July 9, 1940. I. J. KAAR 2,207,587

SIGNAL RECEIVING SYSTEM

Filed June 13, 1936

Fig. 1.

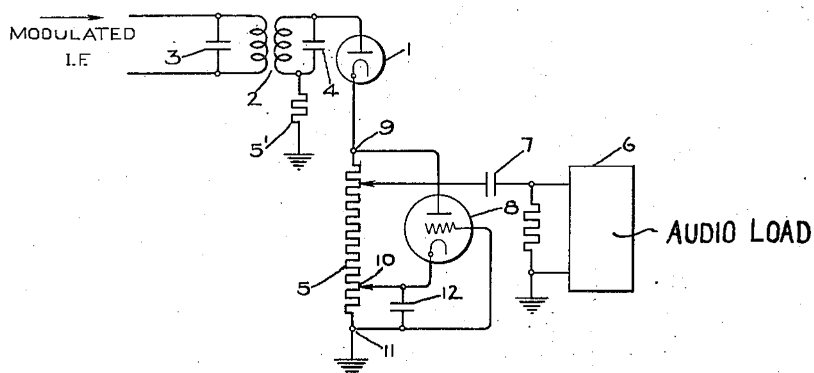
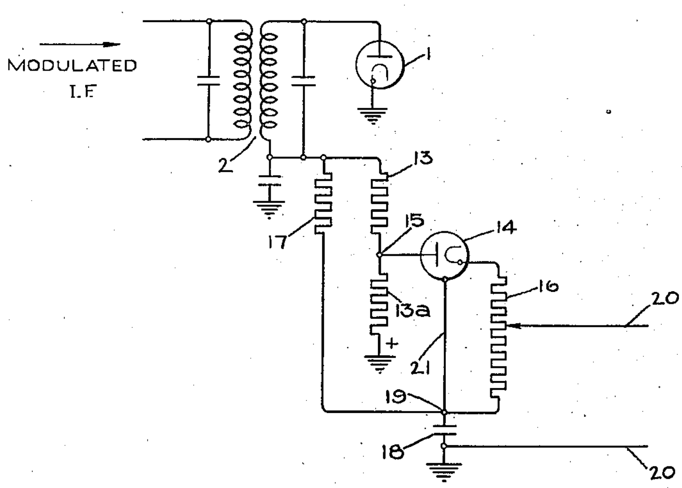


Fig. 2



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UNITED STATES PATENT OFFICE

2,207,587

SIGNAL RECEIVING SYSTEM

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Application June 13, 1936, Serial No. 85,083

15 Claims. (Cl. 250—20)

My invention relates to signal receiving circuits and more particularly to means for use therein to reduce the reception of undesired currents.

One of the objects of my invention is to provide means to reduce the reception of undesired currents when said currents have an intensity in excess of a predetermined relation to the intensity of signal currents being received.

Many means are not known to the art to prevent, or to reduce, the transmission through a signal circuit of undesired noise currents having an intensity in excess of a predetermined fixed value. One of the objects of my invention is to provide means whereby the noise current intensity value above which the transmission of noise currents is reduced is automatically variable in accordance with an depending upon the ratio of the signal or noise component to the average carrier amplitude.

In a radio receiver employed, for example, for voice or music reception, the noise current intensity which may be tolerated varies with the intensity of signals being received. If the signals be strong, noise current intensities of very strong intensity may not be objectionable whereas if the signals be weak this same value of noise current intensity may greatly impair if not completely destroy the reception of the signals.

A further object of my invention is to provide means whereby the intensity value above which the transmission of noise currents is reduced may correspond to a signal intensity which modulates the received carrier wave by a predetermined percentage of modulation.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its organization and method of operation together with further objects and advantages thereof may best be understood by reference to the following description taken in connection with the accompanying drawing in which Figs. 1 and 2 represent different embodiments of my invention.

Referring to Fig. 1 of the drawing I have indicated therein a diode 1 which may, for example, comprise the diode detector of a superheterodyne radio receiver and which may be supplied with currents of the intermediate frequency occurring in said receiver through a transformer 2, the windings of which are tuned to said intermediate frequency by condensers 3 and 4 respectively. The cathode of the diode is connected to ground through load resistance 5, the return path to the anode of the diode being through resistance 5' and the secondary winding of the transformer 2. Signal currents which appear in the load resistance 5 may be supplied to a load 6 through a coupling condenser 7. The load 6 may, of course, comprise an audio amplifier of the radio receiver or other suitable signal device such as a pair of headphones or a loudspeaker.

