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NOISE SUPPRESSOR SYSTEM

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Fig. 1.

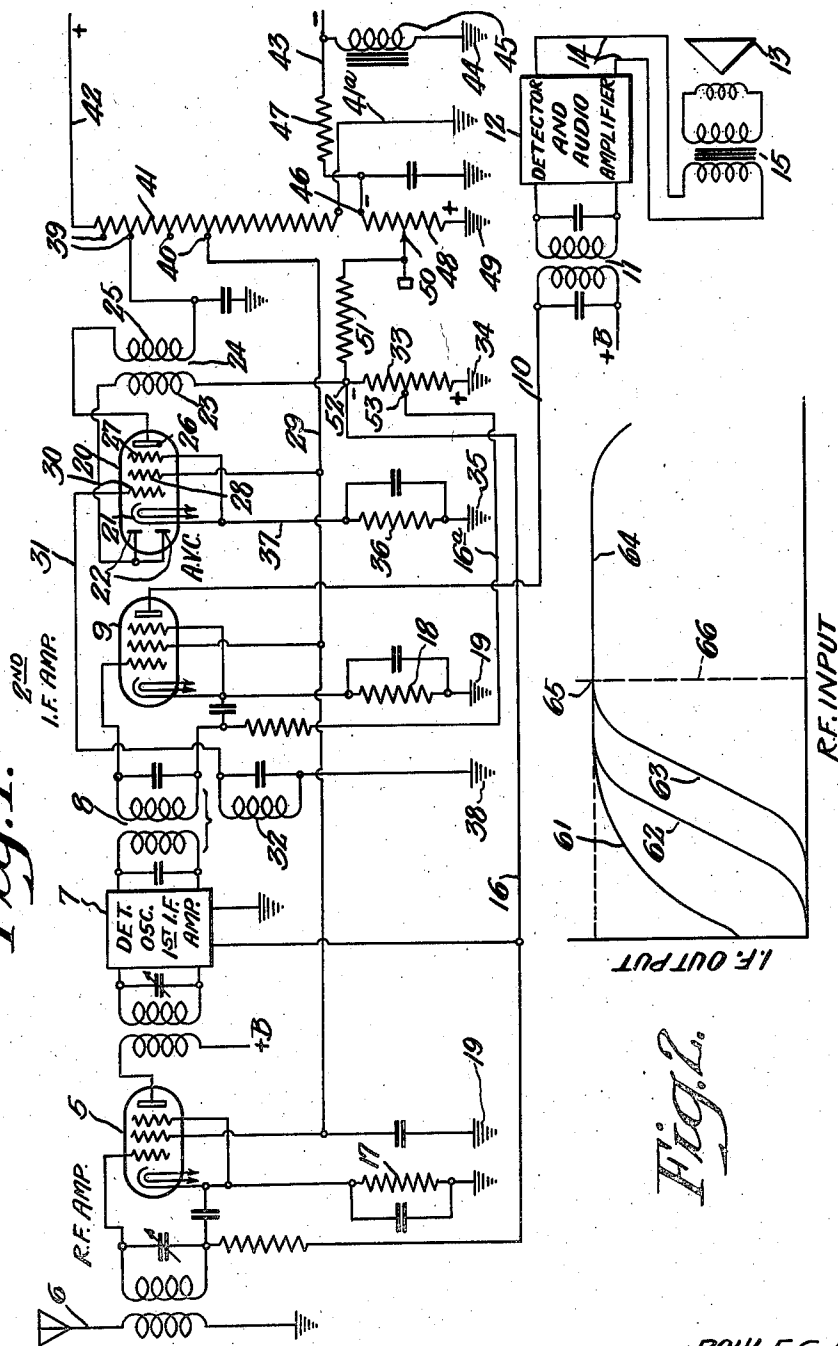
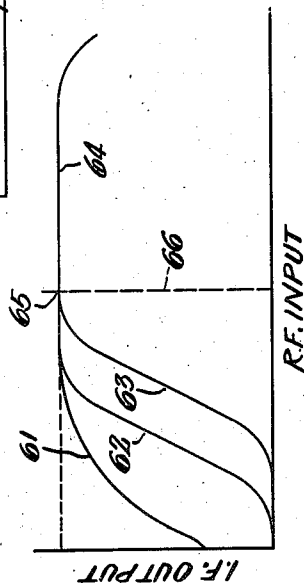


Fig. 2.



