Aug. 12, 1952 G. LEHMANN 2,607,020

PENTODE TUBE

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Fig.1

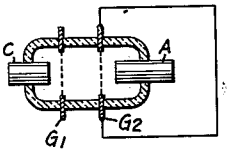


Fig.2

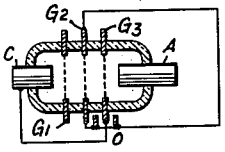


Fig.3

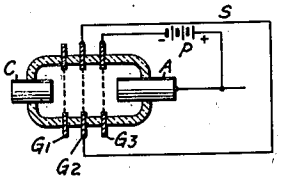


Fig.4

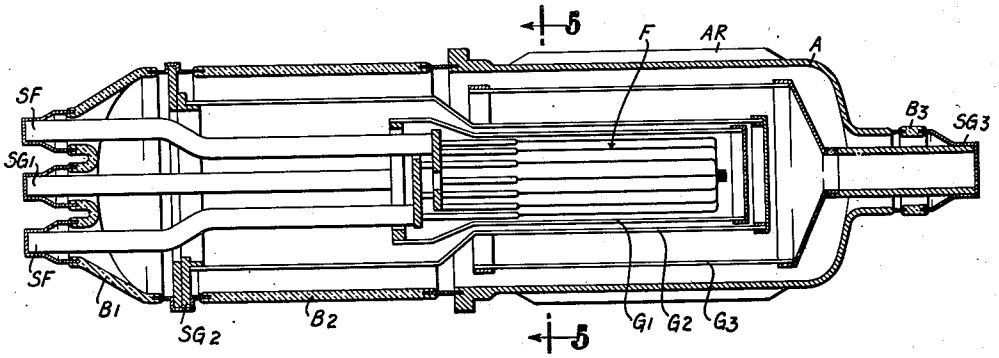
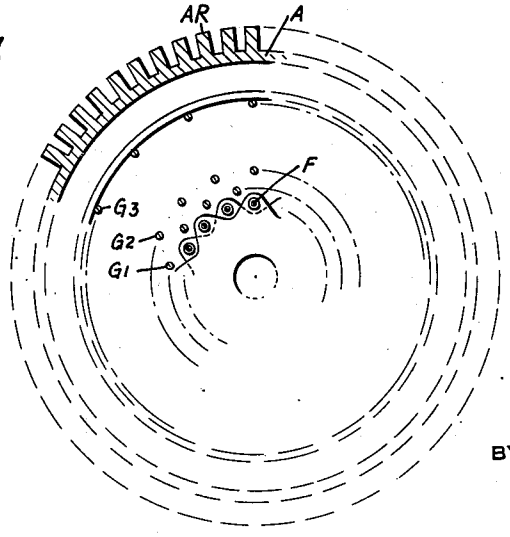


Fig.5



INVENTOR
GERARD LEHMANN
BY Percy P. Lantzy
ATTORNEY

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PENTODE TUBE

Gerard Lehmann, Paris, France, assignor to International Standard Electric Corporation, New York, N. Y., a corporation of Delaware

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2 Claims. (Cl. 315—39)

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The present invention relates to improvements in electron tubes and, more particularly, to improvements in multiple electrode electron tubes.

Electron tubes with several electrodes are well known in the art. Tetrode tubes, in particular, have an electrostatic screening introduced by the screen grid between the input and output circuit, and this permits elimination of neutrodyning circuits, except for very high frequencies.

The difficulties encountered in the construction of tetrode tubes are mainly due to the secondary electrons emitted by the anode. It is accordingly of prior knowledge to employ an auxiliary electrode, called suppressor grid, that creates a field having a suitable direction to the surface of the anode.

In pentodes of the known type, the suppressor grid is always brought to a zero high frequency potential and a constant potential equal or close to that of the cathode. The suppressor grid and the cathode are very frequently connected together. An arrangement of this kind has numerous drawbacks, particularly in the case of tubes with circular grid seals.

