

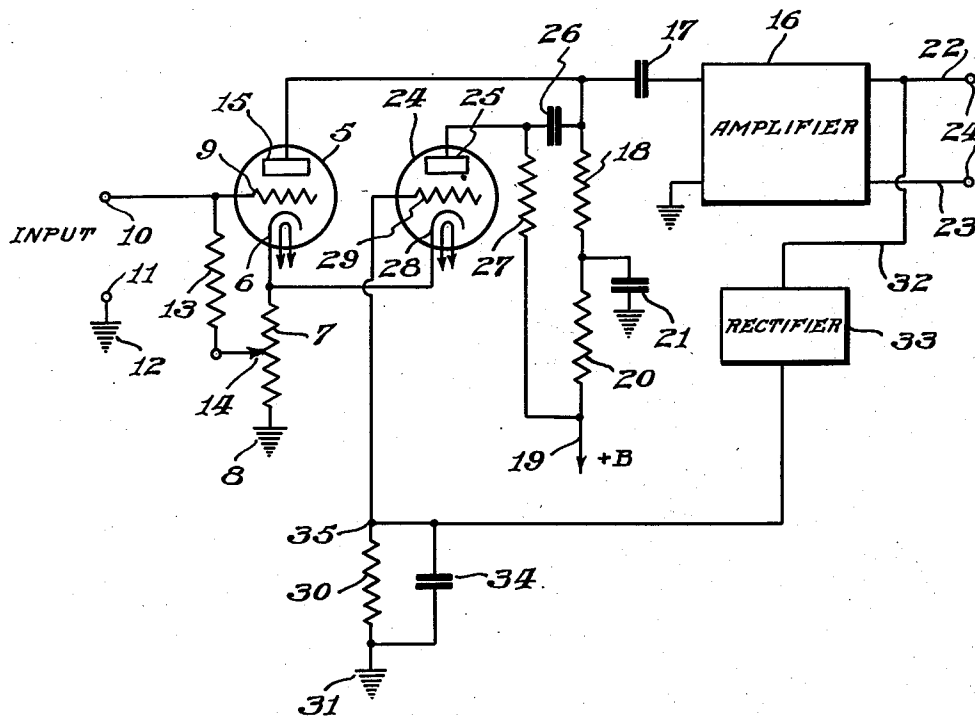
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INVERSE FEEDBACK AMPLIFIER

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INVERSE FEEDBACK AMPLIFIER

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3 Claims. (Cl. 179—171)

The present invention relates to inverse feedback amplifiers, and has for its principal object to provide an amplifier of the character referred to in which the gain is caused to vary by inverse feedback and bias control conjointly as a function of the output voltage to maintain said output voltage substantially constant.

It is also an object of the present invention to provide an audio frequency amplifier and an inverse feedback circuit therein for reducing distortion caused by signal overload, whereby optimum bias and anode potentials may be provided initially for operation of the amplifier.

Another object of the present invention is to provide an audio frequency amplifier having an amplifier stage, the output circuit of which is controlled in impedance and varied as a function of the output voltage of the system by inverse feedback in said stage.

The invention will, however, be better understood from the following description when considered in connection with the accompanying drawing, and its scope is pointed out in the appended claims.

Referring to the drawing, the figure shown therein is a schematic circuit diagram of an audio frequency amplifier embodying the invention and comprising an amplifier tube 5 having a cathode 6 in circuit with which is an unbypassed feedback resistor 7 connected to the negative anode supply circuit represented by chassis or ground connection 8. The control grid 9 of the amplifier stage is connected to signal input terminals 10 and 11, the latter being connected to chassis or ground 12 and thence to the cathode. Bias potential for the grid 9 is supplied through a grid resistor 13 connected to a tap 14 on the feedback resistor 7 in the cathode circuit.

The output anode 15 is coupled to a succeeding amplifier 16 through a coupling capacitor 17. The plate or anode circuit of the amplifier 5 includes a coupling resistor 18 connected between anode and a positive anode potential supply lead 19. This connection includes a filter comprising a series resistor 20 and shunt bypass capacitor 21.

The amplifier output circuit is indicated by the leads 22 and 23 connected to output terminal 24, the lead 22 being the high potential side of the circuit.

The audio frequency output circuit of the amplifier stage 5 includes the output coupling resistor 18, the bypass capacitor 21 and the unbypassed cathode or feedback resistor 7 and,

because of the fact that the cathode resistor 7 is unbypassed, the amplifier is made degenerative to an extent depending upon the relative resistance values of the resistors 18 and 7. This is made such that the amplifier gain is established at a predetermined level in the absence of signals and with optimum values of the anode and biasing potential for most effective operation.

A control tube 24 is connected to act as part of the plate load resistor of the tube 5; that is, with its anode-cathode impedance in parallel with the resistor 18. In the present example, the anode 25 of the tube is coupled through a suitable coupling capacitor 26 with the anode end of the plate resistor 18 of the tube 5 and is supplied with anode potential through a resistor 27 from the positive anode supply lead 19.

The cathode 28 is connected with the resistor 7 and the control grid 29 is connected through a source of controlling potential 30 with chassis or ground 31, whereby initially the full bias across the resistor 7 is applied between grid 29 and cathode 28 sufficient to bias the tube 24 substantially to cut-off, whereby its shunting effect across the resistor 18 initially, and in the absence of signals, is substantially zero.

