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NOISE CONTROL CIRCUIT

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Fig. 1

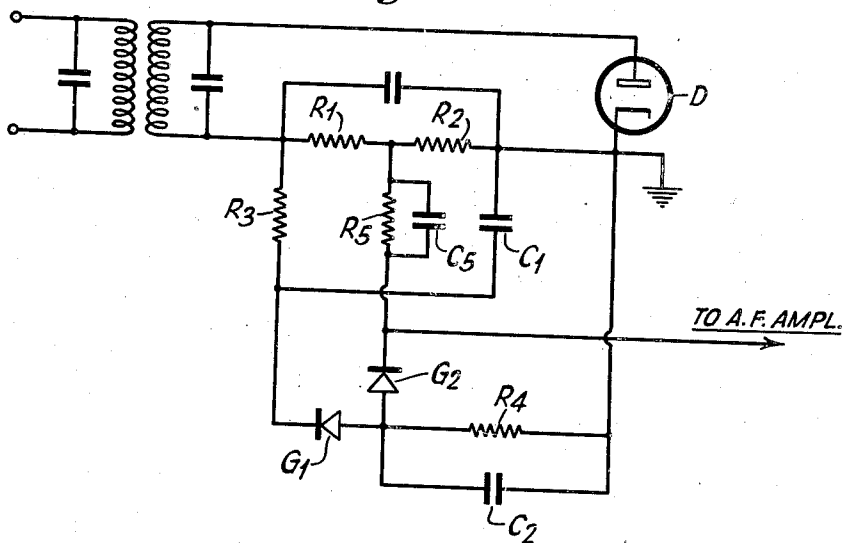
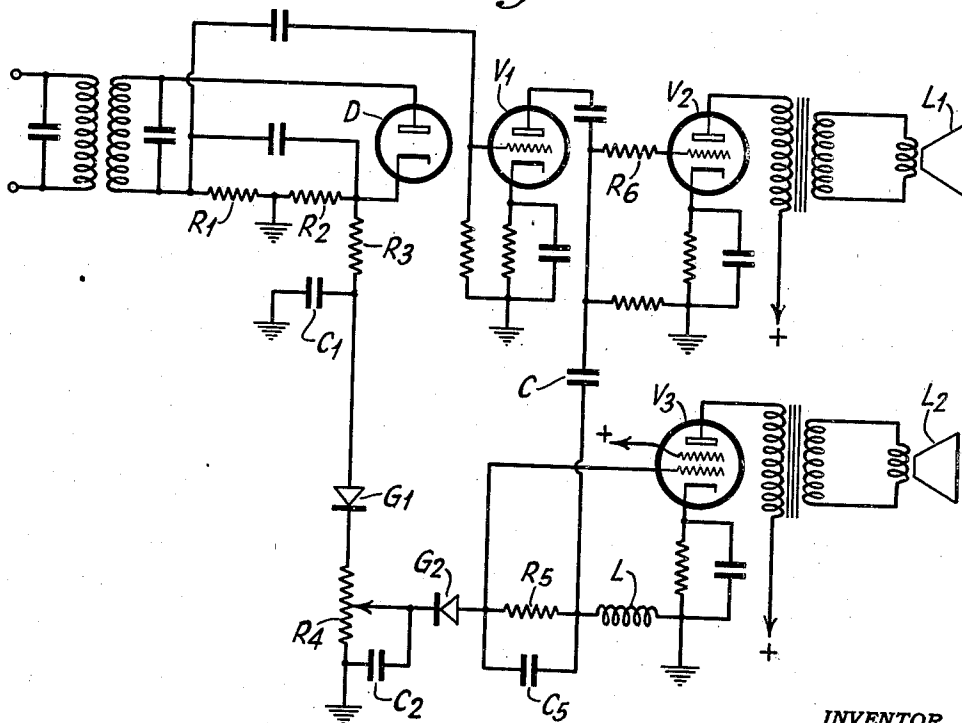


Fig. 2



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NOISE CONTROL CIRCUIT

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8 Claims. (Cl. 250—20)

