June 21, 1938. A. VAN DE RIET 2,120,995

AMPLIFYING ARRANGEMENT

Filed Jan. 23, 1933

Fig. 1

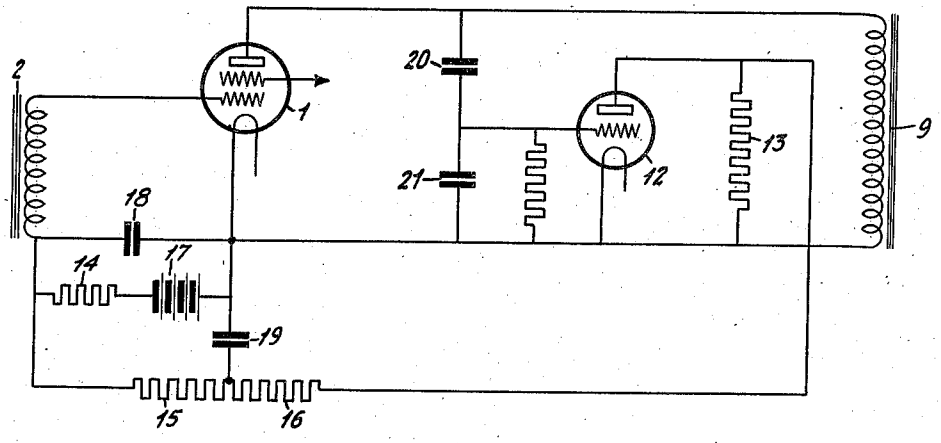
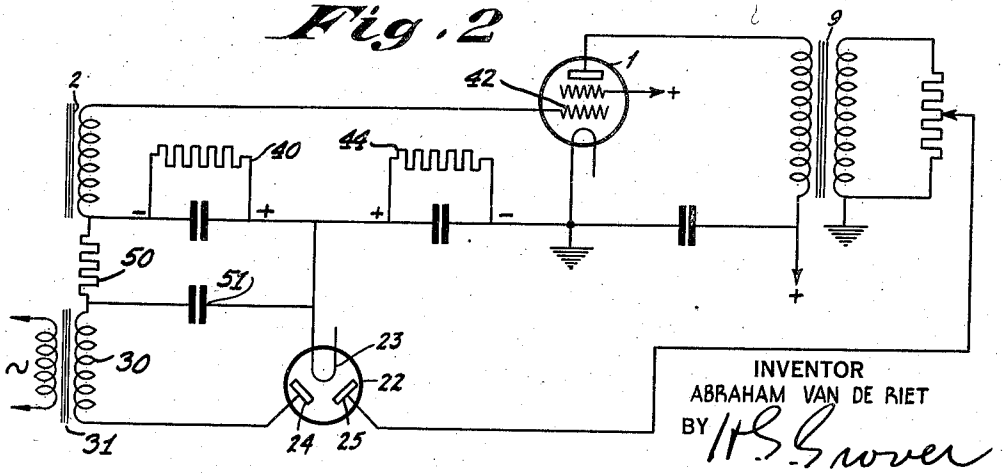


Fig. 2



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Patented June 21, 1938 2,120,995

UNITED STATES PATENT OFFICE

2,120,995

AMPLIFYING ARRANGEMENT

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Application January 23, 1933, Serial No. 652,996
In the Netherlands April 26, 1932

5 Claims. (Cl. 179—171)

This invention has reference to amplifying arrangements, and provides means for increasing the alternating current energy delivered by an amplifying valve without the mean anode dissipation being exceeded.

At a given anode dissipation the alternating current energy delivered by an amplifying valve can only be increased if at the same time the direct current energy delivered is reduced. A reduction of the direct current energy in the output circuit can be obtained at a given anode voltage by the use of a negative grid bias. The value of this grid bias is, however, limited by the condition that the valve should always operate on a linear part of the anode current-grid voltage characteristic curve. That is to say, the algebraic sum of the negative grid bias and the maximum alternating voltage to be amplified should not be so large that the valve operates on a curved part of the characteristic.

In well known circuit arrangements, generally, constant voltages are supplied to the anode and grid of the amplifying valve. The value of these voltages is dependent upon the conditions that a given anode dissipation should not be exceeded, and that a certain maximum voltage should be susceptible to a linear amplification. Independently of the value of the alternating voltage to be amplified at a given moment, a constant direct current energy is delivered by a valve adjusted in the manner of said well known arrangements.

