

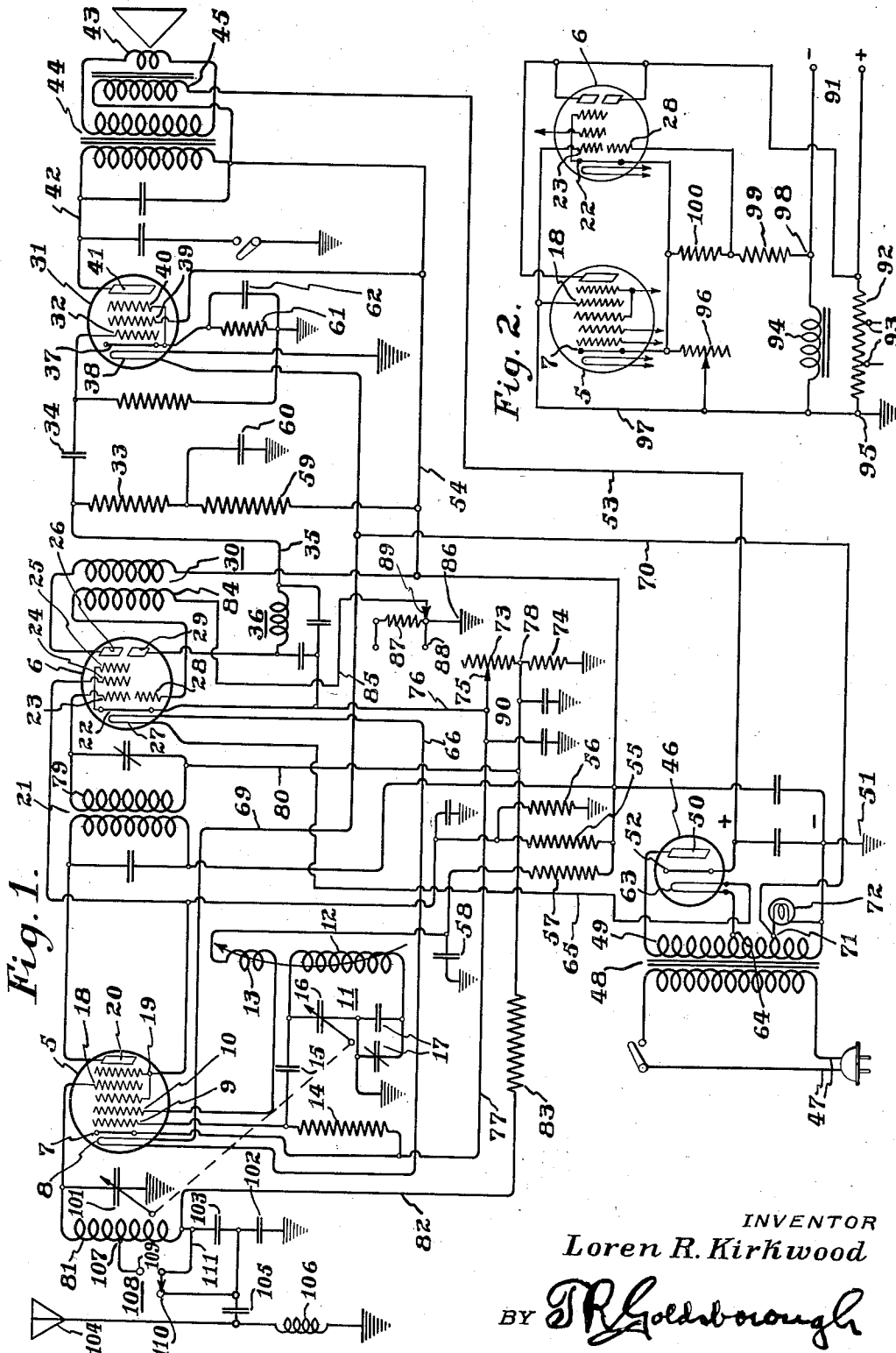
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VOLUME CONTROL CIRCUIT

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VOLUME CONTROL CIRCUIT

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The present invention relates to radio receiving systems and the like, and more particularly to systems of the above character in which one or more of the electric discharge devices or tubes therein is provided with a plurality of control and other associated electrodes for functioning in two or more circuits.

