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ELECTRONIC CIRCUIT

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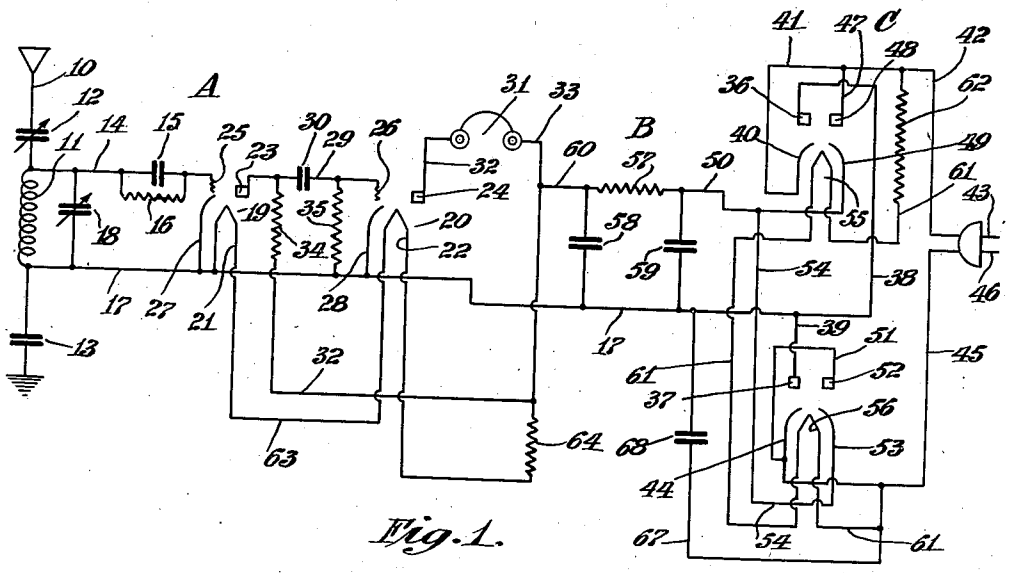


Fig. 1.

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ELECTRONIC CIRCUIT

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14 Claims. (Cl. 250—27)

The invention relates to electronic circuits, and more particularly to a construction and arrangement of an amplifying unit such as a radio receiving set, hearing aid or other appliances, and means for controlling the application of power thereto from any available electrical source, whether it be derived from ordinary house lighting circuits supplying either alternating or direct current, or from an electric battery.

Prior to my invention, the practice was to provide amplifying devices of the character above referred to, which were so constructed as to be used only with an alternating current source, or with a direct current source or with a battery source.

In later developments in the art, such devices were so constructed as to be capable of use with either alternating or direct current from a house lighting source supplying current of 110 volts or higher voltages.

In amplifying units for use with batteries, special high efficiency, low current drain tubes are used, but such tubes, prior to my invention, could not be used with current from an alternating current source for lighting and for other purposes about a house, since they would develop not only interfering hum, but the heaters thereof would be subject to rapid deterioration.

With the above conditions in mind, I have constructed a device of the character herein referred to, in which amplifying tubes of high efficiency and low current drain may be selectively used with an alternating current, with a direct current or with a battery current without the development of hum or without rapid deterioration of the heater or heaters of the amplifying tube or tubes.

Various types of tubes may be used in the device, but the electrical conditions in and about the tubes of the amplifier must be such as to permit the utilization therein of any of the current sources above referred to.

To secure the desired operation of the device, it is essential that a direct current, or a rectified and filtered alternating current be utilized in the heater of the amplifying tube or tubes, and that a rectifying unit be provided which will permit the use of the device with alternating current as well as with direct current, irrespective of the source and of the potential of such direct current.

In the device, I provide a rectifying unit embodying therein an electronic rectifying tube or tubes, connected by branch wires to terminals which may be connected with the terminals of a house lighting circuit, whether from a direct or an alternating current source, and embodying therein an arrangement of parts forming two independent paths alternatively automatically selected according to the polarity of the source, said unit having a single output terminal common to both branches which is connected with a filter.