Means have been disclosed in the prior art for eliminating and suppressing atmospheric and similar disturbances, in the form of crackling and rattling noises, in receiver sets in which transmission gain of the receiver is cut down as soon as the incoming alternating potential exceeds a pre-arranged limiting voltage. Reduction of the transmission gain may be effected, say by amplitude limitation by means of rectifiers impressed with a biasing voltage, or the like, by high-speed volume control, or by the aid of tubes included in the line and acting as switch devices. The said limiting potential, in arrangements known in the art, must be adjusted manually in accordance with the intensity or signal strength of the station which happens to be tuned in. It has already been suggested in the art automatically to regulate the limiting potential in such a way that the direct current component resulting from the rectification of the incoming radio frequency oscillation is used as the limiting potential. The latter is then always proportional to the amplitude of the unmodulated carrier. Such a scheme offers the advantage that both for stations coming in feeble and strong all voltage peaks will always be cut off, that is, peaks which just exceed, say, twice the carrier amplitude. The undisturbed oscillation will then not be affected even when the modulation percentage is 100 percent. On the other hand, such disturbing actions which in heterodyning with the signal oscillation do not exceed twice the carrier amplitude, will not be damped.

If the threshold value at which a reduction in transmission takes place is chosen at a lower level so that also these disturbances will be affected (say, a value attained in the presence of a modulation percentage of 70), then it will happen that, where the modulation percentage is higher, distortion will be caused, and that more particularly also natural or intended crackling or rattling noises such as beats of the kettle drum, cracks of shots, and the like will become attenuated. According to this invention, the limiting potential is regulated more than in direct proportion to the carrier amplitude. This is effected in such a manner that only for transmitter stations which come in with a very strong signal the limiting potential lies above the crest or peak potential of the undisturbed oscillation attained for higher modulation.

The advantage residing in the invention is that stations coming in strongly, which inher-

ently are disturbed very slightly by disturbing actions of atmospheric origin, will be heard without any distortions caused by the limiting means. But stations whose signal is received feebly in which such disturbances affect the reproduction very markedly are very effectively freed from disturbing actions because of the fact that the threshold value is low compared with the carrier amplitude, although it is true that such distortions as may happen when the modulation is of a higher percentage must be accepted as must also the attenuation of natural crackling noises.

In the drawing, Figs. 1 and 2 show two embodiments of the invention. In Fig. 1, the load resistance of the signal diode D in a receiver apparatus is split into two like portions denoted by R_1 and R_2 . The negative direct current voltage arising across the aggregate load resistance is rid of superimposed audio oscillations (components) by means of the filter consisting of the resistance R_3 which is high in contrast with the load resistance and the condenser C_1 which also is of large size. As a result, there arises a direct current voltage at the junction point of R_3 and C_1 which is equal to the amplitude of the unmodulated carrier of the oscillation to be rectified. This voltage is impressed upon a voltage divider which consists of the rectifier G_1 and the ohmic resistance R_4 . The constants of the said rectifier and of the resistance R_4 must be so chosen that the voltage across R_4 , where a strong signal is coming in from a transmitter, will be practically equal to the carrier amplitude so that the drop of potential at rectifier G_1 is then negligibly low, while for a transmitter station whose signal comes in feeble, the drop of potential at G_1 is appreciable compared with the drop across R_4 , say, 15 per cent of the aggregate voltage. R_4 is in this connection presupposed to be high in contrast to R_3 .

The direct current voltage arising across R_4 serves as a limiting voltage for the reduction of the transmission measure or gain. In the present instance, in a way well known in practice, this is insured by a biased rectifier G_2 which operates as an amplitude limiter. In a case where the voltage division at G_1 and R_4 is such that the aggregate potential acts across R_4 , the biasing voltage of the rectifier is exactly as high as the mean direct current voltage arising across R_1 and R_2 in series; in other words, just as high as the maximum value of the voltage which is likely to arise in the presence of 100 percent modulation of the signal oscillation across R_2 .

The junction point of R_1 and R_2 is connected by way of a resistance R_5 with the cathode of the rectifier G_2 whose anode is connected with the junction of G_1 and R_4 . The audio potential is taken off at the cathode of G_2 and then impressed upon the audio amplifier. As long as the reception is free from disturbing actions, rectifier G_2 is not conducting; in other words, its resistance is high compared with the resistance of R_5 , so that the voltage across R_2 is transmitted. Upon the arising of a disturbance which together with the signal potential exceeds the limiting voltage occurring for 100 percent modulation, G_2 becomes conductive; its resistance becomes low in comparison with R_5 and the potential is preserved at its limiting value.