It is an object of the present invention to provide an improved control circuit for a system of the above character in which one control electrode or grid of an electric discharge device may be maintained at a fixed potential while another control electrode or grid in the same envelope and in association with the same cathode may be varied in potential throughout a desired control range.

It is another object of the present invention to provide an improved bias supply circuit for a combination electric discharge device or tube for radio receiving apparatus and the like, which permits a variable bias potential to be applied to one electrode of said device while the bias potential on another electrode of the device is maintained substantially constant.

It is a further object of the present invention to provide an improved volume control circuit for a radio receiving system embodying electric discharge devices, certain of which include a plurality of control electrodes thereby to function in a plurality of circuits.

It is also a further object of the invention to provide an improved input and control circuit for a radio receiver of the superheterodyne type having a combined detector-oscillator and a combined detector-amplifier provided by combination electric discharge devices.

By combination electric discharge devices is meant electronic emission devices or tubes having a common cathode for either separate or electronically coupled electrodes, the latter being adapted to be connected with separate circuits. A tube of this type may, for example, be provided with two separate control grids and two separate anode electrodes associated with a common cathode in a single envelope, and in certain cases additional electrodes such as screen electrodes may be provided. Tubes of this character are known and are available commercially and may be represented, for purposes of a better understanding of the invention, by the types known on the commercial market as the RCA 6A7 and 6F7.

The invention will be better understood from the following description taken in connection with the accompanying drawing in which a receiving system is illustrated and embodying, by way of

example, the electric discharge devices above named, and its scope will be pointed out in the appended claims.

In the drawing, Figure 1 is a schematic circuit diagram of a radio receiving system of the superheterodyne type embodying a combined detector-oscillator in the input circuit and a combined detector-amplifier in a succeeding circuit and Fig. 2 is a detail schematic diagram showing a modification of the circuit of Fig. 1.

Referring to Fig. 1, 5 is a combined first detector and oscillator tube of the electric discharge type and is one of two combination tubes used in the superheterodyne receiving system shown. The other combination tube is shown at 6, and is a combined intermediate frequency amplifier and second detector. Each of the devices is characterized by the fact that a common cathode is provided in association with a plurality of control electrodes and output electrodes for various associated circuits.

In the combined detector and oscillator device 5, there is provided a common cathode indicated at 7, having a suitable heater 8. Directly associated with the cathode 7 is a control grid 9 and an anode electrode 10 for a tuned oscillator circuit 11 having a grid inductance 12 and an anode inductance 13. The grid 9 is provided with the usual grid-leak 14 and condenser 15. A variable tuning condenser 16 in connection with suitable series condensers 17 are provided for gang tuning the inductance 12 over the desired oscillator range. Further description of the oscillator is believed to be unnecessary as the same is known and well understood and forms no specific part of the invention.

The device 5 is further provided with a second control or signal input grid 18, which is suitably screened by an electrode 19, and with an output anode 20. The electrode 19 is a screen grid interposed between the control grid 18 and the oscillator elements and also between the control grid and the output anode.

Signals received on the grid 18 and oscillations provided on the grid 9 from the oscillator circuit 11 are suitably mixed through electron coupling in the tube and appear as intermediate frequency signals on the output anode 20. The output anode is coupled to the next succeeding tube, which in the present example is the combined intermediate frequency amplifier and second detector tube 6, through a suitable tuned intermediate frequency coupling transformer 21. The intermediate frequency signals are first applied to the intermediate frequency amplifier

portion of the tube 6, which comprises a cathode 22, a control grid 23 connected with the transformer 21 to receive the intermediate frequency signals, a screen grid 24, a suppressor grid 25, and an output anode 26. The cathode 22 is provided with a suitable heater indicated at 27.

The elements described above provide a high frequency pentode amplifier, the electrode arrangement being such that signals received on the control grid 23 are amplified and appear in the output circuit of the anode 26.

