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2,204,089

NOISE REDUCTION SYSTEM

Filed July 30, 1938

FIG. 1.

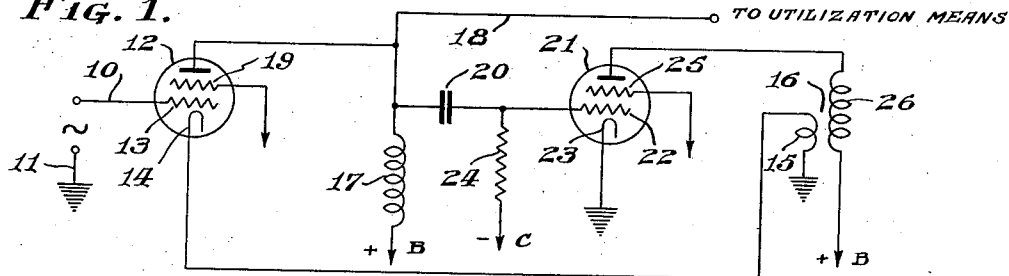


FIG. 2.

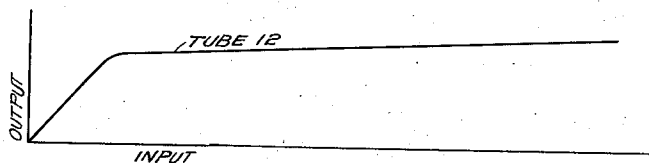


FIG. 3.

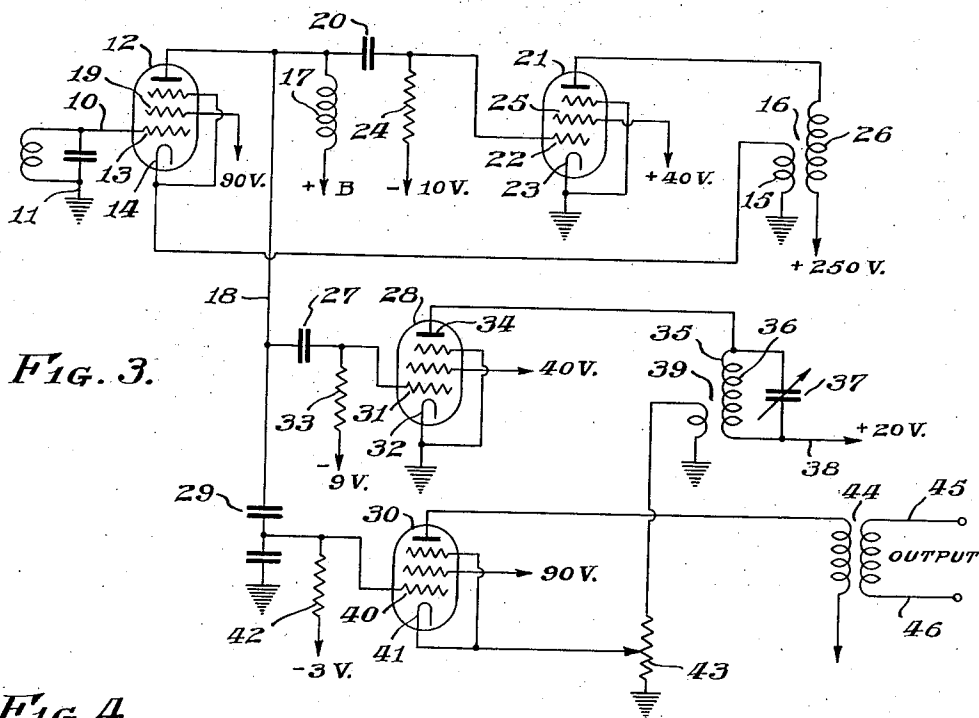


FIG. 4.

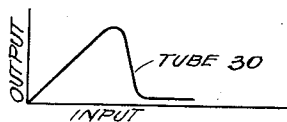


FIG. 5.



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NOISE REDUCTION SYSTEM

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4 Claims. (Cl. 179—171)

This invention relates to noise reduction systems such as are useful in eliminating undesired electrical impulses from the output of radio receiver apparatus and the like, and has for its principal object the provision of an improved system and method of operation whereby weak signals are amplified in the usual manner and strong signals are degenerated to a lower level.

A distinguishing characteristic of the invention is a degenerative feedback circuit including an amplifier which is biased considerably beyond cut-off. In the operation of the system, this amplifier does not degenerate at low signal levels, but does degenerate strong signals down to such a level that only a small output current flows during the positive peak periods. Signals of a higher level are degenerated by a ratio equal to the feedback gain. The feedback is therefore made as large as is practical. It is apparent that, as in the conventional feedback circuit, the phase must be kept degenerative at all frequencies where the gain in the feedback circuit exceeds unity.

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

Referring to the drawing,

Figure 1 is a wiring diagram of a signal channel to which the invention has been applied,

Figure 2 is the input-output characteristic curve of the channel of Fig. 1,

Figure 3 is a wiring diagram of a modified form of the invention, and

Figure 4 is an input-output characteristic curve of the channel of Fig. 3, and

Figure 5 is a similar curve for an intermediate portion of said channel.