In this manner, the device may be promiscuously connected with either a direct or an alternating current source, or with the terminals of an electric battery, irrespective of the polarity of the connection with said source or with said battery.

The invention consists in a combination of parts forming novel circuits as hereinafter set forth and described, and more particularly pointed out in the claims hereto appended.

In the accompanying drawing I have shown a wiring diagram of a device embodying the invention, in which the amplifying tubes have a direct or rectified and filtered alternating current impressed upon the heaters thereof.

In the embodiment of the invention shown in the drawing, the device has therein a translating device A, a filter B and a rectifying unit C.

In the accompanying diagram the invention is shown as applied to a radio receiving set having an antenna 10 and a line therefrom to ground, including therein an inductance 11 and condensers 12 and 13, one of which, as 12, is variable.

Leading from the antenna is a line 14 having therein the usual condenser 15 and grid leak resistor 16.

The return line of the amplifying unit is indicated at 17. Connected across this return line and the line 14 is the usual tuning condenser 18. The amplifying unit is shown as having two vacuum tubes 19 and 20, having respectively heater elements 21 and 22, anodes or plates 23 and 24, grids 25 and 26 and cathodes 27 and 28. The anode or plate 23 is connected with the grid 26 by a line 29 having therein a condenser 30.

The output member of the amplifying unit is indicated conventionally at 31, one terminal of this member being connected by a line 32 with the plate or anode 24, and the other terminal thereof having connected therewith a line 33, by means of which the current necessary to the operation of the amplifying unit A is impressed thereon. This line 33 is connected with the line 29 between the condenser 30 and the anode 23, a resistor 34 being in this line. A second re-

sistor 35 is connected across the lines 29 and 17 between the condenser 30 and the grid 26.

The construction of the amplifying unit above described is merely a conventional showing of such a unit, and is susceptible of wide variation.

The current supply for operating said amplifying unit must be furnished by devices so constructed and arranged as to permit the connection of the device with the outlet of a source which may be of either alternating or direct current, such as is commonly used for lighting purposes or the actuation of various electrical devices about a house, or with an ordinary electric battery.

In the device of the invention, the current supply for the anodes and the heaters of the vacuum tubes in the amplifying unit and for the heaters of the electronic rectifying tubes must be derived from the same source, irrespective of the character of this source, but said current for the amplifying unit anodes and heaters must be rectified and filtered.

Between the amplifying unit and the source, I provide a rectifying unit including therein two anodes 36 and 37, one of which is connected by a line 38 with the return line 17, and the other of which is connected with said line by a line 39.

Associated with the anode 36 is a cathode 40 connected by a line 41 with a branch line 42, and therethrough with one terminal 43 of the rectifying unit.

The anode 37 has an associated cathode 44 connected by a branch line 45 with the other terminal 46 of the rectifying unit.

Also connected with the branch line 42 by a line 47 is an anode 48, associated with which is a cathode 49, the rectifying unit being connected with the filter B, which will later be described, by an output line 50 connected with said cathode.

The branch line 45 is connected by a line 51 with an anode 52, having associated therewith a cathode 53 connected by a line 54 with the output line 50.

It will be noted that with the above arrangement, branch lines 42 and 45 are respectively connected with the anode of one electronic rectifying device and with the cathode of another electronic rectifying device, and that the cathodes associated with those anodes connected with said branch lines are both connected with the rectifier output line 50. It will also be observed that the anodes associated with the cathodes connected with said branch lines 42 and 45 respectively are both connected to the neutral return line 17.

By this arrangement, two constantly closed paths are provided between the source and the line 50 and between the return line 17 and the source, so that when current is flowing through either of these paths, leakage across the branch lines 42 and 45 is impossible.