In the operation of the system as thus described it will be understood that unidirectional currents flow in the load resistance 5 having an intensity dependent upon the intensity of the received carrier wave or the rectified average of the noise voltages and which are modulated with the audio signal to be received. In accordance with my invention a discharge device 8 is provided having an anode connected to a point such as 9 on the resistor, a cathode connected to an intermediate point 10 on the resistor and a grid which is connected to a point 11 on the resistor negative with respect to the point 10. This discharge device may be of any suitable type such as a vapor electric device or a high vacuum triode having low impedance between its anode and cathode.

A condenser 12 is connected between the points 10 and 11 having high capacity and hence low reactance at the frequencies involved in the signal currents. Thus substantially no audio frequency potential appears between the grid and cathode of the discharge device 8.

The point 10 is so chosen between points 9 and 11 that the tube 8 is substantially ineffective during normal reception of signals. If, however, during such reception noise currents of strong intensity be produced then the anode of the discharge device, for the period of said noise currents, becomes so strongly positive with respect to the cathode that the impedance between the anode and cathode is reduced, notwithstanding the bias upon the grid, to such a value that the noise currents delivered to 6 are attenuated.

Thus, for example, let us assume that during normal reception of signals the unidirectional voltage on the diode load resistor 5 is 20 volts. If an unmodulated carrier which produces 20 volts across the detector load be modulated 100%, then the instantaneous voltage on the diode load resistor varies between zero and 40 volts, that is, twice the carrier. The bias applied to the grid and which remains constant by reason of condenser 12 may be so chosen that the tube has no effect upon signals, the maximum intensity of which does not exceed 40 volts. If undesired currents, such as static, be now received having an intensity such that it corresponds to a percentage of modulation in excess of 100%, then the discharge device 8, if it be of a gaseous type, breaks down and passes current until the instantaneous voltage across it is reduced, on the reverse half cycle, below the ionization voltage of the gas, or to zero, and thus, while conducting, it shunts the diode load resistance and prevents the static impulse from reaching the signal device 6. This is true if the discharge device 8 be of the high vacuum type except that the change in resistance between the anode and cathode occurs without gas ionization.

It will be seen that the bias applied to the grid, however, varies with the intensity of the carrier or rectified average noise voltage so that if at any instant the signal be weak, then a low bias is applied to the grid and the discharge device 8 is effective to reduce noise currents of weaker intensity than would be the case were the signal strong and a strong bias were applied to the grid. Thus the value of noise current intensity above which noise currents are reduced varies in accordance with the signal intensity and may be adjusted by adjustment of the point 10 with reference to the points 9 and 11 to correspond to a definite percentage of modulation of the received carrier wave.

Resistance 5' which is in series with resistance 5 between the anode and cathode of the diode 1 aids in the reduction of static in that when current flows through discharge device 8 duing reception of a static impulse, this current produces a drop in voltage on resistance 5' which reduces the voltage on resistance 5. That is, it increases the regulation of the voltage source thereby reducing the voltage on resistance 5 when discharge device 8 becomes conductive.

In Fig. 2 I have shown a further embodiment of my invention which involves a signal detector 1 to which currents from a radio receiver, for example, may be supplied through a transformer 2 in the same way as in Fig. 1. The secondary winding of the transformer 2 in this case is connected between the anode of the diode 1 and ground through the diode load resistors 13 and 13*a* in series. The limiting discharge device 14 in this case comprises a diode the anode of which is connected to the diode load resistance at point 15 and the cathode of which is connected through resistances 16 and 17 to the anode of the diode. Thus the elements 14, 16, and 17 connected in series comprises a path directly in shunt to resistance 13. The point 19 between resistances 16 and 17 is thus at a unidirectional potential equal to the potential at a point intermediate the ends of resistance 13. This point 19 is grounded for alternating current by a large capacitance 18. During reception of a normal carrier, wave signal currents may flow through resistance 13, diode 14, resistance 16 and condenser 18 to ground, and thus the load device, which may be an audio amplifier, may be connected between ground and a point on resistance 16 as indicated by conductors 20.

In the operation of the system direct current from the anode of the diode 1 flows through load resistances 13 and 13*a*. It also flows through resistances 17 and 16, diode 14, and the lower portion 13*a* of the load resistance. The point 19 between resistances 17 and 16 is thus, as already stated, at some unidirectional potential with respect to ground corresponding to the potential at a certain point on resistance 13. If, for example, a large static impulse be now received, the anode of diode 14 is driven negatively. The point 19, however, cannot change in potential by reason of the condenser 18 with the result that the anode of diode 14 becomes negative with respect to point 19 and current ceases to flow in the resistance 16. Thus the static impulse is prevented from reaching the conductors 20 and the load device connected thereto.

