

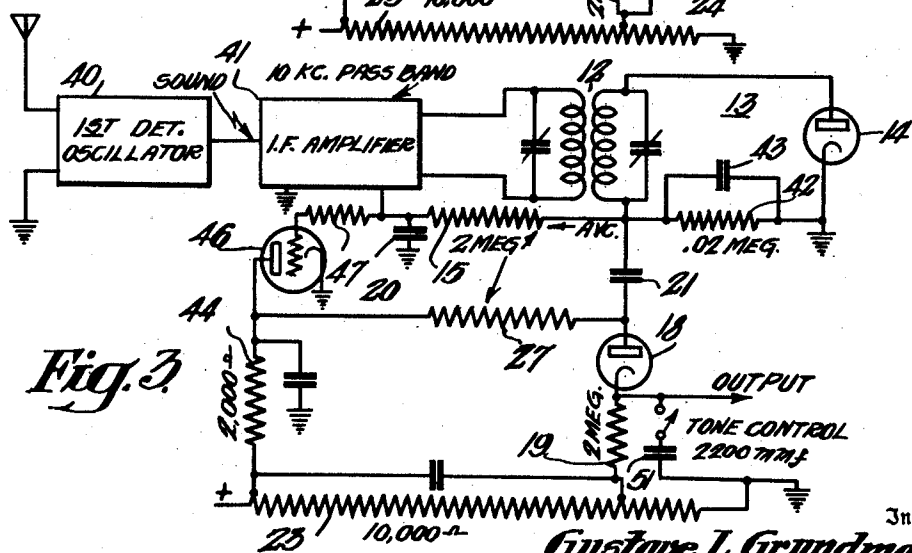
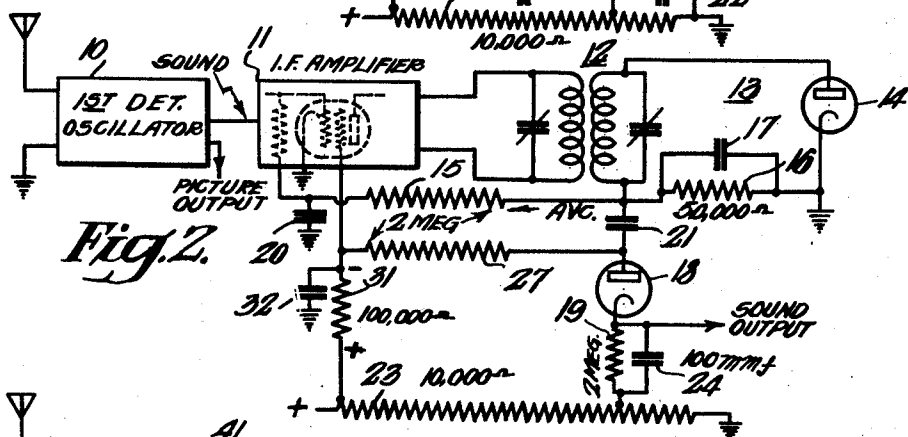
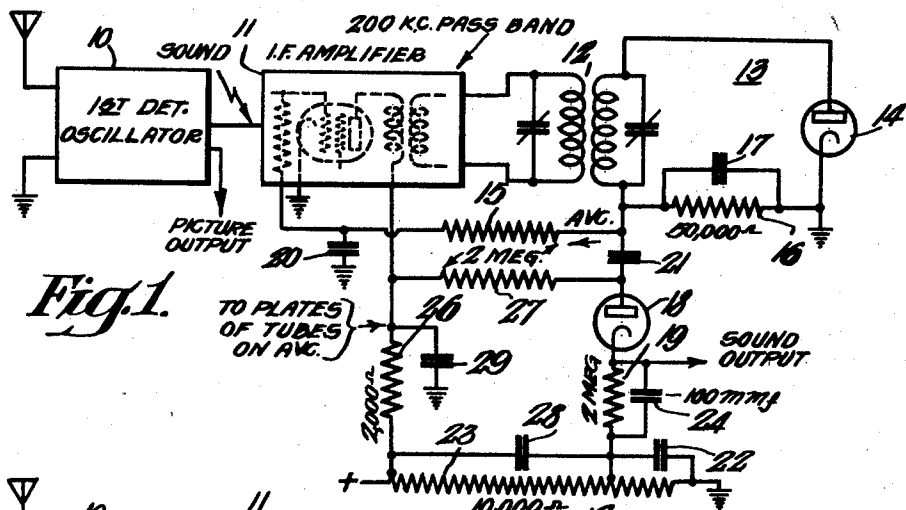
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**G. L. GRUNDMANN**

