

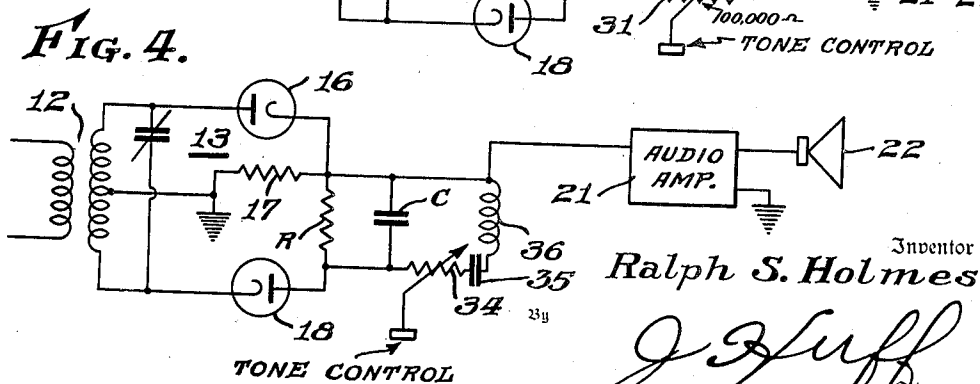
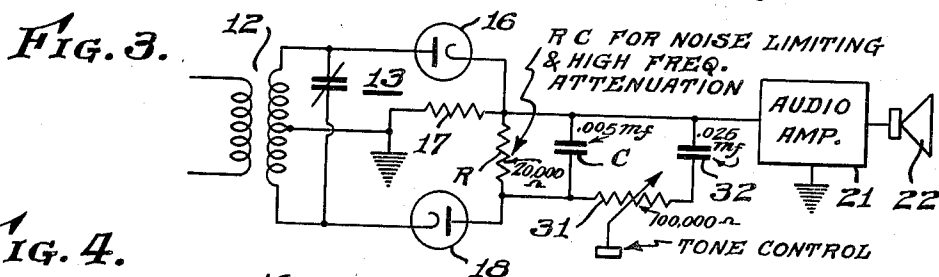
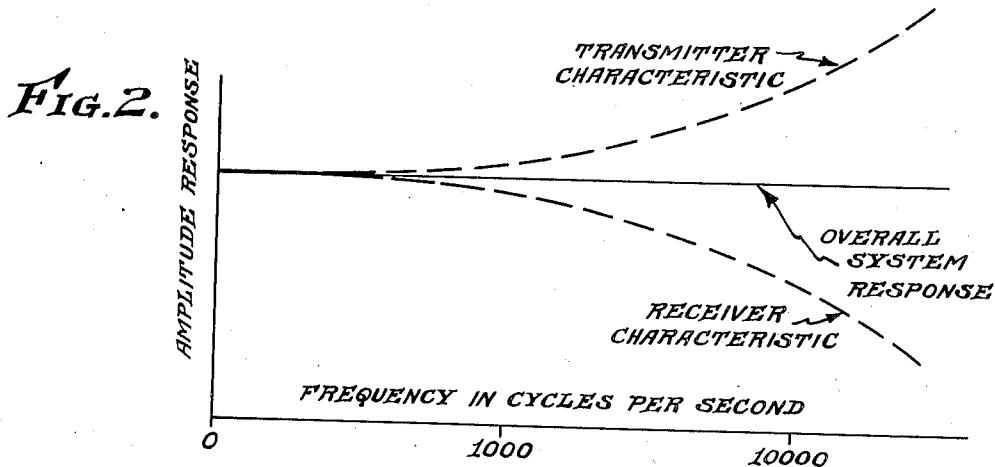
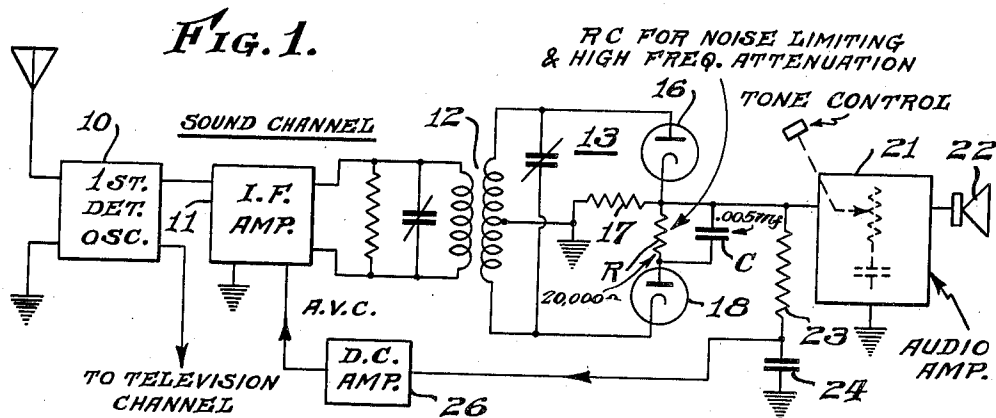
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2,299,391

RADIO RECEIVER

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## UNITED STATES PATENT OFFICE

2,299,391

## RADIO RECEIVER

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Application May 27, 1941, Serial No. 395,346

6 Claims. (Cl. 250—20)

My invention relates to radio receivers and particularly to radio receivers having noise limiting circuits.

