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SIGNAL RECEIVING SYSTEM

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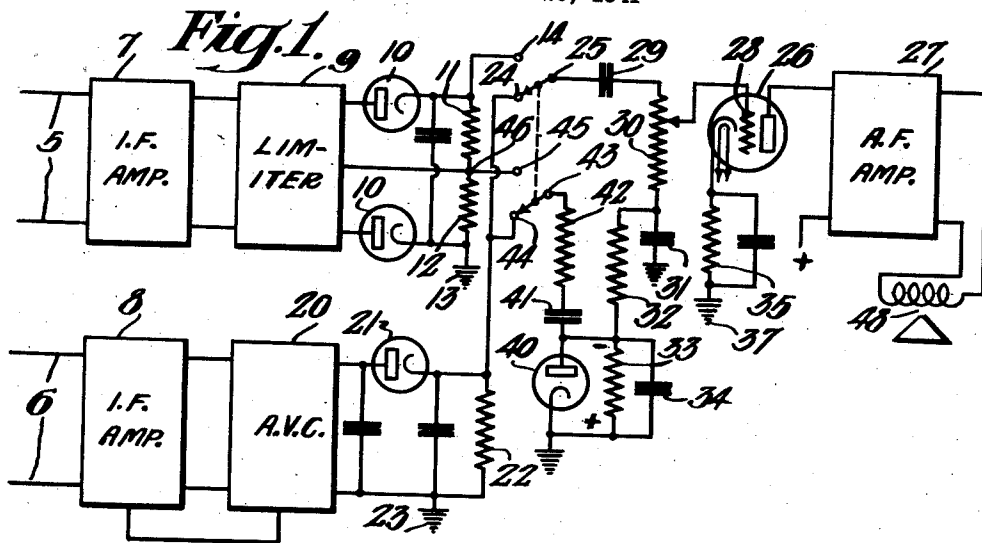
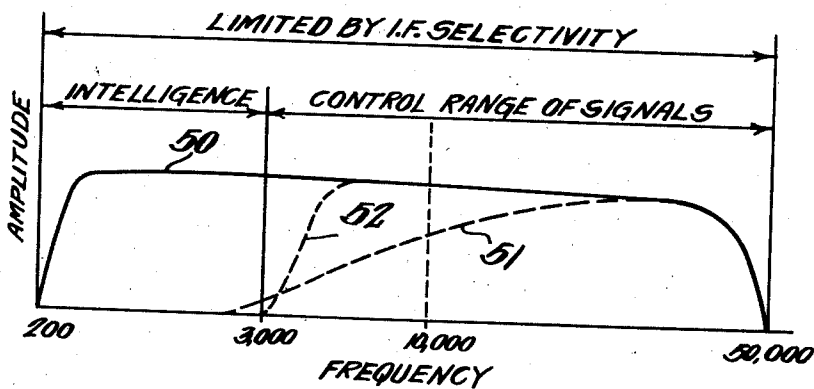


Fig. 2.



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SIGNAL RECEIVING SYSTEM

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2 Claims. (Cl. 250—20)

This invention relates to signal receiving systems, and has for its object to provide an improved signal receiving system having means for preventing noise output when tuning between desired signal frequencies or in the absence of a received signal.

Certain noise reduction systems of this type have heretofore been known as QAVC systems, for the elimination of noise or other signal output in the absence of a desired carrier wave.

As is well known, the principle of operation followed in such systems includes controlling the sensitivity of a signal amplifier, such as an audio frequency amplifier stage, in such a manner that upon failure of a received carrier wave, the amplifier gain is reduced automatically under control of a biasing potential which is adjusted so that the highest noise voltage received will not operate to restore the sensitivity to normal. In such case the received signal must be stronger than the noise voltage, in order to be received.

As an example, the noise level in urban areas is usually high and the noise control or QAVC circuit of a mobile police receiver operating in such areas must be adjusted so that a comparatively strong signal is necessary to restore the sensitivity of the signal amplifier channel. However, when such mobile receiver is operated in rural areas where the noise level is normally low, an excessively strong signal is necessary in order to be received.

It is, therefore, a further object of this invention to provide an improved signal receiving system which operates automatically to adjust the response to different noise levels in such a manner that the noise is not reproduced or does not open the amplifier or other signal circuit, while at the same time, in areas where the noise level is low, the response of the system is such that comparatively weak signals may be received, without manual adjustment.

It is also a further object of this invention to provide an improved signal receiving system which permits the amplifying circuits thereof to be maintained at a high degree of sensitivity in a stand-by condition or when tuning between stations or signal channels while preventing noise output therefrom.

