Nov. 26, 1929. W. J. ALBERSHEIM 1,736,815

AUDION TUBE

Filed May 18, 1926

Fig. 1.

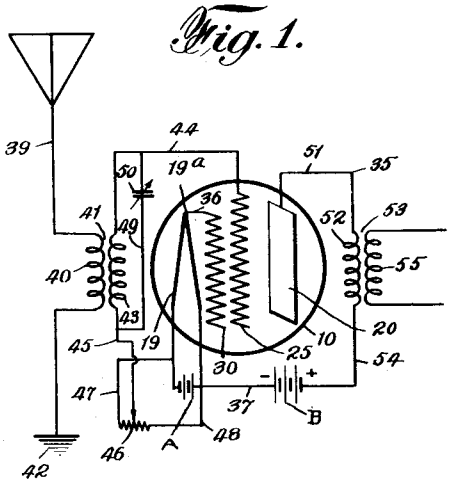


Fig. 2.

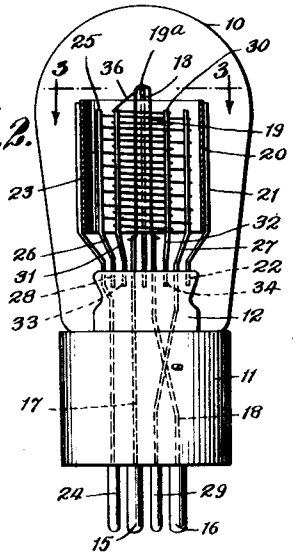


Fig. 3.

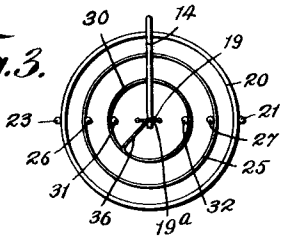


Fig. 6.

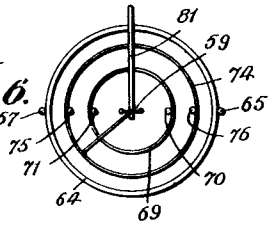


Fig. 4.

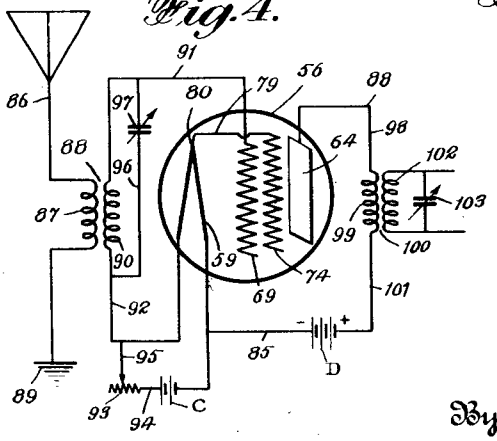
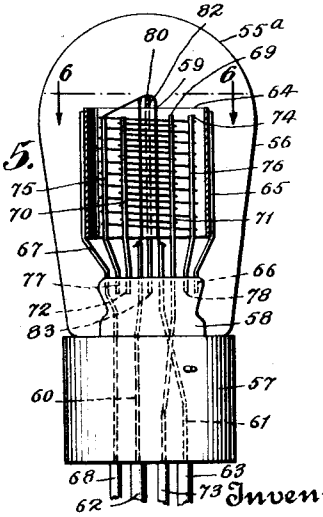


Fig. 5.



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UNITED STATES PATENT OFFICE

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AUDION TUBE

Application filed May 18, 1926. Serial No. 109,927.

This invention relates more particularly to a class of devices for detecting and amplifying wireless electric signals.

My invention has for its object primarily to provide an audion tube designed to be employed in wireless electric or so-called radio systems for improving the quality of transmission, detection and amplification of the signal waves by diminishing the tendency to regeneration or feed back by capacitive conductance of the signals through the medium of a stabilizer provided within the tube for modifying the electrostatic field surrounding the steering or current input electrode of the device. The stabilizer having a fixed potential serves the purpose of overcoming oscillations which tend to cause whistling and noisy howls in the signals passing through the tube.

The invention resides mainly in the provision of conductive means in the form of an independent electrode or grid which leads from the cathode or filament or thermionic means into the space through which flows the stream of electrons from the cathode to the anode through the usual input electrode of the device. The independent electrode is free of all circuit connections exteriorly of the tube other than its connections to the filament for serving to stabilize the electrostatic field surrounding the input electrode by diminishing the influence of fluctuations of the cathode or anode voltage on the input electrode.