In the present example the tube is also provided with a second control grid 28 and a second output anode 29 associated with the common cathode 22 to provide a triode electric discharge device which, in the present example, is utilized as a second detector. To this end the control grid 28 is coupled to the output anode 26 of the intermediate frequency amplifier through an untuned intermediate frequency transformer 30 as indicated. Signals applied to the control grid 28 are detected by the so called anode band method. The detector is coupled to an output audio frequency amplifier electric discharge device or tube 31 which may be any suitable high gain output device for an audio frequency amplifier. In the present example the device 31 is a pentode type audio frequency amplifier of the type known commercially as an RCA—38 tube. This tube is provided with a control grid 32 coupled to the output anode 29 through suitable coupling resistors 33 and the usual coupling condenser 34, and an output anode lead 35 in which is located a suitable intermediate frequency filter 36.

Like the preceding electric discharge devices, the output device 31 is provided with an equipotential cathode 37 having a suitable heater 38 and the usual screen and suppressor grids 39 and 40, respectively, in addition to the output anode 41.

The output anode 41 is provided with an output circuit 42 which is coupled to an output device or loud speaker 43 through a suitable audio frequency output coupling transformer 44. The loud speaker 43 is also provided with a dynamic field winding indicated at 45.

Operating anode and grid potentials are derived from a suitable common source in the present example, provided by an electric discharge rectifier device 46 which is supplied with alternating current through input leads 47 and a step up transformer 48 having a high voltage secondary 49. The anode 50 of the rectifier is connected with one terminal of the high voltage secondary, while the opposite terminal of the high voltage secondary is connected to the chassis ground for the apparatus, as indicated at 51, whereby all return circuit connections for the supply source throughout the apparatus may be made by suitable ground connections to the chassis as indicated throughout the diagram.

The rectifier 46 includes a cathode 52 connected with the high voltage positive supply lead, indicated at 53, which in turn is connected through the loud speaker field 45 as a hum filter choke, to a high voltage supply lead 54 for the various anode and screen grid electrodes. It will be noted that certain of the screen grids such as those in the devices 5 and 6 are supplied from a suitable bleeder resistor comprising resistor elements 55 and 56 connected between the supply lead 54 and ground. Likewise the oscillator plate electrode 10 is supplied with a reduced operating potential through a suitable potential reducing filter means comprising a filter resistor 57 and a by-pass con-

denser 58 to ground. A similar filter resistor 59 and by-pass condenser 60 is provided in the supply connection for the second detector anode 29. It will further be noted that the output tube 31 is provided with the usual self-bias resistor 61 having a shunt by-pass condenser 62.

The various heaters for the electric discharge devices including the cathode 63 of the rectifier 46 are connected in series across portions of the high voltage secondary winding 49 of the power supply transformer 48. In the present example the rectifier heater 63 is connected adjacent to and with an intermediate tap 64 on the high voltage secondary 49 and in series with the heaters of the devices 5 and 6 through a circuit which may be traced through a lead 65 to the heater 27, thence through a lead 66 to the heater 8, and returning through a lead 69—70 to a second intermediate point 71 on the high voltage secondary, so that the three heaters are thus supplied with operating current from an intermediate section of the high voltage secondary 49 between the tap points 64 and 71. Between the supply lead 70 and the ground 51 a second section of the high voltage winding supplies operating current to a pilot lamp indicated at 72 and to the heater 38 of the output tube 31 which is returned through a grounded connection as indicated.

With the anodes of the various tubes supplied with operating potential through the common supply lead 54 from the common source provided by the rectifier 46 the use of self-bias means for providing grid potentials is readily available as is shown in connection with the output tube 31. The combination tubes 5 and 6 are likewise supplied with biasing potentials, except for the oscillator portion of the tube 5 which receives grid or biasing potential directly from the cathode through the grid-leak 14, as is customary in connection with an oscillator of the type shown.

To control the volume of the output from the receiving systems shown, it is desirable to raise and lower the potential of the cathodes of the devices 5 and 6 and this is done through the use of a single variable self-bias resistor 73 which is connected to ground through a fixed impedance device or resistor 74. The variable resistor 73 may be of any suitable type but in the present example is provided with a variable tap 75. The latter is connected to the cathodes in parallel through leads indicated at 76 and 77. To receive the bias potential from the variable self-bias resistor 73, the control grids 18 and 23 are returned to the more negative end thereof, as indicated at the tap point 78. In the present example, the grid 23 is provided with a bias or return connection through the secondary 79 of the transformer 21 and a bias supply lead 80, while the grid 18 is provided with a bias or return connection through a tuning inductance 81 hereinafter referred to, and a supply lead 82, in which is located a high resistance filter element 83.