In accordance with the invention, the signal output of a receiving system is caused to be substantially zero until a desired signal carrier wave is received. The carrier wave then reduces the received noise voltages either by limiting the signal amplitude as in frequency modulation receivers

or by AVC means as in amplitude modulation receivers.

The invention will, however, be further understood from the following description, when considered in connection with the accompanying drawing, and its scope is pointed out in the appended claims.

In the drawing,

Figure 1 is a schematic circuit diagram of a portion of a radio signal receiving system embodying the invention, and

Figure 2 is a graph showing curves illustrating certain operating characteristics of the circuit of Figure 1.

Fig. 1 shows two signal receiving channels from which the signal input portions have been omitted since they do not concern the invention. It is assumed, however, that the circuits involve the usual superheterodyne input system terminating in a frequency modulation intermediate frequency amplifier circuit 5 and/or an amplitude modulation intermediate frequency circuit 6 in connection with which there are provided intermediate frequency amplifiers indicated at 7 and 8, respectively.

The amplifier 7 is coupled to a suitable automatic volume control means such as a limiter represented at 9, in turn connected with a discriminator or frequency modulation detector comprising a pair of rectifier devices 10 having the usual output impedance elements 11 and 12 connected between ground or chassis 13 and an output terminal 14.

The amplitude modulation receiving channel also comprises automatic volume control means 20 which may be of any suitable type, coupled to the amplifier 8 and to the second detector 21 which is provided with an output load impedance or resistor 22 connected to ground 23 and to an output terminal 24. In general, the AVC means for frequency modulation signals is a limiter type, while for amplitude modulation reception it may be of the conventional gain control type.

The terminals 14 and 24 may be arranged as contacts of a selector switch having a contact 25 for selectively connecting with one or the other of the terminals 14 and 24, thereby to apply rectified signals from either the frequency modulation channel or the amplitude modulation channel to an amplifier stage comprising an amplifier tube 26 and further amplifying apparatus coupled thereto as indicated at 27. Either channel may be used separately, however, if but one type of signal is to be received.

The amplifier 26 is provided with a signal in-

put grid 23 coupled to either receiving channel, in the present example, through the switch 25, a coupling capacitor 29 and a suitable volume control potentiometer 30. The latter is provided at its low potential end with a bypass capacity to ground as indicated at 31 and with a filter resistor 32 through which a controlling bias potential is applied to the grid 23 from a controlling potential source 33 also connected to the chassis or ground, and provided with a bypass capacitor 34. The initial bias potential is provided on the grid 23 with respect to cathode by any suitable means such as a self-biasing resistor 35 in the connection between the cathode 36 and chassis or ground 37. It will be noted that in this arrangement the controlling bias potential source 33 is connected serially between ground and the potentiometer 30 through the filter resistor 32.

The voltage source 33 is the output load resistor for a control rectifier 40 connected in parallel therewith and coupled through a frequency discriminating filter 41—42—34 with a second selector switch arm 43 which may be connected with a contact 44 as shown for deriving a controlling potential from the output load resistor 22 or may be connected with a second contact 45 connected with a terminal 46 on the output load resistor 11—12 of the frequency modulation channel. Thus, audio frequency signals from either channel may be applied to the rectifier 40 from either channel. In the present example, the filter comprises a resistor as the element 42 and a capacitor as the element 41.

The output load resistor 11—12 represents the audio frequency detector load resistor of a frequency modulation receiver, and the resistor 22 represents the audio frequency detector load resistor of an amplitude modulation receiver, although in the present example, the two channels are combined in one system to supply rectified signal output potentials at the terminals 14 and 24.

It will be seen that noise voltages will appear at either of the terminals referred to when either of the receiving channels or receivers are in a sensitive condition of operation, as for example in the absence of a received carrier wave. The noise voltages may be generated in the receiver or may be received from the signal conveying medium and will consist of various compound frequencies from a very low audio frequency to as high a frequency as the band width of the R.—F. or I.—F. circuits permit, for example, as high as 50,000 cycles per second in the case of the frequency modulation channel 5.

The elements 41—42—33—34 provide a filter circuit for passing noise voltages having frequencies between the upper limit of the desired signal modulation such as 3000 cycles in the present example, or 10,000 cycles if desired, and the maximum frequency passed by the R.—F. and/or I.—F. circuits, such as 50,000 cycles per second. The noise voltages between these limits is rectified by the control rectifier 40, producing a unidirectional fluctuating voltage across the output resistor 33.