The control grid bias on the control tube 24 is varied to control the amplifier gain by suitable means as a function of the output voltage of the system, thereby to change the gain of the system as the output potential tends to increase. To this end, a portion of the output voltage from the output circuit is taken from the output lead 22 through a connection 32 and is applied through a rectifier device 33 to the source 30 which comprises a resistor provided with a bypass capacitor 34.

With this arrangement, the resistor 30 becomes a source of variable biasing potential responsive to variations in the output voltage of the amplifier system and the connections are such that, as the output voltage of the amplifier increases, the grid terminal 35 of the source 30 increases in a positive direction to lower the anode-cathode impedance of the control tube 24, thereby reducing the plate load impedance of the tube 5 and causing a change in the relative potential drop in the plate resistor 18 and the feedback resistor 7.

The result of this operation is to cause the drop in potential in the plate resistor 18 to be reduced and the drop in potential through the feedback resistor to be increased, thereby increasing the degree of inverse feedback and

thereby reducing the gain of the amplifier stage 5 to compensate for an increase in the output of the amplifier system.

It will be appreciated that the rectifier 33 may be so connected that the terminal 35 of the output resistor 30 or potential source may increase in a negative direction with increased output potential, thereby to provide an increase in gain with increased signal output, resulting in volume expansion, if desired.

With the connections shown for maintaining the output potential substantially constant as the signal input potential applied to terminals 10 and 11 increases, the inverse feedback increase effected in the feedback resistor 7, while causing the gain to be reduced, also causes the amplifier stage 5 to carry the increased signal input without distortion since the inverse feedback potential developed in the resistor 7 is in opposition to the signal input potential.

The change in anode current of tube 24 is also used to obtain a corresponding bias change in tube 15, the amount of which may be controlled by the position of the tap 14 connecting resistor 13 to the feedback resistor 7. Thus, the gain in the system is varied both by the effect of increasing bias and increasing feedback.

From the foregoing description, it will be seen that a variable gain amplifier is provided by utilizing inverse feedback in a single amplifier stage through the control of the relative impedance values of an impedance element in the anode circuit of the amplifier and in the cathode circuit of the amplifier.

A control tube having its anode-cathode impedance shunting the output anode impedance is arranged to control the potential drop in the anode circuit and, in the cathode impedance, which is unbypassed, so that, as the output potential tends to increase for any reason, such as with increased input potential applied to the amplifier, the relative drop in signal potential between the plate impedance and the cathode impedance of the amplifier stage is varied, the cathode impedance providing an increasing potential drop and inverse feedback, thus controlling the overall gain of the amplifier.

In addition, by connecting the two amplifier tube cathodes through the feedback resistor 7 and tapping the latter for bias potential on the input grid 9, the gain of the tube 5 varies in a direction to aid in the control of gain with the feedback.

I claim as my invention:

1. In an audio frequency amplifier, the combination of an amplifier tube having a signal input grid, an anode and a cathode, means providing a feedback impedance in circuit with the cathode, means providing a connection with said last-named impedance for the signal input grid for applying a biasing potential thereto, an output coupling impedance in circuit with the anode, a second amplifier tube having an anode

coupled to the anode end of said coupling impedance and having a cathode connected with the cathode of said first-named amplifier tube, a control grid for said second amplifier tube, means for applying a biasing potential thereto, means responsive to variations in signal amplitude in said amplifier for varying said potential to control the relative potential drop in said coupling impedance and in said inverse feedback impedance, and to vary the inverse feedback to said first named amplifier tube and the gain of said amplifier.

2. In an audio frequency amplifier, the combination of an amplifier tube having a signal input grid, an anode and a cathode, means providing a feedback impedance in the anode-cathode circuit thereof adjacent to the cathode, means providing a tap connection on said last-named impedance for the signal input grid for applying a biasing potential thereto, an output coupling impedance in circuit with the anode, a second amplifier tube having an anode coupled to the anode end of said coupling impedance and having a cathode connected with the cathode of said first named amplifier tube, whereby anode current flows to both tubes through said feedback impedance, an amplifier circuit coupled to said first named amplifier tube for receiving amplified signals therefrom, means for deriving a portion of said signals from said circuit, a signal rectifier connected with said last named means for deriving the direct current component of said signal as biasing potential which varies in accordance with signal amplitude variations, said rectifier having an output impedance across which said potential is applied, and a grid for said second amplifier tube connected with said last-named impedance to receive said biasing potential therefrom.

3. In an audio frequency amplifier, the combination of an amplifier tube having a signal input grid, an anode and a cathode, means providing a feedback impedance in circuit with the cathode, means providing a tap connection on said last-named impedance for the signal input grid for applying a biasing potential thereto, an output coupling impedance in circuit with the anode, a second amplifier tube having an anode coupled to the anode end of said coupling impedance and having a cathode connected with the cathode of said first-named amplifier tube, a control grid for said second amplifier tube, means for applying a biasing potential thereto, means responsive to an increase in signal amplitude in said amplifier for varying said potential in a positive direction to decrease the anode-cathode impedance and increase the anode current of said second amplifier tube and the inverse feedback potential applied to said feedback impedance, thereby to reduce the gain of said amplifier by inverse feedback means and by increase in the negative bias on said first-named grid.

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