With such an arrangement of electronic rectifying units, the polarity of the connection of the terminals 43 and 46 with the source, whether this source be an alternating or direct current, or an electric battery, is immaterial, since, according to the polarity, the current will automatically select the closed path connected with the positive terminals of the source. This is true even with an alternating current where there is a frequent reversal of this polarity.

Associated with the elements of the electronic rectifying unit and connected with the branch line 42 is a heater 55, and associated with the electronic rectifying unit and connected with the branch line 45 is a heater 56.

The filter B includes therein an inductance 57 and condensers 58 and 59. The output line of the filter is shown at 60 and is connected with the line 33 of the translating device. The condenser 58 is connected across the lines 50 and 17 while the condenser 59 is connected across the lines 60 and 17.

This construction of filter, associated with a rectifying unit like that above described, is like that shown in Letters Patent of the United States, No. 2,251,114 granted to me July 29, 1941, the present application being a division of that upon which said Letters Patent was granted.

In the embodiment of the invention shown in the drawing, the heaters 55 and 56 are connected in series across the branch lines 42 and 45 by a line 61 having therein a resistor 62, thus impressing, when the source is alternating current, raw alternating current upon the heater elements of the electronic rectifiers.

Since electronic rectifiers have heaters particularly adapted for use with currents derived from ordinary house lighting circuits derived from an alternating current source, there is no substantial deterioration in these heater elements, even after long continued use, when alternating current is impressed thereon. When a direct current derived from a house lighting circuit or an electric battery is used, deterioration is even slower than when the source is of alternating current.

The conditions in the heaters 21 and 22 of the vacuum tubes of the amplifying unit are radically different from the working conditions about the heaters 55 and 56, since low current drainage tubes must be used to adapt the amplifying unit for use with a current derived from a battery and such tubes are not adapted for use directly with current derived from the source utilized in lighting a house.

In order to provide a device of the character herein described, the amplifying unit must be capable of operation by a battery, a dry cell battery ordinarily being used, and it must also be capable of operation by current derived from ordinary house lighting sources after such current has been properly modified for this particular use, by passage through a rectifying unit and a filter.

To secure the desired result, in the embodiment of the invention shown in the drawing, I connect the heaters 21 and 22 in series with the output line 60 of the rectifying unit by a line 63 having therein a resistor 64, the last heater in the series being connected with the return line 17. Hence, the heaters 21 and 22 are energized by a unidirectional current of positive polarity and substantially constant potential which, when such is derived from an alternating current source, is rectified and filtered.

In the embodiment of the invention shown, I provide a shunt line 67 between the line 17 and the branch line 45, this line having therein a condenser 68.

The arrangement described adapts the device for use under three conditions, to wit: with an alternating current source, with a direct current source and with an electric battery source.

Referring to the use of the device with an alternating current, and assuming that the terminal 43 is of positive polarity, the current flow will be through the lines 42 and 47, anode 48, cathode 49 to the inductance or choke 57, through the line 50 and the lines 60 and 33 to the amplifying unit or translating device. The amplifying circuit includes the member 31, line 32, anode 24 and cathode 28 to the return line 17, line 39, an-

ode 37, and cathode 44 through the branch line 45 to the opposite terminal 46 of negative polarity. The condensers 58 and 59 are alternately charged and discharged in the usual manner.

The input signal is impressed upon the grid 25 in the manner usual in radio sets, the filter output being impressed upon the anode 23 through the line 32, resistor 34 and line 29, this circuit being completed through the cathode 27 to the return line 17. The condenser 30 is charged and discharged through the line 29 and resistor 35 to the return line 17.

Assuming that the terminal 46 is of positive polarity, the current flow will be through the lines 45 and 51 to the anode 52, cathode 53 and the line 54, through the line 50 to the filter, and from the amplifying unit through the line 17, line 38, anode 36, cathode 40 and line 41 to the branch line 42 and the negative terminal 43.

