June 15, 1937. R. P. WIRIX 2,083,626

AMPLIFYING CIRCUITS

Filed April 3, 1934

Fig. 1

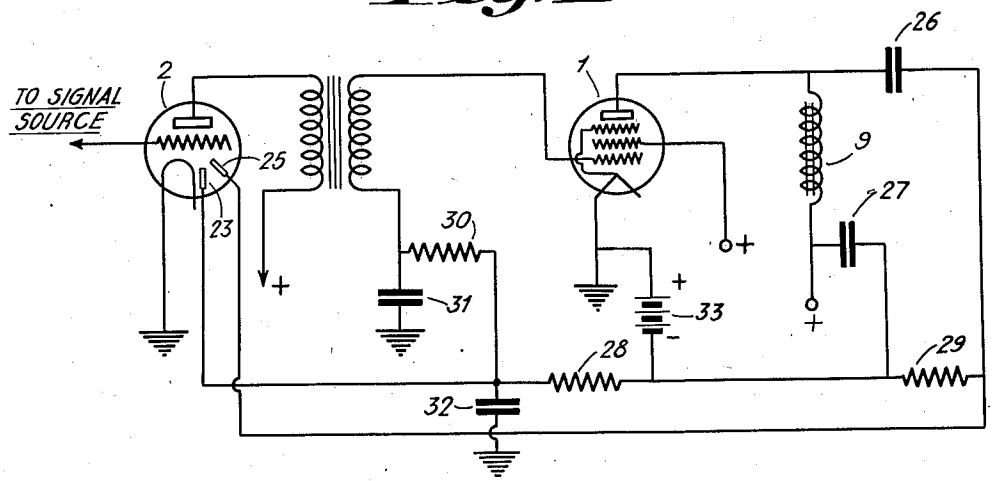


Fig. 2

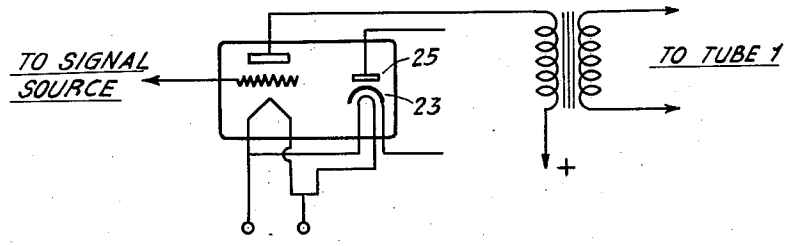
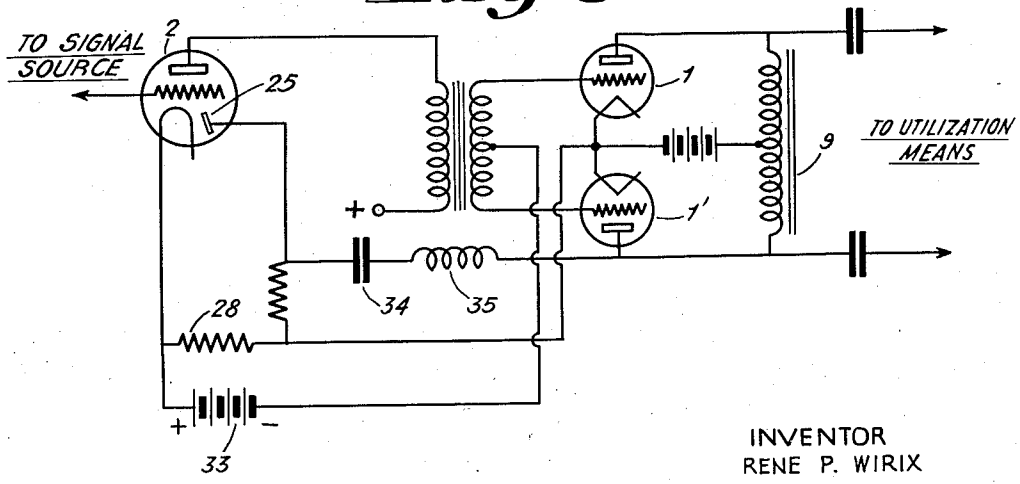


Fig. 3



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AMPLIFYING CIRCUITS

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In Germany June 20, 1933

4 Claims. (Cl. 179—171)

The present invention relates to amplifying installations and concerns an improvement and further perfections of the installations disclosed by A. van de Riet in application Serial No. 652,996, filed January 23rd, 1933, in which an amplifying tube has supplied to it a grid bias which varies with the amplitude of the signal voltage to be amplified, in such a manner that when the amplitude of the signal voltage decreases the grid bias becomes more negative, a saving of anode current being thus obtained which more particularly with battery apparatus is advantageous. This is, however, also of importance for apparatus supplied from the mains as the length of life of a tube depends on the average emission of the cathode, that is to say the length of life is larger according as the average anode current with which the tube is loaded is smaller. The above-mentioned variation of the grid bias is obtained by rectifying part of the amplified energy and by leading it back to the grid circuit.