With this arrangement, the control grids 18 and 23 receive a variable bias potential from the source 73, which is increased in negative value on the grids, as the variable tap 75 is moved to include a greater resistance between it and the tap 78. In the present example, this is in an upward direction as viewed in the drawing.

As the volume control device 73—75 is operated as above described, to increase the resistance and, therefore, the negative bias on the control grids of the first detector in the device 5 and the intermediate frequency amplifier in the device 6, the signal volume or gain of the re-

ceiver is correspondingly reduced. It will be seen that with a self-bias resistor means as shown, the anode current for the controlled devices is also, at the same time correspondingly reduced, serving to cause a reduction in the potential drop in the fixed impedance or resistor 74 connected in series with the variable impedance 73—75. This reduction in current through the impedance 74 causes a reduction in the overall potential drop, to counteract the increase in potential drop between the variable tap 75 and the tap 78, whereby the overall potential drop between the tap 75 and the ground remains substantially constant under all conditions of variation of the tap 75, depending upon the relation of the values of resistance of the sections 74 and 73 included in circuit. In the present example, with the tubes illustrated, it has been found that the resistor 73 may have a total resistance of approximately 4,000 to 5,000 ohms, while the fixed impedance or resistor 74 may have a resistance of substantially 1,500 ohms, for satisfactory operation as above described.

With a common cathode 22 for both the intermediate frequency amplifier and the detector in the device 6, advantage is taken of this constant bias potential arrangement for supplying the detector, by connecting the return circuit for the detector grid 28 to ground. Substantially a constant grid bias potential is then maintained upon said grid while the intermediate frequency amplifier gain may be varied. Likewise the detector may be utilized as an amplifier for supplying audio frequency signals to the output device 31 and in its capacity as an amplifier, the constant bias is required.

In the present example, the detector grid 23 is provided with a return circuit through the secondary 84 of the intermediate frequency transformer 30 and thence through a lead 85 to ground as indicated at 86. The connection from the lead 85 to the ground 86 includes a potentiometer device 87 having signal input terminals 88, one of which is connected to the ground 86. The variable tap 89 of the potentiometer device is connected with the lead 85.

Normally the contact 89 is maintained at the ground end of the potentiometer as shown to connect the grid 28 to ground through the secondary 84 and to exclude the input terminals 88.

Signals from any suitable source, such as separate audio frequency signals for example, from a separate channel, to be amplified and reproduced by the loud speaker, may also be applied to the grid 28 through the terminals 88 by operation of the potentiometer device 87—89, the contact 89 being moved from the grounded end toward the high potential end to adjust the input potential to a desired value. With this arrangement the detector may be utilized as an amplifier and the input terminals may be cut out or into circuit with it by the single volume control means 87—89.

With the above described bias circuit arrangement, a plurality of electric discharge devices in a receiver circuit or the like, may simultaneously be controlled by a common volume control means from a common bias source independently of other electric discharge elements contained in the same envelope and utilizing a common cathode therewith, and even though the anode current for both anodes of the common envelope, such as that of the device 6, for example, flows through the common cathode and common bias supply means of the self-bias type. It will be

appreciated that with an increasing use of combination tubes such a circuit has varied applications and may be used to simplify the bias supply system in which it is connected.

In the present example, with the variable arm 5 or tap 75 at a minimum resistance (high volume) position such as at a point indicated at 90, a certain potential drop will occur across the resistor 74. As the variable tap is moved to reduce the volume and increase the resistance between the taps 75 and 78, the potential drop across the fixed impedance 74 will decrease because the first detector and intermediate frequency amplifier grids 18 and 23 are biased more negatively, thus decreasing the anode current flowing to the anodes 26 and 20. This causes a corresponding reduction in the anode current flow through the fixed impedance 74 in the cathode return circuit, and while the overall bias potential on the grids 18 and 23 thus increases because of the increased drop in the resistor 73, as applied to the grid 28, the increase is neutralized by the decreased potential drop in the impedance 74. The result is that the bias potential applied to the grid 28 remains substantially constant, as is desired.