One of the objects of the present invention relates to a pentode tube in which the effects of the secondary anode electrons are eliminated.

Another object of the present invention relates to a pentode tube having a cylindrical structure and circular grid seals.

According to one feature of the present invention, the suppressor grid is connected to the anode alternating potential and is maintained at a constant potential slightly below that of the cathode.

According to another feature of the present invention, means are provided for incorporating the screen grid in a closed metallic surface that forms the anode cavity resonator.

According to another feature of the present invention, there is provided a screen grid whose outlet connection is disposed in such a way as to permit its incorporation in a closed surface that forms the anode cavity resonator. The outlet connection of the suppressor grid is disposed in such a way as not to destroy the advantages obtained by the direct incorporation of the screen grid in the walls of the anode cavity resonator.

According to another feature of the present invention, a pentode tube of cylindrical structure comprises a cylindrical anode open at both ends. An intermediate insulating bulb is supported at one end of the anode and is traversed by the outlet terminals of the green grid. The top insulating bulb, secured to the intermediate bulb,

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is traversed by the outlets of the filament and the control grid. The insulating bulb is secured to the other end of the anode and is traversed by the connection of the suppressor grid.

According to another feature of the present invention, means are provided for feeding the suppressor grid in such a way as to reduce the alternating voltage that exists between the suppressor grid and the anode. For this purpose, the suppressor grid may be fed by a conductor passing within a tube that constitutes the anode's inductance, or else the suppressor grid-anode circuit may consist of a coaxial line having a low impedance between the suppressor grid and the anode within the tube.

Other objects, features and advantages of the present invention will be found upon reading the following description given with reference to the appended drawings, which are without limitation and in which:

Fig. 1 is a schematic of a tetrode tube.

Fig. 2 is a schematic of a pentode tube.

Fig. 3 illustrates schematically an example of embodiment of a pentode tube employing features of the invention.

Fig. 4 shows an example of embodiment of a pentode tube of cylindrical structure that incorporates features of the present invention.

Fig. 5 is a view in section of the example of embodiment of Fig. 4.

According to modern conceptions of vacuum tubes, and since the adoption of circular grid seals, the space between two electrodes is associated with a closed electric cavity resonator that is entirely distinct from the cavity resonators associated with other spaces of the tube.

The possibility of incorporating the screen grid G2 of a tetrode in a metallic surface that completely encloses the anode resonator accordingly makes it possible to reduce to a minimum the parasitic couplings that exist within the tube between the control grid G1 and the anode A, and to eliminate the neutrodyning of the amplifier, as shown in Fig. 1. The closed cavity resonator may also be adapted to pentode tubes.

If the suppressor grid G3 of a pentode is connected to the cathode C, it is necessary to pierce an opening through the wall that surrounds the anode and extends the screen grid G2, as shown in Fig. 2.

The existence of the orifice O and of the connection between suppressor grid G3 and cathode C cancels the advantage of the arrangement obtained by incorporating screen grid G2 in a

closed surface surrounding anode A, and this constitutes a serious drawback in known arrangements.

The inter-circuit coupling that results from the connection between cathode C and suppressor grid G3, and from orifice O, is so extensive that the circular seals for screen grid G2 become useless.

Another drawback of this arrangement is the connecting of grid G3 to the high frequency potential of cathode C. As a matter of fact, grid G3 is located at a slight distance from the anode. The capacitance G3–A is accordingly high, and this capacitance is one of the well known drawbacks of pentode tubes.

Then again, the purpose of grid G3 is to prevent the secondary electrons from leaving the anode. To do this, the difference of potential created between grid G3 and anode A by the circuit has to be such that the field at the surface of the anode is constantly negative. The electrons that exist between A and G3 are then impelled toward the anode, from which the secondary electrons cannot escape.

The present invention proposes to maintain a constant and low difference of potential between anode A and suppressor grid G3, grid G3 being negative with respect to the anode.