In radio receivers it has been common practice to employ a noise limiter of some type followed by a tone control circuit. Also, in receivers which are to attenuate the higher frequency signal components because of accentuation or pre-emphasis of these components at the transmitter, the prior art practice is to have the attenuation circuit at some point following the noise limiter.

An object of the invention is to provide an improved receiver of the type including a noise limiter and including, also, means for attenuating pre-emphasized signals and/or means for providing tone control.

I have found that improved receiver operation is obtained by employing a noise limiter of the type having a resistor-capacitor or R—C circuit across which there appears a gate or limiter voltage which varies with the envelope of the modulated carrier wave and by combining with this R—C circuit means for obtaining tone control and/or means for obtaining the desired frequency attenuation. With the receiver so designed, most or all of the frequency band width limitation is at the noise limiter itself with the result that there is improved noise reduction.

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 of one embodiment of my invention applied to the sound channel of a television receiver,

Figure 2 is a group of curves that are referred to in explaining the invention, and

Figures 3 and 4 are circuit diagrams showing other embodiments of the invention.

Referring to Figure 1, there is shown at 10 the front or head end of a television receiver comprising a first detector and a tunable oscillator for passing an intermediate frequency picture signal to a television channel (not shown) and for passing the accompanying I. F. sound signal to the sound channel.

The sound channel includes an I. F. amplifier 11 which supplies sound signal through a transformer 12 to a second detector 13. The transformer 12 is tuned to have a wide pass band corresponding to the pass band of the amplifier 11. This pass band is substantially greater than the band width of the signal being passed. For example, the amplifier pass band may be 200,000 cycles wide while the sound signal may have a

frequency band lying between 60 cycles and 8000 cycles.

The second detector 13 comprises a diode 16 having a plate connected to the upper end of the secondary of transformer 12 and having a cathode connected through an output resistor 17 to the midpoint of the secondary.

A noise limiter is provided at the second detector, the limiter in this particular example comprising a diode 18 having its cathode connected to the lower end of the transformer secondary and its plate connected through a resistor R to the cathode of the diode 16. A condenser C is connected across the resistor R whereby a gate or limiting voltage appears across the R—C network. The time constant of this network preferably is such that the gate voltage follows the carrier wave envelope representing the useful modulating signal. It would be made to follow the modulation envelope almost exactly if it were not for the desired attenuation of pre-emphasized signal components referred to below.

The type of noise limiter just described is similar to that described and claimed in application Serial No. 299,064, filed October 12, 1939, in the names of Ralph S. Holmes and Ciro C. Martinelli, and shown in its broader aspects in Gelzer Patent 2,194,499. In this type of limiter, the basic principle of operation in reducing noise is that if the signal (noise) exceeds a certain limiting amplitude (which amplitude here varies with the modulation envelope), it then causes current flow in diode 18 as well as in diode 16 and the noise signal is balanced out. The apparatus of Fig. 1 differs from that described in the Holmes and Martinelli application in that the R—C circuit is so adjusted that it provides both noise reduction and the desired attenuation of high frequency components which have been pre-emphasized at the transmitter. This will be explained later with reference to Figure 2.

The audio signal from detector 13 is supplied to an audio amplifier 21 which may be provided with a suitable tone control means as indicated on the drawing. A loud speaker is indicated at 22.

The receiver preferably includes a suitable automatic volume control circuit of the average carrier type. It may comprise a circuit supplying average carrier signal from the detector 13 through the usual filter 23—24 to a D. C. amplifier 26. The D. C. output of this amplifier is applied to the I. F. amplifier 11 to control its gain.

The specific receiver above described is designed to attenuate a sound signal which has been accentuated or pre-emphasized in accord-

ance with the impedance-frequency characteristic of a series inductance-resistance network, this complementary attenuation being provided by the R—C network of the noise limiter. From a physical viewpoint, this means that the time constant of the R—C network is such that the gate voltage does not follow the envelope of the modulated wave exactly but, instead, "digs into" the portion of the envelope representing high frequency components to prevent the passage of some of the signal as well as the noise.

The attenuation characteristic of the receiver of Fig. 1 is shown in Fig. 2 where the amount of pre-emphasis at the transmitter is also shown. Preferably, the R—C circuit of Fig. 1 is adjusted to provide a flat overall frequency response for the transmitter and receiver combined. This is assuming the tone control in the amplifier 21 is set to pass all the frequencies. Or, stated differently, the overall system characteristic preferably is flat up to the tone control circuit of amplifier 21.