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## NOISE LIMITER

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Inventor

*Gustave L. Grundman*

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*J. J. Jeff* At

Attorney

## UNITED STATES PATENT OFFICE

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## NOISE LIMITER

Gustave L. Grundmann, Westmont, N. J., assign-  
or to Radio Corporation of America, a corpora-  
tion of Delaware

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6 Claims. (Cl. 250—20)

My invention relates to noise limiters for radio receivers and especially to noise limiters of the series type provided with a gate or limiter voltage which follows the average carrier variation or which, preferably, follows both the average carrier variation and the sound modulation envelope. In the latter case the limiter is especially effective for noise reduction in a sound channel having a wide pass band such as that in a television receiver.

By the series type limiter is meant a limiter of the general type described in Kaar Patent 2,207,587 wherein the gate voltage maintains a current flow through a diode and an output resistor in series while the sound signal is applied to this series combination with a polarity opposed to that of the gate voltage. If noise pulses in the signal exceed the gate voltage, the flow of diode current ceases for the duration of the noise pulse thus limiting its amplitude.

An object of my invention is to provide an improved and simplified noise limiter circuit of the above-described type in which the gate voltage varies with changes in the average carrier.

A further object of the invention is to provide an improved and simplified noise limiter circuit of the above-described type in which the gate voltage varies in accordance with changes in the average carrier and in which the gate voltage also substantially follows the useful modulation envelope of the sound modulated carrier wave.

The invention will be better understood from the following description taken in connection with the accompanying drawing in which

Figure 1 is a circuit diagram showing the wide band sound channel of a television receiver embodying my invention,

Figure 2 is a circuit diagram similar to Fig. 1 but showing another embodiment of the invention, and

Figure 3 is a circuit diagram showing another embodiment of the invention applied to a narrow band radio receiver such as a police receiver.

Fig. 1 shows the invention applied to the sound channel of a television receiver. The receiver map comprise a first detector and a tunable oscillator indicated at 10 for converting the incoming picture signal and accompanying sound signal to intermediate frequency signals.

The sound signal is supplied to an intermediate frequency amplifier indicated by the rectangle 11 which has a pass band several times the width of the frequency band occupied by the sound signal being passed. For example, the pass band may be 200 k. c. and the signal band 8

or 10 k. c. One I. F. amplifier tube and a coupling transformer are indicated generally by dotted lines in the rectangle 11.

The I. F. amplifier output is supplied through a coupling transformer 12 to the second detector 13. This detector, in the example illustrated, comprises a diode 14 and a load resistor 16 connected in series with each other and across the secondary of the transformer 12. The resistor 16 is shunted by the usual bypass condenser 17 for bypassing the I. F. carrier wave.

The receiver is provided with a suitable automatic volume control or A. V. C. circuit operating on average carrier. In the example illustrated, the average carrier voltage appearing across the detector load resistor 16 is applied to one or more of the I. F. amplifier tubes through a resistor 15. The usual A. V. C. filter condenser is shown at 20.

