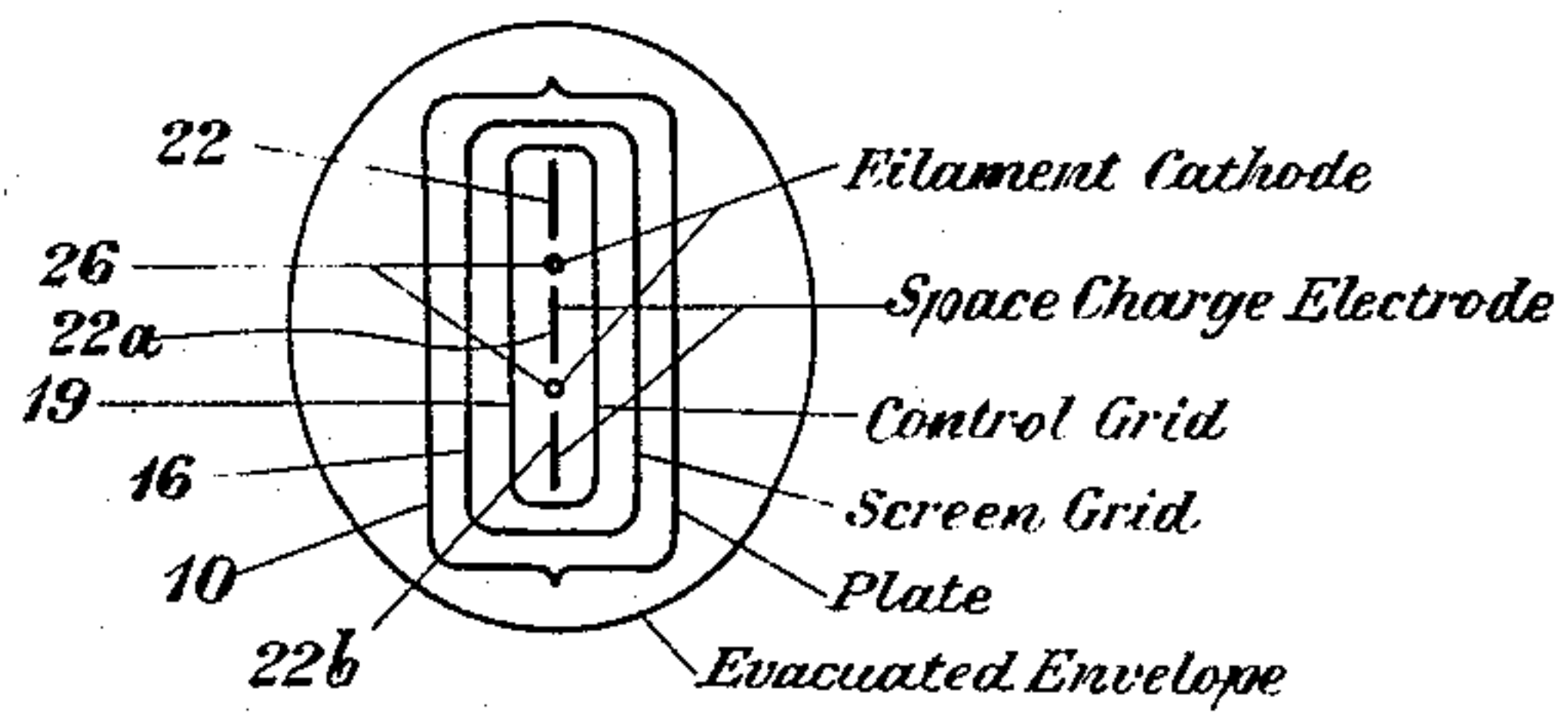


Fig. 1

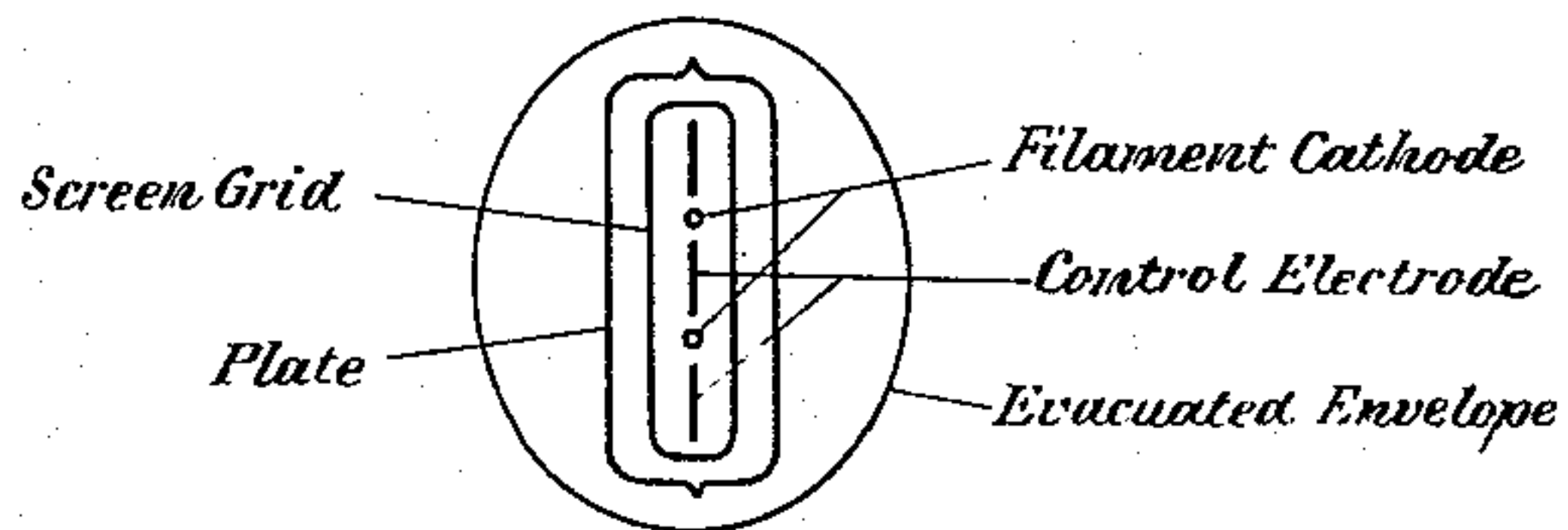


Fig. 2

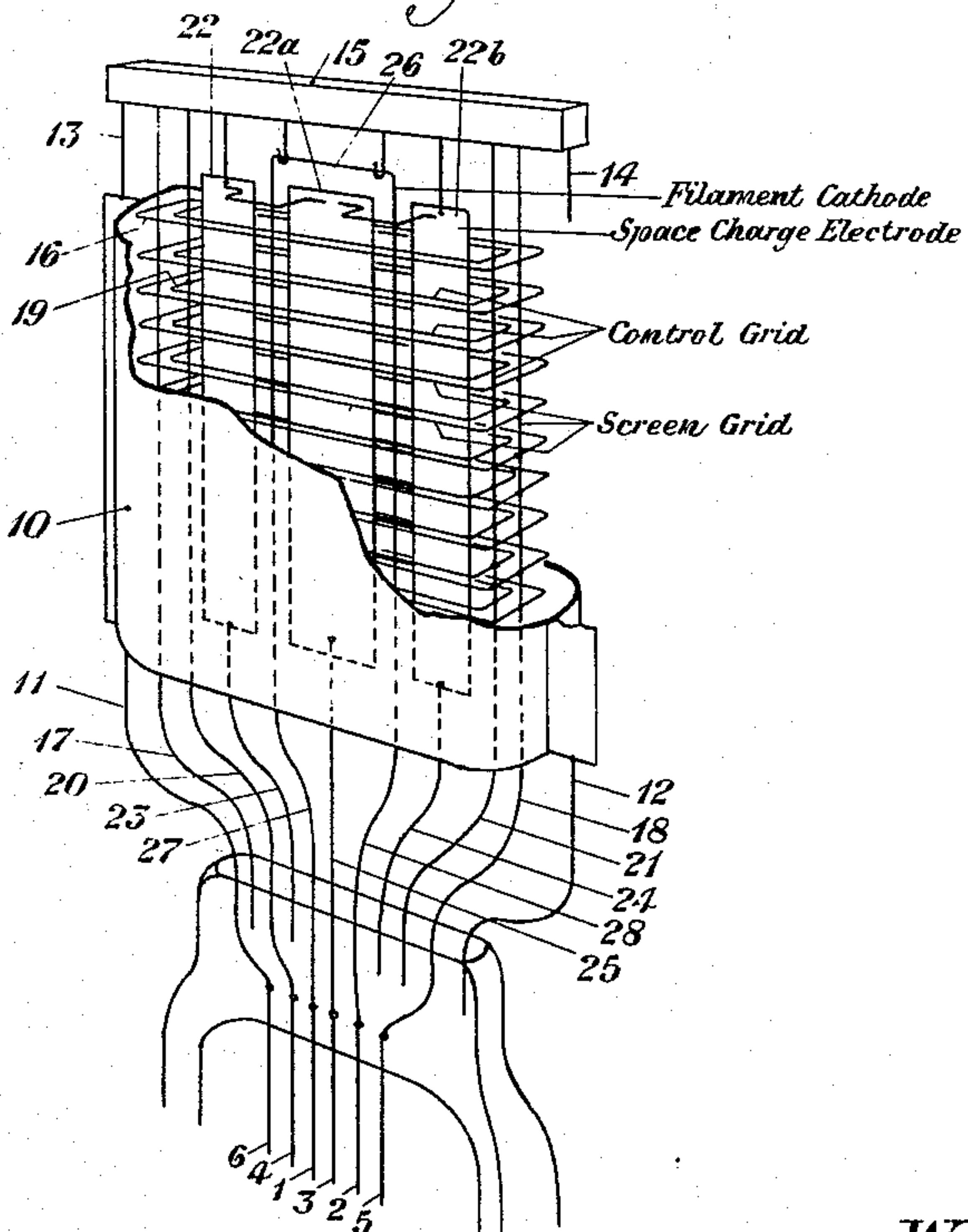


Fig. 3

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THERMIONIC VACUUM TUBE

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This invention relates to vacuum tubes of the electron discharge type and particularly to a tube of that type characterized by a number of electrodes greater than three, the said electrodes being so arranged that the impedance of the path between the plate and the filament is not appreciably greater than that of the three-electrode tube.

In the development of the art of high frequency signaling it has been found desirable to employ vacuum tubes having more than three electrodes, but with the tubes heretofore developed difficulty has been experienced owing to the fact that the plate-filament impedance has been materially increased due to the separation of those electrodes, which has been rendered necessary by the insertion of additional electrodes between them.

My invention resides in a vacuum tube having more than three electrodes, characterized by an electrode in the same plane as the filament, which electrode may be used as a space charge electrode or as a control electrode.

This invention will be clearly understood from the following description when read in connection with the attached drawing, of which Figure 1 is a horizontal cross-section through a tube having a space charge electrode lying in the same plane as the filament and having two grids lying between the filament and the plate of the tube; Fig. 2 (also a cross-sectional view) shows a simpler form of tube having a single grid between the filament and the plate, and Fig. 3 shows diagrammatically the arrangement of the various electrodes of a tube of the type shown in cross-section in Fig. 1.

In Figs. 1 and 3, in which the same numerals have been used to represent the same parts, the plate 10, which has been shown as being broken away in order to disclose the inner electrodes, is supported by means of the rods 11 and 12 which are embedded in the stem of the tube. The rod 11 is connected with the conductor 6, by means of which the plate may be connected with the circuit in which it is to be used. The member 13 is connected with the upper edge of the plate in order to support one end of the member 15 which serves to support the other elec-