A further object of the invention is to provide an audion tube of a simple and efficient construction which may be made in appropriate sizes and shapes.

With these and other objects in view, the invention will be hereinafter more fully described with reference to the accompanying drawing forming a part of this specification in which similar characters of reference indicate corresponding parts in all the views, and will then be pointed out in the claims at the end of the description.

In the drawing, Figure 1 is a diagrammatic view of an arrangement of circuits employing one form of audion tube embodying my invention.

Fig. 2 is a sectional view, partly in elevation, taken through the device.

Fig. 3 is a plan view taken on the line 3—3 of Fig. 2.

Fig. 4 is a diagrammatic view of an arrangement of circuits employing a slightly modified form of the device.

Fig. 5 is a sectional view, partly in elevation, taken through the modified form of the device, and

Fig. 6 is a plan view taken on the line 6—6 of Fig. 5.

The form of the device shown in Figs. 1, 2, 3 has the evacuated bulb or envelope 10 with its lower part sealed in an insulated base 11. Extending upwardly interiorly of the bulb from the base 11 is a supporting stem, as 12, of glass or other insulating material, and all of these parts may be of appropriate sizes and shapes.

Projecting from the supporting stem 12 upwardly towards the top of the bulb 10 is a nonconductive rod or member 13 which may be of the shape of an inverted L to provide an arm 14 extending toward and terminating on a vertical line corresponding to the central part of the supporting stem. Protruding from the underside of the base 11 are two spaced conductive posts 15, 16, and leading from these posts through the base and through the supporting stem 12 are two conductors or wires 17, 18 which lead to the cathode or filament 19 which is of somewhat the shape of an inverted U. The central or neutral part, as 19^a, of the spanning member of the U-shaped filament is supported on the free end portion of the arm 14 of the nonconductive L-shaped rod 13. Surrounding the filament 19 is an annular or sleeve like metallic plate element or output anode 20 of such a diameter that it is spaced some distance from the filament, and the anode is approximately of a similar length to the length of the filament. Part of the anode 20 is supported on the upper portion of a rod, as 21, having its other end embedded, at 22, in the insulated supporting stem 12, and the opposite part of the annular anode is supported on the upper part of a metallic rod or conductor 23 which leads through the supporting stem 12 and

through the base 11 to the conductive post 24 which protrudes from the underside of the base in spaced relation to the posts 15, 16. When heated the cathode or filament 19 serves as thermionic means for producing a stream of electrons to the anode 20, as will be later explained.

Surrounding the filament 19 is an annular input electrode or steering grid 25 which is preferably composed of metal wire wrapped helically on the upper portions of two spaced metallic rods or conductors 26, 27 so that the convolutions of the grid are spaced from each other. The lower end of the conductor 26 is embedded, at 28, in the insulated supporting stem 12, and the conductor 27 leads through the supporting stem 12 and through the base 11 to a conductive post 29 which extends from the underside of the base 11 in spaced relation to the posts 15, 16 of the filament 19 and to the post 24 of the anode or plate 20. The annular grid 25 is of nearly the same length as the length of the anode 20, and the grid is of such a circumference that it is spaced closer to the anode than to the filament or thermionic means 19. The grid 25 is therefore in the space or path for the stream of electrons to pass therethrough from the filament to the anode.

Between the filament 19 and the steering grid 25 is a stabilizer 30 preferably in the form of an annular electrode or grid for serving to modify the electrostatic field surrounding the input electrode or grid 25. The stabilizing electrode 30 is also preferably composed of metal wire wrapped spirally on the upper portions of two spaced metallic rods or conductors 31, 32 so that the convolutions of the winding are in spaced relation, and one end, as 36, of the stabilizing electrode leads to the neutral part 19^a of the filament. The lower ends of both of the conductors 31, 32 are embedded, at 33, 34, respectively, in the insulated supporting stem 12. The conductors 31, 32 do not lead directly to the exterior of the tube, and have no circuit connections other than through the filament. The device is therefore of the usual form having the four conductive posts 15, 16, 24, 29.