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NOISE SUPPRESSOR SYSTEM

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3 Claims. (Cl. 250-20)

The present invention relates to noise suppressor systems for radio receiving apparatus, and the like, which operate normally with a high degree of sensitivity.

In radio receiving systems, a condition of increased sensitivity resulting from operation of the automatic volume control means, tends to produce undesired amplification of stray signals and noise, and control systems for suppressing such noise are known generally as noise suppressor systems. Noise suppressor means permit tuning between carrier waves or received signals, without excessive noise or interference occasioned by operation of the automatic volume control means, which tends to permit full sensitivity of such a receiving system in the absence of a strong carrier wave.

It is an object of the present invention to provide an improved noise suppressor system for radio receiving apparatus, and the like, which may be applied to an automatic volume control circuit without interfering with the automatic volume control action thereof above a predetermined signal level.

It is also an object of the present invention to provide a noise suppressor system of the character above referred to which may be adjusted manually to control the initial sensitivity of a radio receiver without interfering with the operation of automatic volume control means provided therein above a predetermined signal level or carrier wave strength.

In carrying out the objects of the invention, a diode signal rectifier in a signal amplifying channel, preferably in an intermediate frequency amplifier, and separate from the main signal amplifying channel, is provided with a grounded automatic volume control output resistor to which a manually controllable potential may be applied from a fixed potential source to provide noise suppression of signals below a predetermined amplitude, and the same volume control effect as for a signal of that amplitude. In this manner the initial sensitivity of the receiving system may be adjusted without interfering with the normal operation of the automatic volume control means for signals of suitable high amplitude.

A further object of the present invention, to provide a combined automatic volume control and noise suppressor system wherein the sensitivity or noise suppression is manually adjustable independently of the operation of the automatic volume control means above said predetermined signal level.

The invention will be better understood from

further consideration of an embodiment of the invention as shown in the accompanying drawing, and its scope will be pointed out in the appended claims.

In the drawing, Fig. 1 is a schematic circuit diagram of a radio receiving system provided with a combined automatic volume control and noise suppressor system embodying the invention, and

Fig. 2 is a graph or curve illustrating the noise suppressor action of the system shown in Fig. 1.

Referring to Fig. 1, a radio receiving system of the conventional superheterodyne type is illustrated, with the automatic volume control and noise suppressor system embodying the invention, applied thereto. The receiver, per se, may include a radio frequency amplifier 5 coupled to a suitable signal source, such as an antenna circuit 6, and a suitable detector, oscillator and first I. F. amplifier, indicated by the rectangle 7.

The intermediate frequency signal output is applied through an intermediate frequency coupling transformer 8, to an intermediate frequency amplifier 9, and signals amplified therein are conveyed through an output connection 10 and a second intermediate frequency coupling transformer 11 to the second detector and audio frequency amplifier indicated by the rectangle 12. Signals are supplied to a loudspeaker 13 through an output coupling circuit 14 and an output coupling transformer 15.

This circuit arrangement represents any suitable radio receiving system, preferably of the superheterodyne type, which is adapted for automatic control in accordance with the invention. In the present example, the gain of the amplifiers 5, 7 and 9 is arranged to be controlled by controlling the grid biasing potential supplied thereto through automatic volume control leads 16 and 16a, while the initial biasing potential for the amplifiers is supplied from suitable sources such as self-bias resistors 17 and 18.

The system is controlled to reduce the gain in response to increased signal strength, by increasing the negative biasing potential applied between the leads 16 and 16a and ground indicated at 19, whereby the initial negative biasing potential on the amplifiers 5 and 9 is increased in proportion to the signal strength.