trodes of the tube, and also serves to keep the electrodes properly spaced apart. The other end of this member 15 is supported by the member 14 which would be connected with the upper edge of the plate which has been shown as broken away. Immediately adjacent the plate, and between the plate and the filament, is the screen grid 16, which is supported by members connected with the member 15, and is also supported by the stem through the rods 17 and 18, the latter being connected with the conductor 5 for the purpose of connecting this electrode with the external circuit. Between the screen grid and the filament is a control grid 19, which in construction resembles the screen grid 16. The grid 19 is supported in part by the member 15 and also by the rods 20 and 21 which are embedded in the stem of the tube. The rod 20 is connected with the conductor 4 in order to connect this electrode with the external circuit. Within the control grid 19 are two electrodes, namely, the space-charge electrode represented in three parts designated 22, 22^a and 22^b, and the filament 26. As will be seen clearly in Fig. 1, the space-charge electrode and the filament lie in the same plane, which method of construction reduces the space between the filament and the plate and thereby serves to keep down the impedance of that path. The parts of the space-charge electrode are conductively connected by linking members, as shown in Fig. 3 at the upper ends of these parts, and the lower parts are connected by means of the rods 23, 24 and 25 with the stem of the tube, thereby adequately supporting the various parts of this electrode. The rod 25 is connected with the conductor 3 in order to connect this electrode with the external circuit. The filament 26 is supported in part by the member 15, and also by the rods 27 and 28, which are imbedded in the stem and are connected, respectively, with the conductors 1 and 2.

In order to clearly understand the nature of this invention it may be desirable to define certain terms heretofore used. A space-charge electrode is defined as an electrode near the cathode, to which a positive poten-

tial is applied in order to reduce the effect of the negative space charge of the electrons emitted from the filament or the cathode. The use of a space charge electrode reduces the plate impedance of the tube and permits operation at lower plate voltages than otherwise would be feasible.

The control electrode, which may be defined as the electrode to which the input voltage of the circuit is applied, is illustrated by the grid of the well-known three-electrode tube.

A screen grid is defined as a grid between the plate and the control electrode to which is applied a positive potential less than, equal to, or greater than the plate potential. This electrode serves to screen the input or control electrode from the plate and to greatly reduce the tendency to feed back from the plate to the control grid through the capacity of the vacuum tube elements while at the same time impeding the passage of the current to the plate to only a slight extent. The presence of this electrode at a suitable potential may also tend to reduce the plate impedance of the tube.

The arrangement shown in Fig. 2 shows an electrode co-planar with a filament of the tube and having a single grid electrode between the plate and the filament. Structurally, the arrangement shown in Fig. 2 is a simplified form of the tube shown in Fig. 1. In a tube of the type shown in Fig. 2 an electrode co-planar with a filament could be utilized as the control electrode of the tube, and the grid between the filament and the plate could be utilized as the screen grid. It will of course be obvious that if two electrodes are placed in the same plane, the necessary distance from the cathode to the anode in a vacuum tube of the multi-electrode type may be reduced as compared with the distance required if the various electrodes lie in different planes, provided of course that in both cases the clearances between successive electrodes have been reduced to the minimum limit practicable. It is desirable to reduce the anode-cathode distance in order to keep the plate impedance of the plate low, such being necessary in order to secure the maximum gain from the tube.

While this invention has been disclosed as embodied in particular forms and arrangements of parts, it is to be understood that it is capable of embodiment in other and different forms without departing from the spirit and scope of the appended claims.

What is claimed is:

1. A vacuum tube comprising an evacuated envelope enclosing a cathode for the emission of electrons, an anode, a grid interspaced between the said cathode and the said anode to control the flow of electrons between the latter electrodes, and a space charge electrode co-planar with the said cathode.

2. A vacuum tube comprising an evacuated envelope enclosing a cathode for the emission of electrons, an anode surrounding the said cathode, a grid also surrounding the said cathode and interspaced between the said anode and the said cathode, and a space charge electrode co-planar with the said cathode.

3. A vacuum tube comprising an evacuated envelope enclosing a cathode for the emission of electrons, an anode surrounding the said cathode, a screen grid also surrounding the said cathode and interspaced between the said anode and the said cathode, a control grid surrounding the said cathode and interspaced between the said screen grid and the said cathode, and a space charge electrode co-planar with the said cathode.

In testimony whereof, I have signed my name to this specification this 22nd day of September, 1925.

WILLIAM H. T. HOLDEN.