The circuits in the amplifying unit are the same in both instances, and a repetition thereof is therefore unnecessary.

If the supply be drawn from a direct current source, the circuit will vary according to the polarity of the connection with the source. If the terminal 43 be connected with the positive terminal of the source, the path including the anode 48 and cathode 49 upon the input side of the filter, and the anode 37 and cathode 44 upon the return side of the amplifying unit will be used, the current flow being the same as heretofore described in connection with the use of an alternating current source when the terminal 43 is of positive polarity.

On the other hand, if the terminal 46 be connected with the positive terminal of the source, the path which the current will take includes the anode 52, cathode 53 upon the input side of the filter, and the anode 36 and cathode 40 upon the return side of the amplifying unit, the same as when the terminal 46 is of positive polarity when an alternating current source is used.

If the source be an electric battery, the current flow will be as described in connection with a direct current supply from a house lighting circuit.

In the embodiment of the invention shown in the drawing, the heaters 55 and 56 are energized by raw alternating current, these heaters being especially adapted for use with such a current so as not to deteriorate rapidly.

The heaters 21 and 22, however, of the tubes in the amplifying unit must be of high efficiency, low current drain type, the resistance in such heaters being sufficiently high to adapt them to the lower voltages and low amperage available in a battery, and not suited for use with the higher voltages of a raw current supply drawn directly from a house lighting circuit.

In the drawing, the heaters 21 and 22 are energized by a rectified and filtered current, or by direct current drawn from the filter output, while in Fig. 2 these heaters, as well as the heaters 55 and 56, are energized from the same source.

I have found the use of the shunt line 67 and the condenser 68 therein to assist materially in adapting the device for use with the three sources of current herein referred to.

By using raw alternating current upon the heaters 55 and 56, it is possible to reduce the required capacity of the rectifiers and of the filter.

I have shown in the accompanying drawing, and have above described a construction of rectifying unit having substantially constant impedance and delivering a current of substantially constant potential with relation to the potential of the source, but it is obvious that other forms of rectifying units having these characteristics may be employed.

It is essential to the operation of the device, with the three types of sources of supply herein referred to, that the tubes used in the amplifying unit be adapted for use with a current drawn from an electric battery, and that the rectifying unit and the filter unit be adapted to this use of the device.

It is not my intention to limit the invention to the particular number and arrangement of parts shown in the accompanying diagrams, it being obvious that such may be varied without departing from the spirit and scope of the invention.

Having described the invention, what I claim as new and desire to have protected by Letters Patent, is:

1. In a device of the character described, the combination of an amplifying unit having a high efficiency, low current drain tube including therein an anode, a cathode, and means independent of said cathode whereby said tube may be energized, an output, and an input, a filter, having an output connected with said amplifying unit, an electronic rectifying unit having an input adapted to be connected with a source, and an output connected with said filter, whereby uni-directional current of positive polarity is impressed upon said filter and said amplifying unit, irrespective of whether said rectifying unit is connected with an alternating or a direct current source, connections between the output of said filter and the means for energizing the tube in said amplifying unit, whereby said tube is energized by a direct current, or by a rectified and filtered alternating current, according to the character of the current at the source, and a return line of substantially uniform potential throughout from the cathode of the tube of said amplifying unit to the source, whereby said return line is isolated from the connections for energizing said tube and said cathode is always of substantially uniform potential.

2. In a device of the character described, the combination of an amplifying unit having a high efficiency, low current drain tube having an anode, a cathode, and a heater, an output, and an input, a filter, having an output connected with the anode of said tube, an electronic rectifying unit having an input adapted to be connected with a source, and an output connected with said filter, whereby uni-directional current of positive polarity is impressed upon said filter and said amplifying unit, irrespective of whether said rectifying unit is connected with an alternating or a direct current source, connections between the output of said filter and the heater of said tube, whereby said tube is energized by a direct current, or by a rectified and filtered alternating current, according to the character of the current at the source, and a return line of substantially uniform potential throughout from the cathode of the tube of said amplifying unit to the source, whereby said return line is isolated from the connections for energizing said tube, and said cathode is always of substantially uniform potential.