For a particular example let us assume that during reception of a normal carrier the potential on resistance 13*a* is 10 volts and that on resistor 13 is 20 volts. If resistors 16 and 17 now be equal and large compared with the resistance of the diode 14 then the point 19 will be at 20 volts below ground, making the anode of 14 positive with respect to its cathode, and thus current flows from the anode to the cathode of the diode 14 and signal electromotive forces appear between the conductors 20. With the circuit elements so proportioned, if a static impulse be received corresponding to at least 100% modulation of the carrier then the instantaneous potential on the load resistance 13*a* increases to 20 volts or more with the result that the point 15 becomes at least 20 volts negative with respect to ground. The point 19, however, does not change during the static impulse but remains at 20 volts negative with respect to ground. Thus there is no voltage between points 15 and 19, or if there be voltage, it is of such polarity that the anode of diode 14 is negative with respect to the cathode with the result that the static impulse is prevented from reaching the load circuit 20. Thus the static impulse in excess of the intensity corresponding to modulation of the carrier 100% is prevented from reaching the load circuit. This value of percentage of modulation may, of course, be chosen as desired by proper choice of the circuit constants.

It is necessary to the proper operation of diode 1 as a signal detector that resistances 17 and 16 be large. This is desirable also from the standpoint of efficient noise elimination since by making resistance 17 large the rate at which condenser 18 charges when diode 14 is non-conducting is reduced. Thus, for example, in the case assumed the voltage on condenser 18 is 20 volts. If diode 14 be rendered non-conducting by a static impulse, condenser 18 then tends to charge through resistance 17 to the full value of the potential on load resistances 13 and 13*a*. Of course the more the voltage increases on condenser 18, the less effective the discharge device becomes in reducing the static impulses. Accordingly it is desirable that resistance 17 be high thereby to increase the period required by condenser 18 to charge.

It has been found that it is desirable where electron discharge devices of the so-called metal type are employed that the metal shell of the discharge device 14 be connected to the negative end of resistance 16 as indicated by conductor 21 whereby this shell never becomes positive with respect to the diode cathode and thus no current flows between the cathode and the diode shell.

The form of my invention shown in Fig. 2 is described and claimed in copending application of George W. Fyler, filed June 13, 1936, Serial No. 85,077, and assigned to the same assignee as my present application.

While I have shown particular embodiments of my invention it will of course be understood that

I do not wish to be limited thereto since many modifications both in the circuit arrangement and in the instrumentalities employed may be made without departing from the spirit and scope of my invention and I contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In combination, a high frequency receiver having a detector, an output circuit for said receiver, means to transmit noise and signal currents to said output circuit, and means responsive to unidirectional current in said detector to disable said last means only when the intensity of said noise currents is in excess of a predetermined ratio to the intensity of signals supplied to said detector, said first means including means to supply signals modulating the received carrier wave by not more than a desired percentage of modulation corresponding to said ratio to said output circuit, irrespective of their intensity.

2. The combination, in a carrier wave receiver of an output circuit for said receiver, means to demodulate the received carrier and to supply the demodulation products to said output circuit, and means to disable said last means when the instantaneous value of current received in said receiver exceeds a predetermined relation to the average intensity of the received carrier, and means to supply received currents of intensity equal to said instantaneous value to said output circuit when said relation to the received carrier is not exceeded.

3. In combination, a circuit having modulated electromotive force of varying average value supplied thereto, a load circuit coupled therewith, means to supply modulations of said electromotive force to said load circuit, and means to reduce transmission to said load circuit of modulations of said electromotive force in excess of a percent modulation fixed for all values within a range of average values of said electromotive force.

4. In combination, a circuit having a modulated electromotive force of varying average value applied thereto, a load coupled thereto, means to supply to said load modulations of said electromotive force, and means to render said last means ineffective to transmit electromotive forces of intensity in excess of a predetermined percentage of modulation of said electromotive force, said percentage of modulation being substantially fixed over a wide range of average values of received electromotive force.

5. In combination, a circuit adapted for transmission of modulated signals, means to establish a shunt across said circuit in selective response to increase in percentage of modulation of electromotive force in said circuit in excess of a predetermined percentage of modulation, and means operative irrespective of the average value of said electromotive force to prevent increase in instantaneous value of said electromotive force from establishing said shunt unless said percentage of modulation is exceeded.