For this purpose, the invention proposes to connect grid G3 to the alternating voltage of the anode and not of the cathode, the constant potential of this grid being slightly lower than that of the anode.

Referring to Fig. 3 which illustrates schematically an example of embodiment incorporating features of the present invention, G1 is the control electrode, G2 is the screen grid brought to a high potential with respect to the cathode, and G3 is the suppressor grid brought by means of a source P to a low and constant negative potential with respect to the anode.

Since the potential of G3 is stationary with respect to that of the anode, it is no longer necessary to pierce an orifice through the surface S that forms the screening between the input and output circuits of the tube.

The only parasitic coupling that remains is that due to the interpenetration of the fields through the meshes of screen grid G2.

The oscillating output voltage is applied between screen grid G2 and the assembled suppressor grid G3-anode A.

Since the distance G2—G3 is great, the output capacitance is low.

Referring to Fig. 4, this illustrates an example of embodiment of a pentode tube of cylindrical structure that incorporates features of the present invention.

The tube is constructed around anode A, which is a cylinder, e. g. of copper, open at both ends.

For high powers, anode A carries cooling ribs AR and it may even be provided with a cooling jacket having fluid circulation. One end of the anode cylinder carries an intermediate insulating bulb B2 traversed by a circular seal carrying screen grid G2 having its outlet at SG2. To this intermediate bulb B2 there is secured an insulating bulb B1 traversed by the outlets SF of filament F and the outlet SG1 of control grid G1. An insulating bulb B3 is secured to the other end of the anode cylinder and is traversed by the connection SG3 of the suppressor grid G3.

It is to be noted that the distances between the electrodes of the F—G1—G2 assembly are small, and that precise geometric relations are imposed by the electron optics of the beam. Grid G3 has very loose meshes and is not connected to grid G2 by precise geometric conditions.

At high frequencies, grid G3 is fed at a constant voltage, less than that of the anode, by a conductor which may, for example, pass within the copper tube that constitutes the anode inductance. Numerous known arrangements may be employed for reducing the grid G2-anode A alternating voltage.

At very high frequencies, the tube is associated with coaxial circuits. In this case, the grid G3-anode A circuit may, for example, consist of a coaxial line element having a zero impedance between G3 and A within the tube.

Although the present invention has been described in connection with an example of a preferred embodiment, it is evident that it is by no means limited thereto, and that it is capable of numerous variants and modifications without departing from the scope of the invention.

What is claimed is:

1. A pentode tube of cylindrical structure comprising a cathode, a control grid, a screen grid, a suppressor grid, and an anode, all of cylindrical shape and mounted concentrically in the order named, an annular lead-out connection for said screen grid, a lead-out conductor connected to said suppressor grid, said lead-out conductor comprising a cylindrical tube coaxially disposed within said anode for inductive coupling therewith, the impedance to alternating current between said cylindrical tube and said anode being substantially zero at the operating frequency, and a metal tube directly connected to said anode and forming an inductive load therefor, said cylindrical tube forming said suppressor grid lead-out connection being located inside said metal tube and forming therewith a coaxial transmission line of low impedance.

2. A tube according to claim 1, in which said cylindrical anode is open at both ends, a metal annulus carrying said screen grid, an intermediate insulating bulb is connected between one end of said anode and said metal annulus, an end insulating bulb is supported on said annulus, output terminals from said cathode and control grid are sealed through said end bulb, and another end bulb is supported on the other end of said anode, said suppressor grid lead-out conductor being sealed therethrough.

GERARD LEHMANN.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
2,109,843	Kassner	Mar. 1, 1938
2,207,846	Wolff	July 16, 1940
2,228,939	Zottu et al.	Jan. 14, 1941
2,287,845	Varian et al.	June 30, 1942
2,398,829	Haeff	Apr. 23, 1946
2,425,748	Llewellyn	Aug. 19, 1947