The system of Fig. 1 includes signal input terminals 10 and 11, through which signal impulses are supplied to the input circuit of an amplifier 12. The amplifier input circuit includes a control grid 13, a cathode 14, and the secondary winding 15 of a transformer 16.

Anode voltage is applied to the amplifier 12 from the +B terminal through a reactor 17, and the amplifier output is delivered through the lead 18 to the high voltage terminal of a utilization device (not shown), the return lead of this device including a ground connection. The amplifier 12 is provided with a screen grid 19, which is maintained at the customary positive potential.

Coupled to the amplifier output lead through a capacitor 20 is the input circuit of a feed-

back amplifier 21. The input of the feedback amplifier 21 includes a control grid 22, a cathode 23, a resistor and a source of bias potential (not shown) whereby the amplifier 21 is biased considerably beyond cut-off. Under these conditions, the feedback amplifier 21 does not begin to function until the signal delivered through the amplifier 12 exceeds a level predetermined by the bias potential applied to the grid 22.

The feedback amplifier is provided with a screen grid 25 which is maintained at the customary potential and derives its anode potential from the +B lead through the primary winding 26 of the transformer 16.

As frequencies where the gain of the feedback circuit is high, the input-output characteristic of the amplifier 12 is as indicated by the curve of Fig. 2. Otherwise stated, the greater the gain of the feedback circuit the less the slope of the flat portion of the curve, the amplitude of this portion in peak volts being equal to or slightly greater than the value by which the feedback amplifier control grid bias potential exceeds the cut-off bias of the feedback amplifier.

The modified system of Fig. 3 is similar to that of Fig. 1 insofar as the amplifier 12 and its degenerative feedback circuit 21—16 are concerned. It differs from that of Fig. 1 in that the amplifier output lead 18 is coupled (1) through a capacitor 27 to the input circuit of a limiter 28, and (2) through a capacitor 29 to the input of a mixer device 30.

The input circuit of the electron discharge device 28 includes a control grid 31, a cathode 32, a resistor 33, and a source of bias potential (not shown) whereby this device is biased beyond cut-off.

The output circuit of the device 28 includes an anode 34 and the primary winding of a transformer 36, this primary winding being shunted by a capacitor 37 and there being applied through the lead 38 to the anode 34 a low potential so as to ensure operation of the device 28 as a limiter.

The input circuit of the device 30 includes a control grid 40, a cathode 41, a grid leak resistor 42, and a section of a resistor 43 through which the output of the device 28 is injected into the input circuit of the device 30 and thus superimposed on the output of the amplifier 12.

The resultant of these two outputs is amplified by the device 30 and delivered through a transformer 44 to a circuit 45—46.

The relation between the input of the amplifier 12 and the output of the device 30 is indicated by the curve of Fig. 4. It will be noted that the

output of the amplifier 12 is bucked against the output of the device 28 and that the result is a substantially zero level of output when the input exceeds a predetermined high level. This is for the reason that the signal output from the tube 28 increases rapidly after the initial bias is overcome as indicated by the curve in Fig. 5 and provides, at the mixer tube 30, a signal in opposition to that provided by the tube 12. Thus, the output characteristic curve of the tube 30 indicated in Fig. 4 is the resultant of the combination of the two output curves of Figs. 2 and 5.

I claim as my invention:

1. The combination of a signal amplifier provided with input and output circuits, means including a feedback amplifier biased beyond cut-off and arranged between said output and input circuits for applying to said input circuit a degenerative potential only when the signal level at said input circuit exceeds a predetermined value, an electron discharge device provided with an input circuit biased beyond cut-off and coupled to the output circuit of said signal amplifier, and means for deriving the resultant difference of the outputs of said signal amplifier and said device.

2. The combination of a signal amplifier provided with input and output circuits, means including a feedback amplifier biased beyond cut-off and arranged between said output and input circuits for applying to said input circuit a degenerative potential only when the signal level at said input circuit exceeds a predetermined value, an electron discharge device provided with an input circuit biased beyond cut-off and with an output circuit subjected to a relatively low anode potential, and means for deriving the resultant difference of the outputs of said signal amplifier and said device.

3. The combination of a signal amplifier provided with input and output circuits, means including a feedback amplifier biased beyond cut-off and arranged between said output and input circuits for applying to said input circuit a degenerative potential only when the signal level at said input circuit exceeds a predetermined level, an electron discharge device provided with an input circuit biased beyond cut-off and with an output circuit subjected to a relatively low anode potential, and means including an electron discharge device provided with an input circuit coupled to the output circuits of said signal amplifier and said first mentioned electron discharge device for deriving the resultant difference of the outputs of said signal amplifier and said first mentioned electron discharge device.

4. The combination with a signal amplifier including an amplifier tube, a second tube coupled thereto for receiving amplified signals therefrom, means for applying inverse feedback from said second named tube to said first named tube in response to signals above a predetermined amplitude, a third amplifier tube coupled to said first amplifier tube to receive amplified signals therefrom, a limiter tube coupled to said first named amplifier tube to receive signals therefrom and having an output circuit coupled to the third amplifier tube to apply signals thereto in opposition to signals from said first named amplifier tube in response to signals above a predetermined high amplitude, said limiter tube being biased beyond cut-off, means for controlling the relative amplitude of signals applied to said third amplifier tube, and means for deriving an output signal from said third amplifier tube.

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