The automatic volume control potential for the control leads 16 and 16a is supplied from a rectifier and separate channel amplifier, contained in the present example in a tube indicated at 20, which is provided with both amplifier and recti-

fier elements in association with a common cathode 21.

The rectifier elements are indicated by the diode anodes 22 and intermediate frequency signals are applied thereto from the secondary 23 of an intermediate frequency coupling transformer 24, the primary 25 of which is connected with the output anode 26 of the amplifying portion of the tube 20.

The remaining amplifier elements include a suppressor grid 27 connected to cathode, a screen grid 28 connected with a screen grid potential supply lead 29, and a control grid 30 connected through an input circuit 31 with a secondary winding 32. The latter has fixed coupling, as indicated, with the windings of the transformer 8, whereby a portion of the intermediate frequency signal available in the intermediate frequency amplifying channel is applied to the amplifier 20, and after amplification therein is further applied to the rectifier 21—22.

In this manner a broader response may be imparted to the separate amplifying channel for the automatic volume control means, since the selectivity of the input circuit comprising the secondary winding 32 may be coupled to provide a desired lower degree of selectivity than the main signal channel comprising the transformer 8.

The automatic volume control rectifier output circuit includes the secondary winding 23 and an output resistor 33 connected between the secondary 23 and chassis or ground 34, and the circuit is completed to the cathode 21 through a second chassis or ground connection 35 and through a self-bias resistor 36 in the cathode lead 37. The grid circuit 31 is returned also to ground or chassis as indicated at 38 thereby applying a fixed biasing potential from the resistor 36 to the control grid 30.

Operating potentials for the anodes and screen grids are obtained from suitable taps 39 and 40 on a voltage divider resistor 41 which is energized from supply leads 42 and 43 having a polarity as indicated. This current may be supplied from the usual alternating current rectifier (not shown). The negative lead 43 is connected to ground or chassis 44 through a field winding 45 for the loudspeaker device 13 and it is also connected to a terminal 46 on a potentiometer resistor 48 through a series resistor 47. The resistor section 48 is also connected with the chassis 49 and is thus arranged to derive a potential from the winding 45 through the resistor 47.

The drop in potential through the winding 45 is caused by the anode current return from the screen grid and anode circuits of the receiving system and causes a fixed biasing potential to appear across the resistor section 48 having a polarity as indicated.

A movable tap 50 manually controllable, is connected through a series resistor 51, with the negative terminal 52 of the diode or automatic volume control output resistor 33. Since the positive terminal 34 thereof is connected with chassis or ground and with the ground 49, it will be seen that adjustment of the contact 50 toward the negative terminal 46 will cause an increasing potential to be applied to the circuit comprising the series resistor 51 and the diode output resistor 33. The resulting current flow will increase in potential and cause a potential drop in the automatic volume control resistor 33. This is applied to the automatic volume control leads 16 and 16a through the terminal 52 and a tap connection 53 on the output resistor 33, and the

initial potential existing between the taps 52 and 53 and ground 34 will be determined, thereby reducing the gain of the receiving system by a proportional amount.

It will, therefore, be seen that by manually adjusting the contact 50 in connection with the fixed biasing source 48, a current may be impressed upon the automatic volume control or diode output resistor 33 to vary the sensitivity of the receiving system, in the absence of received signals. At the same time it will be seen that as the potential across the resistor 33 is increased, the terminal 52 becomes more negative, thereby increasing the negative potential on the anode electrodes 22 with respect to the cathode 21 and providing an increase in the delay potential effective on the automatic volume control diode rectifier.

Accordingly, the automatic volume control action is delayed increasingly as the negative potential is increased on the terminal 52. However, when the signal strength is sufficient to overcome the negative bias, the rectifier functions to produce a further and higher potential drop through the resistor 33 in response to signal currents and this potential may increase above that predetermined by the adjustment of the contact 50 thereby permitting automatic volume control action above a predetermined signal level.

This action is indicated in Figure 2 by the curves 61, 62 and 63, all of which merge into a single curve 64 at a point 65 with the dotted line 66 indicating a predetermined input signal amplitude.