3. In a device of the character described, the combination of an amplifying unit having a plurality of high efficiency, low current drain tubes, each having an anode, a cathode, and a heater, an output, and an input, a filter, having an out-

put connected with the anodes of said tubes, an electronic rectifying unit having an input adapted to be connected with a source, and an output connected with said filter, whereby uni-directional current of positive polarity is impressed upon said filter and said amplifying unit, irrespective of whether said rectifying unit is connected with an alternating or a direct current source, a line from the output of said filter connecting said heaters in series, and a return line of substantially uniform potential throughout from the cathodes of said tubes respectively to the source, whereby said return line is isolated from the connections for energizing said tubes, and said cathodes are always of substantially uniform potential.

4. In a device of the character described, the combination of an amplifying unit having a high efficiency, low current drain tube having an anode, a cathode, and means independent of said cathode whereby said tube may be energized, an output, and an input, a filter, having an output connected with said amplifying unit, an electronic rectifying unit having an input adapted to be connected with a source, and an output connected with said filter, whereby uni-directional current of positive polarity is impressed upon said filter and said amplifying unit, irrespective of whether said rectifying unit is connected with an alternating or a direct current source, connections between the output of said filter and the means for energizing the tube in said amplifying unit, whereby said tube is energized by a direct current, or by a rectified and filtered alternating current, according to the character of the current at the source, a return line of substantially uniform potential throughout from the cathode of the tube of said amplifying unit to the source, whereby said return line is isolated from the connections for energizing said tube, and said cathode is always of substantially uniform potential, and a shunt circuit having a condenser therein from said return line around said rectifying unit to the source.

5. In a device of the character described, the combination of an amplifying unit having a high efficiency, low current drain tube having an anode, a cathode, and a heater, an output, and an input, a filter, having an output connected with said amplifying unit, means affording two constantly closed paths through which current may alternatively flow, including an electronic rectifying unit having substantially constant impedance and delivering current of a potential substantially constant in relation to that of a house lighting alternating current or direct current source, having an input and an output, two branch lines adapted to be connected respectively with the terminals of a source in the input of said rectifying unit, and connections between the output of said rectifying unit and said amplifying unit, whereby uni-directional current of positive polarity is impressed upon said filter and said amplifying unit irrespective of the source or the polarity of such connection, connections between the output of said filter and said heater, whereby said tube is energized by a direct current, or by a rectified and filtered alternating current, according to the character of the current at the source, and a return line of substantially uniform potential throughout from the cathode of the tube of said amplifying unit to the source, whereby said return line is isolated from the connections for energizing said tube, and said cathode is always of substantially uniform potential.

6. In a device of the character described, the combination of an amplifying unit having a high efficiency, low current drain tube having an anode, a cathode, and a heater, an output member, and a radio frequency input, a filter, having an output connected with said amplifying unit, two branch lines adapted to be connected respectively with the terminals of a house lighting alternating or a direct current source, a return line of substantially uniform potential throughout from the cathode of the tube of said amplifying unit to both of said branch lines, a rectifying unit having an output connected with said filter, said unit embodying therein two electronic rectifying devices, the anode of one of which and the cathode of the other of which are connected with one of said branch lines, and two other electronic rectifying devices, the anode of one of which and the cathode of the other of which are connected with the other branch line, the cathodes associated with the anodes connected with said branch lines both being connected with said filter, and the anodes associated with the cathodes connected with said branch lines both being connected with said return line, whereby two constantly closed paths through which current may alternatively flow are provided, said rectifying devices having substantially constant impedance and delivering current of a potential substantially constant in relation to that of the source, and uni-directional current of positive polarity is impressed upon said filter and said amplifying unit irrespective of the source or the polarity of such connection, and connections between the output of said filter and the heater of the tube in said amplifying unit, whereby said tube is energized by a direct current, or by a rectified and filtered alternating current, according to the character of the current at the source, said return line is isolated from the connections for engaging said tube, and said cathode is always of substantially uniform potential.