As provided in the present example, the grid or grids on which a constant bias potential is desired, in connection with a common cathode in a combination tube, is connected to ground or to the more negative end of a combined fixed and variable impedance means, while the cathode is connected to the positive end of a variable impedance portion at the more positive end thereof. The grid or grids on which a variable bias potential is desired in connection with a common cathode for combination tubes is connected at a point between said variable impedance portion and a fixed impedance portion. Both impedance portions may be regarded as part of a unitary impedance means, one portion of which is fixed and the other portion of which is variable, the fixed portion being at the more negative end.

Viewing the impedance means as a unit, the common cathodes are connected to the variable portion at the more positive end, and the grids to be controlled are connected at a point between the fixed and variable portions of the impedance means to receive a potential derived from the variable portion. The grids on which substantially a constant bias potential is desired, are connected to include also the potential derived from the fixed portion, and in general the potential or a part thereof as derived from the whole impedance means.

It is a common practice in radio receiver power supply circuits and the like, to utilize a loud speaker field winding as a filter choke coil in the negative supply lead. It has been found that in certain supply circuits this form of filter means may be utilized also as the fixed portion of a bias supply impedance as above described, thereby simplifying the supply circuit and conserving the available voltage from the supply means.

A supply circuit employing a filter choke coil such as a loud speaker field winding, in the negative supply lead, is shown in Fig. 2 in its application to a portion of the circuit of Fig. 1. Attention is, therefore, directed to Fig. 2.

The combined detector oscillator tube is indicated at 5, and the combined intermediate frequency amplifier and detector is indicated at 6, as in the preceding figure. In the circuits provided in connection with said tubes the circuit coupling elements for signal transmission have been omitted for purposes of simplifying the

drawing and for a clearer understanding of the circuit.

In the circuit of the present example, high voltage direct current is supplied from a suitable source (not shown) such as the rectifier described in the preceding figure, to terminals indicated at 91. The high voltage or positive terminal is connected to a voltage supply impedance or resistor 92 having taps 93 thereon for supplying operating potentials to the apparatus associated therewith. The negative supply terminal is also connected to the impedance 92 through a filter choke coil 94, which may be a loud speaker field winding. The junction of the impedance 92 and the filter choke coil 94 may be grounded as indicated at 95.

Connected in series with the choke coil 94 is a variable impedance or resistor 96, through which current is taken for the cathodes 7 and 22 of the devices 5 and 6 respectively. The impedance 96 corresponds to the impedance 73 of Fig. 1, and the choke coil 94 corresponds to the impedance 74 of Fig. 1. It will, therefore, be seen that there is connected in the negative supply lead an impedance means comprising a fixed portion 94 and a variable portion 96 in connection with the cathodes of combination electric discharge devices.

The grids 18 and 23 of the devices 5 and 6 are both connected with the impedance means between the fixed and variable portions through a lead indicated at 97, whereby the variable portion is included between said grids and the cathodes and as the portion 96 is varied a variable bias potential is placed upon grids 18 and 23.

The grid 28, on which a fixed bias potential is desired, is connected across the impedance means comprising both the fixed and the variable portions as in the preceding figure. However, in the present example, a lower fixed biasing potential as may sometimes be required, is provided by tapping the grid 28 to a voltage divider means 99-100, connected in shunt to both the fixed portion 94 and the variable portion 96. In this manner low bias voltage such as 3 volts substantially constant, may be applied to the grid 28 when the grids 18 and 23 receive a variable bias of a much higher average value, such as 20 volts average, for example.

With the above described arrangement it will be seen that as the variable portion 96 of the impedance device is varied the anode current of the devices 5 and 6 will likewise vary and cause a variable potential drop across the impedance means comprising the elements 94 and 96. As the resistance of the portion 96 is increased to lower the gain of the receiving system by increasing the potential drop across it and the negative bias on the grids 18 and 23, the resulting drop in anode current through the fixed impedance 94 will provide a balancing decrease in potential drop as applied to the voltage divider 99-100 and to the grid 28, whereby the gain of the system may be varied without appreciably changing the bias potential on said last named grid.

This modification of the invention is otherwise the same as that described in the preceding figure and has the advantage that the loud speaker field winding or other filter choke element in the negative lead of the potential supply circuit may be utilized as the fixed portion of the impedance means, thereby to simplify the circuit and to reduce the cost of the apparatus.