The noise limiter comprises a diode 18 and an output resistor 19 connected in series with each other and across the load resistor 16 through a coupling condenser 21 and through a bypass condenser 22 of the voltage divider 23. Thus the A. C. sound signal is applied across the series combination 18—19. As explained hereinafter, the output resistor 19 has a small capacity condenser 24 connected thereacross for causing the gate or limiter voltage to follow the useful modulation envelope.

A flow of direct current is maintained through the limiter diode 18 by means of a voltage drop produced by the automatic volume control current or a portion thereof. In the embodiment of Fig. 1, this voltage drop is obtained from a resistor 26 through which plate current flows to one or more of the I. F. amplifier tubes controlled by the A. V. C. circuit. The said voltage drop is applied to the series combination 18—19 through a D. C. connection comprising a high impedance resistor 27 and the left hand portion of the voltage divider 23, this portion having the usual bypass condenser 28 thereacross.

The resistor 26 may be the usual filter resistor for the plate supply to one or more of the amplifier tube plates. A filter condenser is indicated at 29.

From the foregoing it will be apparent that there is applied to the limiter diode 18 a gate voltage which varies with changes in the average carrier and that this voltage and the signal voltage are applied to diode 18 with opposing polarities.

Furthermore, as previously indicated, the R—C circuit 19—24 causes the gate voltage to follow the useful modulation envelope of the sound

modulated carrier wave. The time constant of this R—C circuit is such that it has a cut-off just beyond the highest frequency component of the sound signal if the signal is to appear at the output circuit without any attenuation of the higher frequency signal components.

However, as described and claimed in the co-pending Holmes application Serial No. 395,346, filed May 27, 1941, it may be desirable to make the time constant of the R—C network 19—24 such that some of the higher frequency signal components are attenuated. This may be desirable for tone control purposes and/or for complementary attenuation in a system transmitting a pre-emphasized signal. In that case the gate voltage follows the modulation only approximately and some portions of the envelope representative of higher frequency components are attenuated.

In Figure 1, the values of certain elements have been indicated, merely by way of example, in ohms, megohms, and micromicrofarads.

The embodiment of the invention shown in Fig. 2 is similar to that shown in Fig. 1, the difference being that the average carrier change in the gate voltage for the noise limiter in Fig. 2 is obtained from the screen grid circuits of the I. F. amplifiers which have an A. V. C. control thereon. In Figs. 1 and 2, like parts are indicated by the same reference characters.

The average carrier variation of the gate voltage appears across a screen grid resistor 31 which is bypassed by the usual filter condenser 32. One or more amplifier tubes controlled by the A. V. C. circuit may have their screen grids supplied by the operating voltage through the resistor 31. If a plurality of tubes is so supplied, the resistance of resistor 31 ordinarily should be less than the 100,000 ohms indicated on the drawing.

The operation of the circuit of Fig. 2 is similar to that of the circuit previously described. If the incoming signal fades, the control grid of the I. F. amplifier tube becomes less negative with the result that the screen grid current increases and the gate voltage on the plate of the limiter diode 18 becomes less positive whereby the limiter diode becomes nonconducting at a lower value of signal voltage.

The circuit of Fig. 2 has an advantage over that of Fig. 1 in that there is a degenerative action in the screen grid circuit whereby the changes in screen grid voltage are nearly linear with respect to changes in average carrier and, therefore, follow the output of the linear detector 14 rather closely.

It will be understood that an important feature of the circuit in Fig. 2, as well as in Fig. 1, is that the gate voltage is caused to follow the useful modulation envelope as well as the average carrier variations by giving the R—C circuit 19—24 the proper time constant.

In Fig. 3, there is shown an embodiment of the invention in which the average carrier variations of the gate voltage are obtained by means of an extra tube, not a signal amplifier tube, which is controlled by the A. V. C. voltage. Also, in Fig. 3, the invention is shown applied to a sound receiver, such as a police receiver, having a narrow band sound channel and the gate voltage in the example illustrated is not made to follow the modulating envelope. Like parts in Figs. 1 and 3 are indicated by the same reference characters.