7. In a device of the character described, the combination of an amplifying unit having a high efficiency, low current drain tube having an anode, a cathode, and a heater, an output member, and a radio frequency input, a filter, having an output connected with said amplifying unit, two branch lines adapted to be connected respectively with the terminals of a house lighting alternating or a direct current source, a return line of substantially uniform potential throughout from the cathode of the tube of said amplifying unit to both of said branch lines, a rectifying unit having an output connected with said filter, said unit embodying therein two electronic rectifying devices, the anode of one of which and the cathode of the other of which are connected with one of said branch lines, and two other electronic rectifying devices, the anode of one of which and the cathode of the other of which are connected with the other branch line, the cathodes associated with the anodes connected with said branch lines both being connected with said filter, and the anodes associated with the cathodes connected with said branch lines both being connected with said return line, whereby two constantly closed paths through which current may alternatively flow are provided, said rectifying devices having substantially constant impedance and delivering current of a potential substantially constant in relation

to that of the source, and uni-directional current of positive polarity is impressed upon said filter and said amplifying unit irrespective of the source or the polarity of such connection, heaters in said electronic rectifying devices respectively, a series connection including said heaters extending from one of said branch lines to the other, whereby the potential of the source is applied to said heaters, and connections between the output of said filter and the heater of the tube in said amplifying unit, whereby said tube is energized by a direct current, or by a rectified and filtered alternating current, according to the character of the current at the source, said return line is isolated from the connections for energizing said tube, and said cathode is always of substantially uniform potential.

8. In a device of the character described, the combination of an amplifying unit having a high efficiency, low current drain tube having an anode, a cathode, and a heater, an output, and an input, a filter, having an output connected with said amplifying unit, means affording two constantly closed paths through which current may alternatively flow, including an electronic rectifying unit having substantially constant impedance and delivering current of a potential substantially constant in relation to that of a house lighting alternating current or direct current source, two branch lines adapted to be connected respectively with the terminals of a source, whereby uni-directional current of positive polarity is impressed upon said filters and said amplifying unit irrespective of the source or the polarity of such connection, connections between the output of said filter and said heater, whereby said tube is energized by a direct current, or by a rectified and filtered alternating current, according to the character of the current at the source, a return line of substantially uniform potential throughout from the cathode of the tube of said amplifying unit to the source, whereby said return line is isolated from the connections for energizing said tube, and said cathode is always of substantially uniform potential, and a shunt circuit having a condenser therein from said return line around said rectifying unit to the source.

9. In a device of the character described, the combination of an amplifying unit having a high efficiency, low current drain tube having an anode, a cathode, and a heater, an output member, and a radio frequency input, a filter, having an output connected with said amplifying unit, two branch lines adapted to be connected respectively with the terminals of a house lighting alternating or a direct current source, a return line of substantially uniform potential throughcut from the cathode of the tube of said amplifying unit to both of said branch lines, a rectifying unit having an output connected with said filter, said unit embodying therein two electronic rectifying devices, the anode of one of which and the cathode of the other of which are connected with one of said branch lines, and two other electronic rectifying devices, the anode of one of which and the cathode of the other of which are connected with the other branch line, the cathodes associated with the anodes connected with said branch lines both being connected with said filter, and the anodes associated with the cathodes connected with said branch lines both being connected with said return line, whereby two constantly closed paths through which current may alternatively flow are provided, said rectifying devices having substantially constant impedance and delivering current of a potential substantially constant in relation to that of the source, and uni-directional current of positive polarity is impressed upon said filter and said amplifying unit irrespective of the source or the polarity of such connection, heaters in said electronic rectifying devices respectively, a series connection including said heaters extending from one of said branch lines to the other, whereby the potential of the source is applied to said heaters, connections between the output of said filter and the heater of the tube in said amplifying unit, whereby said return line is isolated from the connections for energizing said tube, and said cathode is always of substantially uniform potential, and a shunt circuit having a condenser therein from said return line around said rectifying unit to the source.