The improvement according to the present invention consists in that the system for the rectification is incorporated in one of the amplifying tubes. It has proved to be most advantageous of all to incorporate the rectifying system in one of the tubes of the preliminary amplification stages. The final tube less suits this purpose for this would result in an appreciable reduction of the total emission of this tube which emission is destined for a large output.

The invention provides a material simplification of the installations described in the aforesaid application. The improvement is also of importance because there exist tubes which are furnished for other purposes such, for example, as detection, with an additional small anode and which may be employed in an amplifier according to the present application without taking any further measures. It is a surprising circumstance that although part of the output energy is led back, the system does not give rise to disturbing phenomena of retroaction. If desired, the working may be improved still further by screening the auxiliary anode from the control grid.

In the drawing:—

Fig. 1 shows a circuit embodying one form of the invention,

Fig. 2 shows a modification,

Fig. 3 illustrates still another form of the invention.

In Fig. 1, **1** denotes the final tube; **9** is the output choke. Part of the output energy is supplied through condensers **26** and **27** to a rectifying system **23—25** which is incorporated in an amplifying tube **2**. **23** is the cathode which is to be indirectly heated and **25** is the anode. The rectified current flows through a resistance **28** with the result that owing to the fact that the voltage across this resistance counteracts the voltage of the bias battery **33**, the negative voltage applied to the control grid of the final tube decreases when the amplitude of the low-frequency voltages to be amplified increases. **31** and **32** are smoothing condensers, and **30** is a leakage resistance. In the installations described the filaments may be connected up to the same source of voltage.

The amplifying tube may also be constructed as shown in Fig. 2, that is: be furnished with two separate filaments connected in parallel. The advantage of this construction is that the correct temperature of the cathode can be more easily attained. It may be of advantage to connect within the tube the two filaments at one end to one another, and to lead the two other ends separately to the outside and to interconnect them there.

Fig. 3 represents a circuit-arrangement in which the final amplification stage comprises two tubes **1** and **1'** in push-pull connection. Part of the output energy is supplied through a condenser **34** to the rectifying system. The resistance **28** is consequently traversed by a direct current which depends on the amplitude of the amplified currents with the result that across the ends of the resistance there is set up a voltage which counteracts the voltage of the battery **33**. The condenser **34** more readily allows the high-frequency currents to pass than the low-frequency currents. In order to compensate for this action a choke coil **35** is connected in series with the condenser, an action substantially independent of the frequency being thus obtained. The system for rectification and the amplifying tube **2** in which it is incorporated have one common cathode. The anode **25** may be formed in a known manner as a small ring surrounding the cathode and located outside the main anode. A common source of filament current is not possible with this circuit arrangement. This drawback may however be removed in a simple manner by equipping the tube **2** or the tubes **1** and **1'** with a cathode which is to be indirectly heated. When slightly modified the circuit-arrangement shown in Fig. 3 may also be applied to a final stage comprising a single tube.

What I claim is:—

1. In combination, a plurality of cascade-coupled audio frequency amplifier tubes, the last of

said tubes having associated therewith input and output circuits, means for negatively biasing the input electrode of said last tube, a resistor connected in said input circuit in series with the biasing means, said output circuit having coupled to it a circuit comprising said resistor and a diode rectifier contained in one of said tubes preceding the last tube for producing a voltage across said resistor proportional to the amplified signal, the produced voltage being such that it opposes the voltage impressed on the input electrode of the last tube by the biasing means.

2. The combination defined in claim 1 wherein the coupling between the output circuit and the circuit comprising the resistor and diode rectifier includes a series-connected inductance and condenser whereby the energy transfer from said output circuit is substantially independent of the frequency.

3. A multi-stage audio frequency amplifier comprising a last stage amplifier tube having associated therewith input and output circuits and a preceding amplifier tube having its output circuit coupled to the input circuit of the last stage, means for providing a fixed bias for the input electrode of said last stage amplifier tube, diode rectifier elements contained within said preceding amplifier tube, and a circuit, including said rectifier elements and a resistor, coupled to the last stage output circuit for producing a voltage across said resistor proportional to the amplified signals, said resistor being included in the last stage input circuit and in series with the aforesaid fixed biasing means.

4. A multi-stage audio frequency amplifier comprising a last stage consisting of two tubes connected in push-pull relation and having associated therewith input and output circuits and a preceding amplifier tube having its output circuit coupled to the input circuit of the last stage, means for providing a fixed bias for the input electrodes of said last stage, diode rectifier elements contained within said preceding amplifier tube, and a circuit, including said rectifier elements and a resistor, coupled to the last stage output circuit for producing a voltage across said resistor proportional to the amplified signals, said resistor being included in the last stage input circuit and in series with the aforesaid fixed biasing means.

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