The above-described receiver design will give better noise suppression than can be obtained by adjusting the R—C circuit for proper noise suppression alone and then obtaining the complementary high frequency attenuation by means of a subsequent separate network.

My invention may be carried a step further by locating the tone control means at the R—C network as shown in Fig. 3, by way of example. Thus all band width limitation for the sound channel is at the noise limiter itself and maximum effectiveness of noise reduction is obtained.

In Figs. 1 and 3, like parts are indicated by the same reference numerals. In this embodiment the time constant of the R—C circuit is effectively varied for tone control purposes by means of a resistor 31 and a condenser 32 connected in series with each other and across the R—C network. A change in the amount of resistance 31 in the circuit changes the amount of capacity effectively across the resistor R of the R—C network. Thus the gate voltage may be caused to vary at a rate that removes more or less of the high frequency components as desired. More specifically, if the tone control is adjusted to reduce the amount of highs in the signal, the overall frequency response of the system will not be flat as shown in Fig. 2 but will droop a certain amount depending upon the setting of the tone control.

The apparatus shown in Fig. 4 is the same as that of Fig. 3 except that the tone control means comprises a resistor 34, a condenser 35 and an inductance coil 36 in series with each other and connected across the R—C network. By changing the value of resistor 34 the effectiveness of the series resonant section 35—36 is changed whereby the amount of attenuation of the high frequency components may be varied at will. The elements 35 and 36 may be tuned for resonance at one of the higher frequencies of the sound signal band such as 5000 cycles per second.

It may be noted that the circuit of Fig. 3 is preferred as compared with that of Fig. 4 since a resistor and condenser in parallel may be given a characteristic which is exactly complementary to the series resistor-inductance network used for pre-emphasis at the transmitter with which the receiver is to operate.

On the drawing the values of various elements have been indicated, merely by way of example, in ohms and microfarads.

It should be understood that my invention is

not limited to the balanced type of noise limiter described herein and may be applied to other noise limiters such as the limiter described in application Serial No. 395,363, filed on the same day as the present application in the name of Ciro C. Martinelli.

I claim as my invention:

1. A receiver for the reception of a carrier wave modulated by a signal which has been pre-emphasized at a transmitter in accordance with a rising frequency-impedance characteristic which is substantially the same as that of an inductance coil and a resistor in series, said receiver including a noise suppressor circuit in which the limiting noise level is determined by a network including a condenser and a resistor in parallel, the capacity and resistance values of said condenser and said last resistor being such that the said noise suppressor circuit has a falling frequency-impedance characteristic which is substantially complementary to said frequency-impedance characteristic utilized at the transmitter for pre-emphasis.

2. A receiver for the reception of a carrier wave modulated by a signal which has been pre-emphasized at a transmitter in accordance with a rising frequency-impedance characteristic which is substantially the same as that of an inductance coil and a resistor in series, said receiver including a noise suppressor circuit comprising means for producing a limiting noise level voltage, said means comprising a network including a condenser and a resistor in parallel across which at least a portion of said voltage appears, the capacity and resistance values of said condenser and said last resistor being such that the said noise suppressor circuit has a falling frequency-impedance characteristic which is substantially complementary to said frequency-impedance characteristic utilized at the transmitter for pre-emphasis.

3. A receiver for the reception of a carrier wave modulated by a signal that has been accentuated at a transmitter in accordance with a rising frequency-impedance characteristic which is substantially the same as that of an inductance coil and a resistor in series, said receiver including a noise suppressor circuit in which the limiting noise level is determined by a network including a condenser and a resistor in parallel, the capacity and resistance values of said condenser and said last resistor being such as to provide a falling frequency-impedance characteristic which may be adjusted to be substantially complementary to said frequency-impedance characteristic utilized at the transmitter for accentuation, and tone control means included in said network whereby its time constant may be adjusted for tone control purposes.

4. A receiver for the reception of a carrier wave modulated by a sound signal, said receiver including a noise suppressor circuit in which the limiting noise level is determined by a network including a condenser and a resistor in parallel across which at least part of a noise limiting voltage appears, the capacity and resistance values of said condenser and said last resistor being such that said limiting voltage follows at least approximately the envelope of said modulated carrier wave, and tone control means for varying the time constant of said network for tone control purposes.

5. The invention according to claim 4 wherein said tone control means consists of a resistor

and condenser connected in series with each other and connected in parallel across said network.

6. The invention according to claim 4 wherein the said capacity and resistance values of said network also are such as to provide a falling frequency-impedance characteristic which is

complementary to the frequency-impedance characteristic of an inductance coil and a resistor in series utilized at the transmitter for pre-emphasizing the modulated carrier wave being received.

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