The curve 61 continuing in the curve 64, indicates the response characteristic of the automatic volume control system in controlling the intermediate frequency output when the contact 50 is moved to the positive or ground end of the resistor 48, the automatic volume control system being effective to control the sensitivity of the receiving system in a normal manner and without delay in its operation.

The sensitivity of the receiving system may be reduced as illustrated by the curves 62 and 63 when the contact 50 is moved toward the terminal 46 to apply increasing negative biasing potential to the automatic volume control output resistor 33, whereby a higher radio frequency or input signal strength is required to cause the automatic volume control system to function.

The system is adjusted in such a manner that, with a maximum potential applied through the contact 50 for reducing the sensitivity to a low degree, the automatic volume control system functions above a signal amplitude represented by the dotted line 66 and above which value of signal strength the automatic volume control system is effective to maintain a substantially constant signal output level.

The resistor 51 serves to prevent the automatic volume control resistor 33 from being short-circuited when the contact 50 is moved to the positive or ground terminal of the resistor 48, and, therefore, preferably should be of a relatively high resistance with respect to the resistor 33.

The sensitivity of the radio frequency and intermediate frequency circuits may, therefore, be limited by a sensitivity control device which operates to apply a negative potential to the negative terminal of the automatic volume control resistor and the potential is effective in the same manner as the automatic volume control potential itself to control the sensitivity of the receiving

ing system. The limitation of the sensitivity is the same as if the signal were limited in response to an incoming signal of a certain strength. In other words, the automatic volume control system may be limited to respond to signals of a predetermined strength whereby the receiving system is prevented from amplifying undesired noise signals between carrier waves when tuning, and the limit of the response may be adjusted by the manual control means directly through the automatic volume control circuit.

It should be noted as hereinbefore described, that as the sensitivity is changed, a delay is impressed upon the diode, causing the latter to become inoperative until the signal strength is of such a magnitude that it corresponds to the gain predetermined by the adjustment of the manual sensitivity control device.

We claim as our invention:

1. The combination with a radio receiving system having a main signal amplifying channel, of automatic volume control means comprising a second signal amplifying channel, a diode signal rectifier terminating said last named channel, a diode output resistor having the positive terminal thereof connected directly to ground and having automatic volume control connections thereon, means providing a fixed source of biasing potential, potentiometer means in circuit with said last named means having a movable contact for selecting a portion of said potential, means providing a connection equally conductive in either direction of direct current flow between said selecting means and the negative terminal of said output resistor, and a series resistor in said connection.

2. In a radio receiving system, the combination with a plurality of gain controllable signal amplifiers, of a gain control circuit therefor, a signal amplifier, a diode rectifier for rectifying signals from said amplifier, an output resistor for said

rectifier connected with said gain controlling circuit and having a positive terminal connected to ground, a resistor providing a fixed source of controlling potential having a positive terminal connected to ground and a movable tap on said resistor connected with the negative terminal of said output resistor through a circuit connection conductive for direct current in either direction to or from said tap, and means in said connection and exclusive of said gain controlling circuit connection providing a relatively high resistance with respect to the resistance of the said output resistor.

3. In a radio signal receiving system, the combination with a plurality of signal amplifier tubes, of means for controlling the gain of said amplifier tubes including a diode rectifier device having a cathode connected to ground and to the cathode circuit of said amplifying tubes and having an anode associated with said first named cathode, means for applying amplified received signals to said rectifier between the cathode and the anode, a diode output resistor connected between said signal applying means and the rectifier cathode, whereby one end of said resistor and said cathode are connected with ground, means providing tap connections on said resistor for the control electrodes of said first named amplifier tubes, whereby automatic volume control potentials are applied thereto from said resistor, means providing a source of fixed direct current potential having a positive connection with ground and having a variable negative tap connection, and a series resistor connected between said last named connection and a negative terminal on said diode output resistor, said last named connection being equally conductive for direct current flow therethrough in either direction.

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