If the amplitude of the unmodulated carrier is altered, say, as a result of fading or owing to a change to another transmitter, then also the biasing potential of G_2 will change in the same sense. However, this change is greater than in direct proportion. Only for a comparatively powerful transmitter, the drop of potential across G_1 may be neglected in respect to that across R_4 . Where the transmitter station signal is weak, an appreciable part of the aggregate potential acts at G_1 so that the biasing voltage of rectifier G_2 becomes lower; in fact, voltage peaks which correspond, say, to modulation ranging between 70 and 80 percent, will be cut off. For instance, constants may be so chosen that for the feeblest station yet to be received, the voltage at G_1 and across R_4 will be divided approximately at the ratio of 1:4 so that the threshold value of the amplitude limitation lies around a 60 percent modulation value. If desired, R_4 inside certain limits may be varied manually so that also the threshold value may be variable by hand.

Fundamentally speaking, resistance R_5 is not necessary, though recommendable in order to cause a marked drop of potential and to prevent condenser C_2 from being charged up too rapidly, for this would have the result that, concomitantly, the threshold value would be cut down too fast. The parallel connection of the condenser C_5 which is small compared with C_2 , though at least as great as the grid-filament capacitance of the amplifier tube next following, is to prevent a drop of the high frequencies by action of the resistance R_5 and the input capacitance of the next tube. This circuit is suitable, fundamentally and by itself, in other words, without the scheme of the invention, for a regulation of the limiting potential that is more than in direct proportion. If it is necessary to make R_4 and R_3 , say, of like size, then R_1 and R_2 must be so chosen that R_2 is equal to one-fourth of the value of R_1 .

Another exemplified embodiment of the invention is shown in Fig. 2. The load resistance of the signal diode D also in this embodiment is split into two equal halves R_1 and R_2 . Their junction terminal is grounded. The voltage arising across R_1 is applied to the amplifier tube V_1 . In the output of the latter is effected a separation of the audio voltage into a low-pitch band which by way of amplifier V_2 is fed to the loudspeaker L_1 , and a high-pitch band which is fed to the loudspeaker L_2 by way of tube V_3 . The said separation is effected by including in the grid lead of V_2 a resistance R_6 , while, on the other hand, the plate end of the resistance by way of a series circuit comprising L and C and tuned to the range of high tonal frequencies on a broad resonance curve, is connected with ground. The voltage at L is fed to the control grid of V_3 . The amplitude of this alternating

potential is limited by a rectifier G_2 which is biased by the positive direct current voltage acting across R_2 . This voltage is rid of its alternating ripple component by means of the filter R_3-C_1 , and is then passed through the voltage divider G_1, R_4 , which operates in a similar way as the combination G_1-R_4 , Fig. 1. The biasing voltage for the limiting rectifier G_2 is taken off at R_4 by an adjustable tap. The latter is capacitively grounded by the large condenser C_2 . The plate of the rectifier G_2 is connected by way of resistance R_5 , which is capacitively shunted or bridged by means of the low condenser C_5 and which acts similarly as the resistance R_5 in Fig. 5, with the non-grounded end of the coil L . At the anode of G_2 the limited potential is tapped and impressed upon the control grid of V_3 .

Since as a result of the rectifier action the disturbances superimposed upon the signal or incoming oscillation and being of large amplitude occur across the load resistance R_1, R_2 , in the form of a negative voltage shock, and at the grid of the tube V_3 as positive voltage shocks or impulses, it will be seen that only the positive voltage alternations need to be limited. The alternating potential arising at the control grid of tube V_2 may also be limited.

The time-constant of the series circuit consisting of R_5 and C_2 is primarily decisive for the length of time within which, in the case of oscillations exceeding the limiting potential, the condenser C_2 is charged to the new crest value. In other words, the time-constant governs the longest duration of a disturbing action still being cut off or flattened, and at the same time the length of the period during which, upon a sudden high modulation of the incoming feeble carrier, distortion will still happen. If the time-constant, for instance, is made equal to one-half second approximately, then conditions can be made so that brief atmospheric disturbances as well as natural crackling noises, say, in excess of the 60 percent modulation mark are cut off, whereas a loud, continuous sound which also surpasses the 60 percent mark, will be distorted only during the first half second by the amplitude limitation, while being transmitted and reproduced thereafter without distortion. It goes without saying that the last-mentioned means are usable also separately.