10. In a device of the character described, the combination of an amplifying unit having a plurality of high efficiency, low current drain tubes, each having an anode, a cathode, and a heater, an output, and an input, a filter, having an output connected with said anodes respectively, an electronic rectifying unit having an input adapted to be connected with a source, and an output connected with said filter, whereby uni-directional current of positive polarity is impressed upon said filter and said amplifying unit, irrespective of whether said rectifying unit is connected with an alternating or a direct current source, a line from the output of said filter connecting said heaters in series, whereby said tubes are energized by a direct current, or by a rectified and filtered alternating current, according to the character of the current at the source, a return line of substantially uniform potential throughout from the cathodes of said tubes to the source, whereby said return line is isolated from the connections for energizing said tube, and said cathodes are always of substantially uniform potential and a shunt circuit having a condenser therein from said return line around said rectifying unit to the source.

11. A circuit of the character described embodying therein a translating device, an amplifying unit having a multi-electrode vacuum tube including a heater, a cathode and an anode, an electronic rectifier including a heater, a cathode and an anode, means whereby said rectifier may be selectively connected with an alternating or a direct current source, means whereby the cathode of the rectifier is heated, a filter connected to the output of said rectifier, and connections from said filter to said translating device and to the anode of, and the heater for heating the cathode of, said vacuum tube, whereby said vacuum tube is energized by a substantially direct current, regardless of the character of the current at the source.

12. A circuit of the character described embodying therein a translating device, an amplifying unit having a multi-electrode vacuum tube including a heater, a cathode and an anode, an electronic rectifier including a heater, a cathode and an anode, means whereby said rectifier may be selectively connected with an alternating or a direct current source, a filter having an input and an output, said filter input being connected to the output of said rectifier, connections between each side of the source and said heater, whereby the rectifier is energized directly from the source regardless of the char-

acter of the current at the source, and connections from the output of said filter to said translating device, to the anode of, and the heater for heating the cathode of, said vacuum tube, whereby said vacuum tube is energized by a substantially direct current, regardless of the character of the current at the source.

13. A circuit of the character described embodying therein a translating device, an amplifying unit having a multi-electrode vacuum tube including a heater, a cathode and an anode, an electronic rectifier including a heater, a cathode and an anode, means whereby said rectifier may be selectively connected with an alternating or a direct current source, means whereby the cathode of the rectifier is heated, a filter connected to the output of said rectifier, connections from said filter to said translating device and to the anode of, and the heater for heating the cathode of, said vacuum tube, whereby said vacuum tube is energized by a substantially direct current, regardless of the character of the current at the source, a return line from the tube of said amplifying unit to said rectifier, and a shunt connection having a condenser therein, from said return line around said rectifier to the source.

14. A circuit of the character described embodying therein a translating device, an amplifying unit having a multi-electrode vacuum tube including a heater, a cathode and an anode, an electronic rectifier including a heater, a cathode and an anode, means whereby said rectifier may be selectively connected with an alternating or a direct current source, a filter having an input and an output, said filter input being connected to the output of said rectifier, connections between each side of the source and said heater, whereby the rectifier is energized directly from the source regardless of the character of the current at the source, connections from the output of said filter to said translating device, to the anode of, and the heater for heating the cathode of, said vacuum tube, whereby said vacuum tube is energized by a substantially direct current, regardless of the character of the current at the source, a return line from the tube of said amplifying unit to said rectifier, and a shunt connection having a condenser therein, from said return line around said rectifier to the source.

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