In practice this form of the device may be used in an amplifying or radio circuit, as 35, Fig. 1. In the circuit is the battery A or other source of direct or alternating current supply for heating the filament 19, and the battery and filament are connected by a conductor 37 to another battery B or other source of direct current supply. The input circuit includes the antenna 39 which receives the high frequency wave signals for flowing through the primary coil 40 of an input transformer 41 to ground, as 42. One end of the secondary coil 43 of the transformer 41 leads by a conductor 44 to the steering grid 25, and the other end of the secondary coil leads by a conductor 45 to a potentiometer 46. The potentiometer 46 is connected to the ends of the filament 19 by a conductor 47 and a conductor 48. Leading from the secondary coil 43 to the conductor 44 is a conductor 49 in which is interposed a variable condenser 50. With the heating of the cathode or filament 19 by the battery A the current is shunted to the potentiometer 46 over conductors 47, 48. The potential of the grid 25 is made substantially equal to that of the filament by the conductive connection 45 to the potentiometer, and the secondary coil 43 of the transformer 41 is tuned by the variable condenser 50. The voltage alternations of the current through the conductor 44 from the secondary coil 43 are imposed on the electrode or grid 25 which vary its potential relative to the filament potential. The oscillations of the grid potential will thereby vary the intensity of the space current or stream of electrons flowing from the filament 19 to the anode or plate 20 through the stabilizing electrode 30. The output or plate circuit includes the conductor 51 which leads to one end of the primary inductance or coil 52 of the output transformer 53, and the coil 52 leads by a conductor 54 to the battery B. From this battery the current will flow over conductor 37 to the filament 19. The alternations of the space current in the coil 53 will induce an alternating voltage in the secondary coil 55 of the transformer 53 which may be detected in this unit or further amplified as desired. If the current from the battery A produces an alternating or fluctuating voltage in the filament 19 these fluctuations will vary the steering electrostatic potential between the filament and the grid 25 in a similar way as the fluctuations from the grid itself. They will therefore be amplified in the bulb and cause undesirable fluctuations of the output voltage. These undesirable fluctuations are diminished by the stabilizing electrode or grid 30, which grid has a shape similar to the steering grid 25, and is interposed between the stabilizing electrode 30 and the filament. The electrode 30 being conductively connected, at 36, to the neutral point 19^a of the filament has a fixed potential, and being interposed in the stream of electrons between the filament and grid 25 serves to diminish the influence of the fluctuations of the filament voltage on the steering grid, and in turn effects a quieter operation of the amplifying system.

The form of the device 55^a illustrated in Figs. 4, 5, 6 has the evacuated bulb 56, base 57, insulated supporting stem 58, U-shaped filament or cathode 59 with its conductors 60, 61 leading to the posts 62, 63 which protrudes from the underside of the base 56, and these parts are preferably of similar formations to the like parts 10, 11, 15, 16, 17, 18, 19 of the form of the device shown in Fig. 2. The device 55^a has the sleeve like metallic plate

element or output anode 64 which is of such a circumference that it surrounds and is spaced from the filament 59. Part of this anode is supported on the upper portion of a rod 65 having its lower end embedded, at 66, in the insulated stem 58, and the opposite part of the anode is supported on the upper part of a metal rod or conductor 67 which leads through the supporting stem 58, and through the base 57 to a conductive post 68 extending from the underside of the base in spaced relation to the posts 62, 63. Surrounding the filament 59 is an annular steering electrode or input grid 69 which is formed of metal wire wrapped spirally on the upper portions of two spaced rods or conductors 70, 71 so that the convolutions of the winding are spaced from each other, and this steering grid is of such a circumference that it is spaced from the filament. The anode 64 and the grid 69 are of lengths approximately similar to the length of the filament 59 proper. The lower end of the rod 70 of the steering grid 69 is embedded, at 72, in the supporting stem 58, and the conductor 71 leads through this supporting stem and through the base 57 to a post 73 which protrudes from the underside of the base in spaced relation to the posts 62, 63, 68.

