

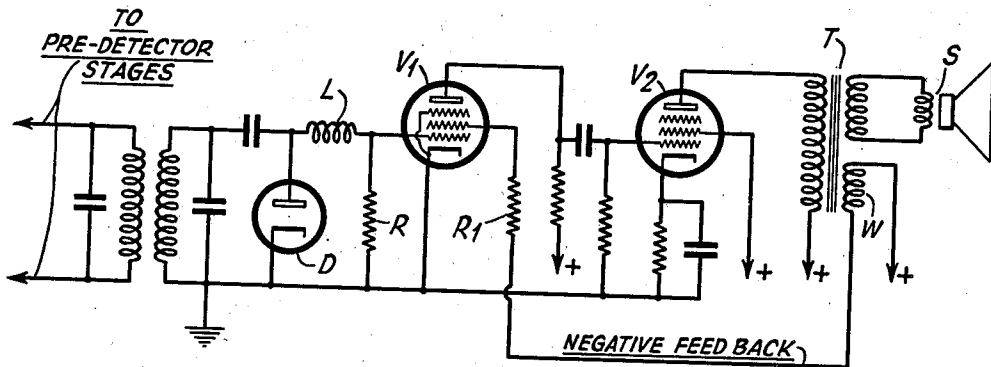
Jan. 6, 1942.

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2,269,249

CONTROLLED FEEDBACK CIRCUIT

Filed Nov. 29, 1938



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## UNITED STATES PATENT OFFICE

2,269,249

## CONTROLLED FEEDBACK CIRCUIT

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Application November 29, 1938, Serial No. 242,885  
In Germany December 16, 1937

7 Claims. (Cl. 250—20)

There has been disclosed an amplifier in which the volume or gain is controlled by change of the grid biasing potential in one, or several, amplifier tubes, and comprising anti-regeneration or negative regeneration means, and in which the fraction of the output potential which is in negative feedback relation to the input end is made variable in such a way that it increases as the gain diminishes. The advantage residing in this arrangement is that an undesired reduction of the negative feedback, and thus the impairment of the correction of distortion, with decreasing gain is avoided. Conditions may be made so that the value, or degree, of the negative feedback which is given by the relationship between the negative feedback potential and the input potential, and thus also the amount of correction or compensation of distortion, stay constant or even decreasing with diminishing gain so that the volume control is boosted. In the particular arrangement disclosed in the past the output potential was applied to a voltage divider, one arm of which contained a resistance having a negative resistance-current characteristic. This resistance was inserted in the cathode lead of the controlled tube and was regulated by the plate direct current.

The identical effect, according to the present invention, is accomplished more simply by impressing the alternating potential serving for the negative feedback upon the screen grid of a gain-controlled tube by way of a resistance which is of at least the same magnitude as the inner resistance of the screen grid to cathode path. The operation and effect of the arrangement of the invention is predicated upon the fact that the inner resistance is connected so as to be used as part of the voltage divider across which the potential subject to negative feedback is impressed. By the variation of the grid biasing voltage the inner resistance is regulated in such a way that in the presence of more negative biasing voltage, that is lower gain, the inner resistance becomes higher and thus the fraction of the potential in negative feedback also higher.

An exemplified embodiment of the invention is shown in the drawing. From the load resistance  $R$  which, in series with the radio frequency choke coil  $L$ , is connected in parallel relation to the signal detector diode  $D$  of a radio receiver, both the audio potential as well as the negative direct current potential are impressed upon the control grid of the pentode tube  $V_1$ . The anode of this tube is connected by the usual resistance-condenser coupling with the control

grid of tube  $V_2$ . The amplified audio alternating voltage is fed to the loudspeaker  $S$  by way of the transformer  $T$ . Wound on the said transformer is an additional secondary winding  $W$ . One end of the latter is connected with a source of positive potential. The other end thereof is associated by way of resistance  $R_1$  with the screen grid of tube  $V_1$ . The polarity of the said additional winding must be so chosen that the alternating potential impressed upon the screen grid is in phase opposition to the alternating potential acting upon the control grid. Resistance  $R_1$  should be at least as high as, or preferably higher than, the inner resistance of the screen grid to cathode path. In such case the fraction of the output potential which is associated with the screen grid in negative feedback is roughly proportional to the inner resistance of the screen grid to cathode path, or circuit, and it varies in accordance with the inner resistance; in other words, it increases as the biasing potential of the control grid becomes more negative. The constants may be chosen in such a way that the ratio between the negative feedback potential and the input potential, inside the regulating range, will not diminish as the gain diminishes, but will, on the contrary, become even higher. In the present instance, this means that automatic volume control is boosted by the change in negative feedback. Another fact is that when a powerful transmitter is received the negative regeneration, and thus the compensation both of linear as well as of non-linear distortion, becomes particularly high.