The receiver may comprise a first detector and

an oscillator indicated at 40 for supplying an I. F. signal to an amplifier 41 connected through a transformer to the second detector 13. The detector 13 comprises a diode 14 having a load resistor 42 shunted by a condenser 43.

The noise limiter connections are substantially the same as in the other figures except that the average carrier variations in the gate voltage are obtained from across a resistor 44 which supplies plate voltage to the above-mentioned extra tube indicated at 46.

The tube 46 has a control electrode connected through a resistor 47 to a point on the A. V. C. circuit whereby the current through the plate resistor 44 will vary with the A. V. C. voltage and thus vary the gate voltage applied to the limiter diode 18 in accordance with changes in average carrier.

In this embodiment of the invention, it may be desirable to provide a condenser 51 which may be switched across the output resistor 19 for attenuating the higher frequency components of the sound signal for tone control and/or additional noise reduction. It will be noted that the condenser 51 has substantially greater capacity than the condenser 24 in the circuit of the other figures where the gate voltage is made to follow the modulation envelope.

From the foregoing, it will be apparent that an important feature of the present invention is the provision of a simplified noise suppressor circuit of the series diode type in which the gate voltage follows both the average carrier and the useful modulation envelope, the circuit also having the desirable feature of utilizing the full voltage output of the second detector.

I claim as my invention:

1. A radio receiver having a sound channel which includes an amplifier, a detector supplied from said channel and having a load resistor across which the demodulated signal appears, a noise limiter of the series diode type connected across at least a portion of said load resistor, said limiter comprising a diode and an output resistor in series, an automatic volume control circuit for said amplifier, means controlled by said circuit for applying to said limiter a gate voltage which varies with average carrier, and means for also causing the gate voltage to follow at least partially the useful modulation envelope of the received carrier wave.

2. A radio receiver having a sound channel with a pass band which is several times the width of the frequency band occupied by the signal components passed by said channel, said channel including an amplifier, a detector supplied from said channel and having a load resistor across which the demodulated signal appears, a noise limiter of the series diode type connected across substantially the entire portion of said load resistor, said limiter comprising a diode and an output resistor in series, an automatic volume control circuit for said amplifier, means controlled by said circuit for applying to said limiter a gate voltage which varies with average carrier, and means for also causing the gate voltage to vary with the useful modulation envelope of the received carrier wave.

3. A radio receiver having an intermediate frequency amplifier with a pass band which is several times the width of the frequency band occupied by the signal components passed by said channel, a detector supplied from said amplifier and having a load resistor across which the demodulated signal appears, a noise limiter of

the series diode type connected across at least a portion of said load resistor, an automatic volume control circuit for controlling the gain of said amplifier, said limiter comprising a diode and an output resistor in series, a resistor through which voltage is supplied to an electrode of an amplifier tube in said amplifier, and means for applying the voltage drop appearing across said last resistor to said limiter as at least a portion of its gate voltage whereby the gate voltage varies with average carrier.

4. The invention according to claim 3 wherein the output resistor of the limiter is shunted by capacity of such value that the gate voltage also follows the useful modulation envelope of the received carrier wave.

5. A radio receiver having a sound channel including an amplifier tube, a detector connected

to be supplied with signal from said channel, said detector having a load resistor across which the demodulated signal appears, a noise limiter connected across at least a portion of said load resistor, an automatic volume control circuit for controlling the gain of said amplifier tube, a resistor through which voltage is applied to a screen grid electrode in said amplifier tube, and means for applying the voltage drop appearing across said last resistor to said noise limiter as at least a portion of its gate voltage whereby the gate voltage varies with average carrier.

6. The invention according to claim 5 wherein said limiter is of the series type which has an output resistor shunted by capacity of such value that the gate voltage also follows the useful modulation envelope of the received carrier wave.

GUSTAVE L. GRUNDMANN.