The invention provides for an arrangement in which the direct current energy delivered is not constant, and in which this energy is smaller than in the case above described so that a higher alternating current energy can be admitted for a given valve. The amplifying arrangement, according to the invention, is characterized by a grid bias which is so variable with the signal voltage to be amplified that when the signal voltage decreases the grid bias becomes more negative.

Thus, in the case of feeble signals, a high, and, in the case of more powerful signals, a lower negative grid bias is applied to the amplifier valve. In any case this grid bias should be such that the algebraic sum of the bias and of the voltage to be amplified is smaller than a voltage by which the valve would be adjusted to a curved part of the characteristic curve. Preferably, the adjustment is such that the sum hereinbefore indicated of the grid voltages is substantially constant, and is so large as to prevent the valve from operating on a curved part of the characteristic.

This arrangement ensures that in the case of feeble signals, also, the direct current energy delivered is smaller than in the case of powerful signals. Thus, the total direct current energy delivered decreases when receiving weak signals, whereas, the alternating current energy delivered remains unvaried so that the total quantity of energy delivered is reduced, and the tube is not fully loaded. Consequently, the primarily impressed signal voltage can be increased. This results in an increase of anode direct and alternating current energy until the admissible load of the tube is reached again.

The circuit arrangement according to the invention is particularly advantageous for valves having to deliver a high power; consequently, for example, for the last valve in an amplifying circuit arrangement. The alternating current energy delivered by a given type of amplifying valve is increased by the use of the invention.

In order that the invention may be clearly understood and readily carried into effect two embodiments thereof will now be described more fully with reference to the accompanying drawing, in which:

Fig. 1 shows the last amplifying stage of a battery receiver embodying the invention;

Fig. 2 shows a modification employing power amplifier supplied with alternating current.

Referring to Fig. 1, 1 designates a thermionic valve illustrated as a screen grid valve. Its input circuit includes an impedance 2 which is, for example, the secondary of a transformer to which the voltages to be amplified are supplied. The output circuit of the valve includes an output impedance 9; for example, the primary of a transformer to which a loudspeaker may be connected. The screen grid is connected to a point of the anode voltage battery (not shown to preserve simplicity of disclosure).

The valves used may comprise directly, or indirectly, heated cathodes which are supplied with direct, or alternating, current. Generally, it is desirable to withdraw the voltages to be rectified from the output circuit of the amplifier, as the voltages which occur in the input circuit are often too small to ensure a proper control, and moreover, a connection of the rectifier in parallel with the input circuit results in a rather great decrease of the amplification. Generally, therefore, a part of the output voltage will be rectified, and in this case said part should be so large that the grid voltage of the amplifying valve is constantly as much as possible negative but

always so that no operation ensues in a curved part.

The diagram shown in Fig. 1 represents the last stage of a battery amplifier and can be used, for example, in a portable set. Such a device is always supplied with direct current. In this case it is important that the cathodes of all the valves should be connected to the same source of voltage. This condition is satisfied in the circuit arrangement illustrated. A triode 12 which is connected as a grid detector is used as the rectifier. The anode circuit of this valve includes a high resistance 13. When no signal is impressed on the input circuit 2 of valve 1, the anode current of valve 12 is a maximum.

The potential drop across the resistance 13 is thus high, and the voltage at the plate of valve 12 is consequently low. This voltage summed up with the voltage of battery 17 is supplied to the grid of valve 1 by means of a potentiometer 14, 15, 16. Thus, the negative grid voltage of this valve is rendered a maximum, but the grid voltage is not negative enough to operate the tube on the curved portion of the characteristic. Now, if an alternating voltage is supplied to the input circuit of valve 1, this results in that the voltage at the input circuit of the detector is lowered, the current passing through resistance 13 decreases, and the voltage at the plate of valve 12 consequently increases. Thus, the grid voltage of valve 1 becomes less negative. The grid bias is smoothed by means of condensers 18 and 19. The condensers 20 and 21 constitute a capacitative potentiometer on the output circuit by which a desired part of the voltage is supplied to the detector valve. The condenser 20 serves simultaneously as a grid condenser for this detector valve.