Referring again to Fig. 1, and the signal input

circuit for the combined detector oscillator 5, the tuning inductance 81 is provided with a variable tuning condenser 101 in series with which are two condensers 102 and 103. It will be noted that the condensers 101 and 102 are interconnected through ground connections.

The condenser 102 is a coupling condenser for the antenna input circuit and is connected to an antenna or other energy collecting device 104 through a coupling condenser 105 and a coupling impedance or choke coil 106. The choke coil 106 is connected between the antenna 104 and ground. The choke coil 106 is also substantially in parallel with the coupling condenser 102 being connected therewith through the coupling condenser 105.

The choke coil 106 is tuned to a relatively low frequency, such as 35 kilocycles, for example, by means of the coupling condenser 105 and the coupling condenser 102 which are in effect in series across it. This arrangement provides an antenna input circuit for the receiver which is not responsive to interference signals to such a high degree as ordinary transformer coupling systems heretofore employed.

The tuning inductance 81 is provided with a tap connection 107 and a switch 108 is provided for short circuiting a portion of the winding 81 through said tap connection when connected to one contact 109, and to short circuit the condenser 103 when connected to a contact 110, the arm of the switch being connected to the common or lower end of the winding 81 through the lead 111.

The operation of this circuit is as follows: A 460 kilocycle intermediate frequency is employed in the receiver and accordingly the antenna input circuit is tuned to a relatively lower frequency, such as 35 kilocycles, by the antenna choke coil 106 and the coupling condensers 105 and 102, the latter being included in the input circuit for the tube 5, with the tuning inductance 81. Interfering signals at the intermediate frequency are therefore prevented to a considerable degree from entering the tuned input circuit.

The tuned circuit may also be utilized for short wave reception when the switch 108 is thrown to the contact 109, thereby short circuiting a portion of the winding 81 and inserting in the circuit with the tuning condenser 101 the additional condenser 103 which is for the purpose of permitting the condenser 101 to track with the oscillator tuning condenser 16 which is ganged thereto for simultaneous uni-control operation. When the switch 108 is thrown to the contact 110, the entire winding 81 is cut into circuit and the tracking condenser 103 is short circuited. For short-wave operation, the second harmonic frequency of the oscillator is used to beat with the incoming signal to produce the same intermediate frequency.

As this portion of the receiver circuit is shown, described and claimed in my co-pending application Serial No. 708,941 filed January 30, 1934 and assigned to the same assignee as this application, further description is believed to be unnecessary.

While the invention has been described in its application to a radio receiving system it will be apparent that it is not limited thereto, but may be applied to any electrical apparatus embodying electric discharge amplifier devices of the combination type where both fixed and variable biasing potentials are required from a common source.

I claim as my invention:

1. The combination with an electric discharge device having a pair of control electrodes and a common cathode, of a voltage drop producing impedance means including a variable impedance element connected with the cathode in circuit adjacent thereto, means for deriving substantially a fixed biasing potential from said impedance means including said variable element and applying said potential between the cathode and one of said electrodes, and means for deriving a variable biasing potential from said variable impedance element only and applying said potential between the cathode and the other of said electrodes.

2. The combination with an electric discharge device having a pair of control electrodes and a common cathode, of a voltage drop producing impedance means including a variable impedance element connected in circuit with the cathode adjacent thereto, means providing a connection between each of said electrodes and said impedance means, one of said connections including said variable impedance element only between one of said electrodes and the cathode for deriving a variable potential therefor from said element alone, and means in the other of said connections for deriving substantially a fixed potential from said impedance means for the other control electrode.

3. The combination with an electric discharge device having a pair of control electrodes and a common cathode, of a voltage drop producing impedance means including a variable impedance element connected in circuit with the cathode adjacent thereto, means providing a connection between each of said electrodes and said impedance means, one of said connections including said variable impedance element between one of said electrodes and the cathode for deriving a variable potential from said element, and means in the other of said connections for substantially deriving a fixed potential from said impedance means, said impedance means including a power supply filter choke and said variable impedance element in series, and said last named means including a voltage divider resistor connected in shunt to said series connected filter choke and variable impedance element.

4. The combination with an electric discharge device having a pair of control electrodes and a common cathode therefor, of means for supplying biasing potentials to said electrodes comprising a negative potential supply lead connected with said cathode and an impedance means in said lead comprising a variable portion and a fixed portion, the latter portion being at the more negative end thereof, one of said grids being connected with the impedance means to derive a biasing potential from both the fixed and variable portions thereof, and the other of said grids being connected with said variable portion whereby the latter is included in circuit between it and the cathode to derive a biasing potential from said variable portion.