The control voltage is filtered by the filter elements 31 and 32 so that it is substantially a D. C. voltage and is then applied through the volume control potentiometer 30 to the control grid 23 of the amplifier stage 26. This voltage, in series with the normal bias voltage provided by the resistor 35, biases the audio frequency amplifier stage 26 beyond cut-off so that the receiving system is not responsive to noise pulses

or voltages. If the output of the amplifier is applied, for example to a loudspeaker or other sound producing device as indicated at 48, the noise output will be substantially zero.

Upon reception of a desired signal carrier wave, in the case of frequency modulation reception, with the switches 25 and 43 connected with the terminals 14 and 45, respectively, the limiter 9 preceding the discriminator and the output resistor 11—12 thereof, reduces the noise voltage peaks at the terminals 14 and 46. Thus the rectified voltage across the resistor 33 is reduced and the bias potential on the grid of the amplifier stage 26 returns it to a sensitive operating condition permitting a received signal to be amplified and transmitted to the loud-speaker 48.

In the case of amplitude modulation reception, the action of the automatic volume control means 20 reduces the noise voltage at the terminals 24 and 44, and with the switches 25 and 43, respectively, connected thereto, the rectified voltage across the resistor 33 is reduced and the amplifier 26 is restored to an operating condition for transmitting signals to the loud-speaker 48.

It is thus apparent that noise voltages, regardless of the strength thereof cannot be received through the control amplifier 26 and that it requires the action of a signal carrier to restore the amplifier 26 to a sensitive condition.

Referring to Fig. 2, assuming that for a police receiver, audio frequency signals in the range between 200 cycles and 3,000 cycles are desired, and that the response of the receiving system is substantially as indicated by the curve 50, from 200 cycles out to the limit of the frequency response of said system, noise voltages between 3,000 cycles and 50,000 cycles are passed through the filter 41—42—34 causing cut-off in the amplifier stage 26 at a predetermined frequency, and thus dividing the frequency response of the system into one range for the reception of intelligence and another range which is the control range of signals for operating the rectifier 40. The actual response of the filter arrangement of the present example is indicated by the dotted curve 51. This may be made to approach more nearly an ideal response curve as indicated at 52 by suitable choice of the filter elements interposed between the audio frequency detector and the control rectifier 40.

With this system the receiving circuits may be maintained in a condition of maximum sensitivity, as when standing by for signals or in tuning between stations without subjecting the output or sound producing device to the noise output which normally accompanies such operation.

This is accomplished by utilizing the noise voltages above the useful range of audibility or intelligence, after rectification and filtering, to control the sensitivity of a following amplifier stage. The system therefore depends upon the use of a limiter or suitable AVC system for reducing the noise voltage upon receiving a carrier wave. Thus, unless the AVC system or other sensitivity control means is functioning, the amplifier will not respond and the output will remain substantially zero.

It will further be seen that with the system disclosed, the response is adjusted automatically to different noise levels in such a manner that the noise alone may not cause the cut-off amplifier to operate, and at the same time when the noise level is relatively low a comparatively weak signal may be received. Thus it is highly effective in connection with mobile radio signal

receiving systems such as for use in police work where the operation may include urban areas having a high noise level and rural areas having a relatively low noise level, without attention or manual adjustment.

I claim as my invention:

1. The combination with a high frequency amplifier having a predetermined selectivity characteristic providing for the transmission of signals in a relatively wide frequency band, of a signal detector coupled to said amplifier, signal responsive volume control means for limiting the signal flow from said amplifier to said detector in the presence of a received carrier wave, a signal output circuit for said detector including a gain control amplifier, a second output circuit for said detector including a rectifier having an output circuit, a filter in said last named connection for passing signals from said detector to said rectifier in a control range above a predetermined upper frequency limit of desired intelligence transmission and below the upper limit of the frequency response range of said high frequency amplifier, and means for reducing the

gain of said last named amplifier in response to current flow in said rectifier output circuit.

2. A signal receiving system comprising, in combination, a high frequency signal amplifier, a detector coupled to said amplifier, means responsive to a received signal for limiting the signal flow from said amplifier to said detector, means for deriving a rectified signal from said detector, means for amplifying said derived signal including a gain control amplifier stage, and means for controlling said amplifier stage in the absence of a received signal to cut off the output of said receiving system, said last named means including a rectifier having an output circuit connected with said gain controlling stage to apply a gain control potential thereto, and an input circuit coupled to the output of the detector and including a noise filter for applying thereto noise voltages in a frequency range above a predetermined signal frequency and below the upper limit of the signal transmission range of said system.

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