What is claimed is:

1. In combination with a source of audio-modulated signals having superimposed noise impulses, a rectifier including a load resistor for developing direct current voltage and audio voltage components from the rectified signals and noise impulses, means for utilizing the audio component, means for utilizing the direct component for impairing utilization of the audio component, the last means comprising a series path of a device of unidirectional conductivity and an impedance in shunt with at least a portion of said load resistor, and a connection to said impedance including a second device of unidirectional conductivity.

2. In combination with a source of audio-modulated signals having superimposed noise impulses, a rectifier including a load resistor for developing direct current voltage and audio voltage components from the rectified signals and noise impulses, means for utilizing the audio component, means for utilizing the direct component for impairing utilization of the audio component, the last means comprising a series path of a device of unidirectional conductivity and an impedance in shunt with at least a por-

tion of said load resistor, a connection to said impedance including a second device of unidirectional conductivity, each of said devices being a rectifier, and the rectifiers being arranged in opposition.

3. In combination with a source of audio-modulated signals having superimposed noise impulses, a rectifier including a load resistor for developing direct current voltage and audio voltage components from the rectified signals and noise impulses, means for utilizing the audio component, means for utilizing the direct component for impairing utilization of the audio component, the last means comprising a series path of a device of unidirectional conductivity and an impedance in shunt with at least a portion of said load resistor, and a connection to said impedance including a second device of unidirectional conductivity, said second device being connected between a point on the said load resistor and the junction of said first device and its series impedance.

4. In combination with a source of audio-modulated signals having superimposed noise impulses, a rectifier including a load resistor for developing direct current voltage and audio voltage components from the rectified signals and noise impulses, means for utilizing the audio component, means for utilizing the direct component for impairing utilization of the audio component, the last means comprising a series path of a device of unidirectional conductivity and an impedance in shunt with at least a portion of said load resistor, and a connection to said impedance including a second device of unidirectional conductivity, said audio utilizing means comprising a tube, and said second device being connected to an input electrode of the latter.

5. In an audio-modulated carrier receiver of the type having a rectifier provided with a load impedance across which are developed direct current voltage and audio frequency voltage components, and an audio amplifier having an audio voltage connection to the load; the improvement including a resistive path in shunt with at least a portion of the load providing a voltage divider for said direct component, said path comprising a device of unidirectional conductivity having an impedance variable in magnitude with the carrier amplitude, and a direct current voltage connection from said device to said audio amplifier having an impedance variable in

magnitude with the carrier amplitude, said last connection including a second device of unidirectional conductivity arranged in opposition to said first device.

6. In an audio-modulated carrier receiver of the type having a rectifier provided with a load impedance across which are developed direct current voltage and audio frequency voltage components, and an audio amplifier having an audio voltage connection to the load; the improvement including a path in shunt with at least a portion of the load providing a voltage divider for said direct component, said path comprising a device of unidirectional conductivity having impedance variable in magnitude with the carrier amplitude, a direct current voltage connection from said device to said audio amplifier, said last connection including a second device of unidirectional conductivity, said shunt path including a resistive impedance in series with the first device, and said second device being arranged in opposition to said first device and being connected to an input electrode of said audio amplifier.

7. In a carrier rectifier network of the type comprising a diode arranged in series with a carrier input circuit and load resistor, a shunt path across the load comprising a rectifier in series with a resistive impedance, a second path including a second rectifier connected between an intermediate point of said load resistor and the junction of said resistive impedance and first rectifier.

8. In combination with a source of audio-modulated signals having superimposed noise impulses, a rectifier including a load resistor for developing direct current voltage and audio voltage components from the rectified signals and noise impulses, means for utilizing the audio component, means for utilizing the direct component for impairing utilization of the audio component, the last means comprising a series path of a device of unidirectional conductivity and an impedance in shunt with at least a portion of said load resistor, a connection to said impedance including a second device of unidirectional conductivity, said audio utilizing means comprising a pair of parallel audio amplifiers of different frequency response characteristics, and said last connection being made to one of said audio amplifiers.

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