If a final valve of very great power is used, preferably an arrangement as shown in Fig. 2 may be utilized. In this arrangement use is made of valves supplied with alternating current. The grid bias for the amplifying valve is delivered by two rectifiers preferably housed in one valve and having one common cathode. The rectifier formed by the cathode 23 and the anode 24 is connected to a winding 30 of the public supply transformer 31 and consequently delivers a constant rectified voltage. The rectifier formed by the cathode 23 and the anode 25 is connected to a part of the output impedance 9 of valve 1 so that this rectifier produces voltages the value of which depends on the signal voltage. The two rectified voltages are smoothed in known manner, and are supplied in opposite directions to the input circuit of the amplifying valve so that the bias of this valve varies in the desired manner with the signal intensity. The current from supply source 31 is rectified, and develops across resistor 40 a direct current voltage. Since the signal grid is connected to the anode side of resistor 40, the signal grid is negatively biased to a constant value; as explained previously this value is not great enough to operate the tube 1 on the curved portion of the characteristic. A portion of the signal energy is rectified by diode 25—23; resistor 41 having developed thereacross a direct current voltage proportional in magnitude to the signal intensity. Since the resistor 41 is connected in series between the cathode of tube 1 and resistor 40, and the positive end of the latter is connected to the positive terminal of resistor 41, the voltages across both resistors oppose each other. Hence, with increasing signal intensity the negative bias of grid 1 is reduced by the positive voltage across resistor 41. Each of resistors 40 and 41 is shunted by a condenser of low impedance to signal currents. Resistor 50 functions as a high impedance to signal currents; condenser 51 is a path of low impedance to current from source 31.

While I have indicated and described several systems for carrying my invention into effect, it will be apparent to one skilled in the art that my invention is by no means limited to the particular organizations shown and described, but that many modifications may be made without departing from the scope of my invention as set forth in the appended claims.

What is claimed is:

1. In combination with an audio frequency amplifier, an audio frequency signal input circuit coupled to the amplifier input electrodes, an output circuit coupled to the output electrodes of the amplifier, a source of alternating current potential, a diode rectifier coupled to said source, a direct current connection between said input circuit and the diode anode whereby the amplifier signal grid is maintained at a negative direct current potential with respect to the cathode, and means, responsive to variations in the amplifier output amplitude, for varying said signal grid bias.

2. In combination with an audio frequency amplifier, an audio frequency signal input circuit coupled to the amplifier input electrodes, an output circuit coupled to the output electrodes of the amplifier, a source of alternating current potential, a diode rectifier coupled to said source, and a direct current connection between said input circuit and the diode anode whereby the amplifier signal grid is maintained at a negative direct current potential with respect to the cathode, a second anode in the envelope of said diode, and a path of low impedance to the audio output of said amplifier connected between the amplifier output circuit and said second anode.

3. In combination with an audio frequency amplifier, an audio frequency signal input circuit coupled to the amplifier input electrodes, an output circuit coupled to the output electrodes of the amplifier, a source of alternating current potential, a diode rectifier coupled to said source, and a direct current connection between said input circuit and the diode anode whereby the amplifier signal grid is maintained at a negative direct current potential with respect to the cathode, said diode being provided with a second anode adjacent the diode cathode, a signal connection between the amplifier output circuit and the second anode, said diode cathode and second anode being connected together to provide a diode rectifier for developing a biasing direct current voltage from amplified signal currents which biases said amplifier in a direction to increase the amplifier plate current flow.

4. In combination with a source of audio frequency signals, an audio frequency signal amplifier, a potential source for applying a constant negative bias to the amplifier grid sufficient in magnitude to adjust the amplifier operation to a predetermined point on the linear portion of the amplifier grid potential-plate current characteristic, a rectifier tube coupled to the amplifier output circuit to rectify audio signals, a resistor connected in the space current path of said rectifier for developing an amplifier grid biasing voltage which varies in magnitude

with the amplitude of the audio signals impressed on the rectifier, means for impressing said varying bias voltage on the amplifier grid in a sense to decrease said negative bias, and the magnitude of said varying biasing voltage being maintained within such limits as to operate the amplifier over the linear portion solely of its said characteristic.

5. In combination with an electric wave amplifier tube, a source of waves, to be amplified, coupled between the wave input grid and cathode of said tube, said cathode being at a relatively fixed potential, a source of alternating current energy, a rectifier circuit, including an impedance, coupled to said alternating current source, said impedance being connected in series between the said grid and cathode of said amplifier tube and having a magnitude such that the direct current voltage developed thereacross, by rectification of said alternating current, is sufficient to maintain said control grid at a predetermined negative direct current potential with respect to the cathode, a second rectifier circuit, including an impedance, arranged to have waves amplified by said amplifier impressed thereupon from the amplifier output circuit, said impedance being connected between the control grid and cathode of said amplifier tube and having a magnitude such that the direct current voltage developed thereacross, by rectification of said amplified waves, biases said control grid in a positive direction with respect to said cathode.

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