If the direct current voltage is impressed upon the screen grid by way of a separate resistance rather than by way of resistance  $R_1$ , then such separate resistance should be chosen high in comparison with the inner resistance of the screen grid to cathode path of tube  $V_1$  to the end that, on the one hand, a high over-all outer resistance may be obtained, and that, on the other hand, the inner resistance may not be short-circuited. An expedient plan is to insert in the lead from the additional winding  $W$  to the screen grid, frequency-dependent means in order that the negative regeneration effect may be brought about in definite frequency ranges, more particularly and predominantly upon the medium range of tonal frequencies.

From the load resistance  $R$  the direct current voltage may be fed by way of an audio filter network to the radio frequency and intermediate frequency amplifier tubes of the receiver for the purpose of gain regulation, where automatic vol-

ume control is used in a superheterodyne receiver. Interdependence between the screen grid current of tube  $V_1$  and the control grid potential is suitably insured by an exponential characteristic. It is, also, possible to connect tube  $V_1$  to operate as a screen grid amplifying detector or audion, thus saving the diode  $D$  and the choke coil  $L$ .

What is claimed is:

1. In a signal amplifier of the type comprising a tube having at least a cathode, signal grid, screen grid and plate, a signal input circuit coupled to the signal grid, a signal output circuit coupled to the plate, means for feeding back to the screen grid from the output circuit a signal potential in degenerative phase with the signal potential applied to the signal grid, said feedback means comprising a potential divider including the screen grid to cathode resistance of said tube, and means for simultaneously increasing the negative bias of said signal grid thereby decreasing the tube gain thereby to increase the magnitude of said resistance whereby the value of said degenerative potential is increased.

2. In a signal amplifier of the type comprising a tube having at least a cathode, signal grid, screen grid and plate, a signal input circuit coupled to the signal grid, a signal output circuit coupled to the plate, means for feeding back to the screen grid from the output circuit a signal potential in degenerative phase with the signal potential applied to the signal grid, said feedback means comprising a potential divider including the screen grid to cathode resistance of said tube, and means for controlling the bias of said signal grid in a sense to decrease the tube gain thereby to increase the magnitude of said resistance whereby the value of said degenerative potential is increased.

3. In a signal amplifier of the type comprising a tube having at least a cathode, signal grid, screen grid and plate, a signal input circuit coupled to the signal grid, a signal output circuit coupled to the plate, means for feeding back to the screen grid from the output circuit a signal potential in degenerative phase with the signal potential applied to the signal grid, said feedback means comprising a potential divider including the screen grid to cathode resistance of said tube, and means responsive to signal amplitude increase at the signal input circuit for increasing the signal grid bias of said tube whereby said resistance magnitude is increased and thereby increasing the magnitude of said degenerative potential.

4. In a signal amplifier of the type comprising a tube having at least a cathode, signal grid, screen grid and plate, a signal input circuit coupled to the signal grid, a signal output circuit coupled to the plate, and means for feeding back to the screen grid from the output circuit a signal potential in degenerative phase with the signal potential applied to the signal grid, said feed-

back means including a resistive impedance whose magnitude is substantially equal to the screen grid to cathode resistance and means for varying the gain of said tube in such a manner as to vary the magnitude of said resistance sufficiently to adjust said degenerative potential value.

5. In a radio receiver provided with a detector having a modulated carrier input circuit and a modulation voltage output circuit, a modulation voltage amplifier tube of the screen grid type, means coupling the detector output circuit to the modulation amplifier input electrodes, an output circuit coupled to the output electrodes of the modulation amplifier tube, means feeding to the screen grid of the latter from the last named output circuit a modulation voltage in degenerative phase with the modulation voltage at the said input electrodes, said feeding means comprising a voltage divider which includes the screen grid to cathode resistance of said amplifier tube, and means for simultaneously controlling the gain of said modulation amplifier tube in such a manner as to adjust the magnitude of said resistance and thereby control the value of the degenerative voltage.

6. In a radio receiver provided with a detector having a modulated carrier input circuit and a modulation voltage output circuit, a modulation voltage amplifier tube of the screen grid type, means coupling the detector output circuit to the modulation amplifier input electrodes, an output circuit coupled to the output electrodes of the modulation amplifier tube, means feeding to the screen grid of the latter from the last named output circuit a modulation voltage in degenerative phase with the modulation voltage at the said input electrodes, and said feeding means comprising a voltage divider including a resistor whose value is at least as great as the screen grid to cathode resistance of the modulation amplifier tube and means for controlling the amplifier tube gain in such a manner as to adjust the value of said resistance over a substantial range of values.

7. In a wave repeater circuit, a tube provided with at least a cathode, an input electrode, an output electrode and an auxiliary cold electrode in the electron stream to said output electrode, a wave input circuit coupled to said input electrode and cathode, a wave output circuit coupled to the output electrode and cathode, means for applying to said auxiliary electrode wave potentials in desired degenerative phase relation to the wave potential applied to the input electrode, said applying means comprising a potential divider which includes the resistance existing in said tube between the cathode and said auxiliary electrode, and means for controlling the input electrode bias of said tube thereby simultaneously to control the magnitude of said resistance and the magnitude of said auxiliary electrode wave potential in inverse relation.

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