5. In a superheterodyne receiver, the combination with a combined detector-amplifier electric discharge device having a pair of control grids and a common cathode, and a combined detector-oscillator electric discharge device having a second pair of control grids and a second common cathode, of means for supplying a variable biasing potential to the amplifier control grid of said first named device and the detector control grid of the

second named device and substantially a fixed biasing potential on the detector control grid of said first named device from a common potential supply source, said means comprising a negative anode current supply lead to which said cathodes are connected in parallel, a potential drop producing impedance in said connection, a bias potential supply connection for the detector control grid of the first named device with said impedance means for deriving a biasing potential from the fixed and variable portions thereof, and a connection for the amplifier control grid of the first named device and the detector control grid of the second named device with an intermediate point on said impedance means for deriving a biasing potential from said variable portion of said impedance.

6. The combination with an electric discharge device having a pair of control grids and a common cathode and a second electric discharge device having a second pair of control grids and a second common cathode, of an anode current supply lead to which said cathodes are connected in parallel, a potential drop producing impedance means in said connection, means providing a negative potential supply connection for a control grid of the first named device with said impedance means, means providing a negative potential supply connection for a second control grid of the first named device and a control grid of the second named device with an intermediate point on said impedance means, and means for varying the potential drop in said impedance means between said intermediate point and said cathodes.

7. The combination with a combined detector amplifier electric discharge device having a pair of control grids and a common cathode and a combined detector oscillator electric discharge device having a second pair of control grids and a second common cathode, of potential supply and volume control means therefor comprising a negative anode current supply lead to which said cathodes are connected in parallel, a potential drop producing impedance means in said connection, means providing a connection for the detector control grid of the first named device with the more negative end of said impedance means, means providing a connection for the amplifier control grid of the first named device and the detector control grid of the second named device with an intermediate point on said impedance means, and means for varying the impedance between said intermediate point and said cathodes.

8. The combination with an electric discharge device having a pair of control grids and a common cathode and a second electric discharge device having a second pair of control grids and a second common cathode, of means for supplying biasing potentials to said devices from a common supply source, said means comprising a negative anode current supply lead to which said cathodes are connected in parallel, and a potential drop producing impedance in said lead having a negative potential supply connection for a control grid of the first named device thus with a connection for a second grid of the first named device and a grid of the second named device with an intermediate point on said impedance means, said impedance means comprising a filter choke coil providing a fixed impedance element therein at the more negative end thereof, and a variable resistor providing a variable portion therefor at the more positive end thereof.

9. The combination with an electric discharge device having a pair of control grids and a common cathode and a second electric discharge device having a second pair of control grids and a second common cathode, of means for supplying biasing potentials to said devices from a common supply source, said means comprising a negative anode current supply lead to which said cathodes are connected in parallel, a potential drop producing impedance in said lead having a negative potential supply connection for a control grid of the first named device thus with a connection for a second grid of the first named device and a grid of the second named device with an intermediate point on said impedance means, said impedance means comprising a filter choke coil providing a fixed impedance element therein at the more negative end thereof, and a variable resistor providing a variable portion therefor at the more positive end thereof, and means for supplying operating current to said devices comprising a rectifier device having a cathode, a supply transformer having a single high voltage secondary winding connected with said rectifier device, and having a tap connected with said cathode, and a cathode heater circuit for said first

and second named devices connected in series with said rectifier cathode and a second tap connection on said high voltage secondary winding.

10. In a radio receiving system, the combination with an electric discharge amplifier device having a pair of control grids and a common cathode, of means for supplying differing control potentials and signal potentials to said control grids comprising a negative anode supply lead, impedance means in series between said cathode and said supply lead, said impedance means comprising a fixed impedance element at the more negative end thereof and a variable impedance element, means providing an input circuit for one of said control grids having connection with said impedance means to receive negative biasing potential therefrom, a variable potentiometer device in said connection, said potentiometer device having signal input terminals and a variable tap connected with said input circuit, and means providing a second input circuit for said second control grid connected with an intermediate tap point between said impedance elements.

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