Between steering grid 69 and the anode 64 is a stabilizer for modifying the electrostatic field or capacitive conductance between the filament 59 and anode 64. The stabilizer 74 is preferably in the form of an electrode or grid composed of metal wire wrapped spirally on the upper portions of two spaced rods 75, 76 having their lower ends embedded respectively, at 77, 78, in the insulated stem 58. The convolutions of the winding of the stabilizing electrode 74 are spaced from each other, and this electrode is of sufficient diameter and is positioned so that it surrounds the steering grid 69 about midway between the anode 64 and the steering grid 69. The stabilizing electrode 74 is therefore in the space or path for the flow of the stream of electrons from the filament 59 to the anode 64, and the upper end, as 79, of the winding of the electrode 74 leads to the neutral point, as 80, of the spanning member of the U-shaped filament 59, this part of the filament being suspended on the end of an arm 81 of an inverted L-shaped rod 82 having the lower end of its other arm embedded, at 83, in the supporting stem member 58. The stabilizing electrode 74 as provided has no conductive connection exteriorly of the tube other than its connection 79 to the filament 59.

This form of the device 55^a is adapted to be employed in a high frequency amplifying or radio circuit 84, Fig. 4. When the device is arranged in the circuit the filament 59 is heated from the current of the battery C or other source of direct or alternating current supply, and a conductor 85 also leads to this filament and to the battery C from a second batery D or other source of direct current supply. The input of the circuit 84 includes the antenna 86 which receives the high frequency wave signals which pass through the primary coil 87 of an input transformer 88 to ground, as 89. One end of the secondary coil 90 of the transformer 88 leads by a conductor 91 to the input or steering grid 69, and the other end of the secondary coil leads by a conductor 92 to the filament 59. A resistance or rheostat 93 is interposed in the filament heating circuit by a conductor 94 which leads from the battery C and by a conductor 95 which leads from the resistance 93 to the conductor 92. Leading from the secondary coil 90 to the conductor 91 is a conductor 96 in which is interposed a variable condenser 97. The current heating the cathode or filament 59 from the battery C is regulated by the resistance 93 over conductors 85, 94, 95. The potential of the tuned input inductance of the secondary coil 90 of the input transformer 88 is made equal to that of the filament by the connection 92 to the conductor 95, and the high frequency voltage in the secondary coil 90 of the transformer 88 is amplified by the variable condenser 97 in the circuit over conductor 96. The voltage alternations of the current through the conductor 91 from the secondary coil 90 are imposed on the electrode or grid 69 which vary its potential relative to the filament potential. The oscillations of the grid potential will then vary the intensity of the space current or stream of electrons flowing from the filament 59 to the anode or plate 64 through the grid 69 and through the stabilizing electrode 74. The output or plate circuit includes the conductor 98 which leads to one end of the primary inductance or coil 99 of the output transformer 100, and this coil 99 leads by a conductor 101 to the battery D. From the batery D the current will pass over conductor 85 to the filament. The alternations in the space current in the coil 99 will induce an alternating voltage in the secondary coil 102 of the transformer 100 which may be further amplified in the same way as the secondary voltage of the input transformer 88 by means of a tuning condenser 103. It is known that the electrostatic field between the anode 64 and the grid 69 forms a capacitive connection between the output circuit and input circuit with resultant detrimental effect; first, the fluctuations of the plate voltage caused by the space current fluctuations in the output circuit tend to counteract the governing effect of the steering grid and limit the amplifying ratio of the audion device; second, if the output and input circuit are tuned to the same frequency, the capacitive connection may feed back sufficient energy from the output circuit to the input circuit to cause regeneration which will

make the circuit unstable and produce whistling and howling noises. These defects are met by means of the stabilizing electrode 74 which being connected to the filament 59 by its portion 79 is interposed between the steering grid 69 and the anode 64. The stabilizing electrode thereby serves to weaken the undesired electrostatic field or capacitive conductance between the grid 69 and the anode 64 for increasing the amplifying ratio of the tube and diminishing the feed back effect to avoid oscillations, howls and whistling.

In the foregoing description, I have embodied the preferred form of my invention, but I do not wish to be understood as limiting myself thereto, as I am aware that modifications may be made therein without departing from the principle or sacrificing any of the advantages of this invention, therefore, I reserve to myself the right to make such changes as fairly fall within the scope thereof.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:—

1. An audion tube comprising an anode, a filamentary cathode, a perforated input electrode, and a second perforated electrode electrically connected to the center of said cathode within said tube, said second electrode being positioned between the cathode and the anode.

2. An audion tube comprising an anode, an input grid, an electron emitting cathode, and a second electrode positioned between the input grid and the anode, said second electrode being electrically connected to the center of the cathode within said tube.

This specification signed and witnessed this 17th day of May A. D. 1926.

WALTER J. ALBERSHEIM.