6. In combination, a circuit adapted for transmission of modulated signals, means selectively responsive to the percentage of modulation of electromotive force supplied to said circuit as distinct from instantaneous intensity of said electromotive force for altering the transmission characteristics of said circuit, and means to prevent such altering of the transmission characteristics of said circuit produced by increase in intensity of electromotive force across said circuit not accompanied by increase in percentage of modulation.

7. In combination, a circuit adapted for transmission of modulated signals, means selectively responsive to increase in the percentage of modulation of electromotive force supplied to said circuit as distinct from increase in instantaneous magnitude of said electromotive force to reduce transmission of said signals through said circuit, and means to prevent such reduction of transmission of signals through said circuit from being caused by increase in instantaneous voltage across said circuit not accompanied by increase in percentage of modulation.

8. The combination in a carrier wave receiver of a diode detector having a load resistance upon which appears a unidirectional potential having a varying average value, means to shunt said resistance in response to instantaneous potential thereon in excess of a predetermined relation to the average value of the uni-directional potential thereof, said predetermined relation being fixed for a range of said average values, and means to prevent shunting of said resistance in response to increase in intensity of potential across said resistance when accompanied by increase in average value of said potential.

9. The combination, in a carrier wave receiver, of a detector for the received carrier wave, an output device, means to supply signals from said detector to said output device, means to disable said last means in response to electromotive forces received in said receiver having absolute intensities which are such wide departures from the average value of the received carrier that they exceed a fixed predetermined percentage of modulation of the received carrier wave and means to prevent such disablement in response to electromotive forces of even greater absolute intensities but which are not such wide departures from the average intensity of the received carrier as to exceed said fixed predetermined percentage of modulation of the received carrier wave.

10. In combination with a circuit carrying direct current modulated to a certain percentage by signal variations, of an electrical control device operable to control the effective impedance of said circuit, means for establishing a threshold voltage for said device increasing as said direct current increases comprising means for impressing upon said device with a storing action a fixed proportion of the incoming pulsating voltage, and means for impressing upon said device a different proportion of said incoming pulsating voltage to overcome said threshold voltage whereby, when said direct current is large, a larger incoming pulsating voltage is required to overcome said threshold.

11. In combination with a circuit carrying pulsating direct current of an electrical control device operable to control the effective impedance of said circuit, means for establishing a threshold voltage for said device increasing as said direct current increases, said means comprising means for impressing upon said device with a storing action a fixed proportion of the incoming pulsating voltage, and means for impressing upon said device a different proportion of said incoming pulsating voltage without storing action, the latter voltage being polarized to cause operation of said device and said first voltage being polarized to prevent operation thereof.

12. The combination, of a circuit carrying pulsating unidirectional current, of an electron discharge device connected across said circuit, means to establish a threshold voltage for said discharge device comprising means to apply to said discharge device a unidirectional voltage of magnitude varying only with the average value of said unidirectional voltage and means to apply to said discharge device a voltage varying with the instantaneous value of said pulsating voltage, said latter voltage being polarized to overcome said first mentioned unidirectional voltage and to operate said discharge device when said instantaneous voltage exceeds a predetermined relation to said unidirectional voltage.

13. The combination of a circuit carrying pulsating unidirectional current of an electron discharge device having a discharge space connected across said circuit whereby it is subjected to the instantaneous voltage of said circuit, a control electrode in said space, means to apply to said control electrode with storing action a unidirectional voltage poled to prevent flow of current in said discharge space and of such value that current flows in said discharge space only in response to voltage peaks exceeding a predetermined relation to said unidirectional voltage applied to said control electrode.

14. In apparatus of the character described having a circuit carrying pulsating direct input current, the combination of a by-pass circuit to ground including a bias-governed electrical control device operable to control the effective impedance of said circuit and means for establishing an automatically varied threshold voltage for said control device bearing a predetermined proportion to the average input voltage, said means comprising means for impressing upon one side of said device with a filtering and storing action a given negative potential variable in predetermined proportion to the average input voltage, and means for impressing upon the other side of said device, a potential also variable in predetermined proportion to said average input voltage, the voltage impressing means to one of said sides including a time-delay device operable to delay the charging of said one of said sides for an interval exceeding the normal time duration of peak-type electrical interferences.

15. In combintion with a circuit carrying pulsating direct current, a non-linear electrical control device having a pair of elements across which a governing bias may be applied, said device being operable to control the effective impedance in said circuit, said circuit including a voltage dividing network and individual circuits from said network to said elements of said control device, said individual circuits being tapped from said network at different points arranged to maintain normally a predetermined differential on said two elements of said device.

IRA J. KAAR.

CERTIFICATE OF CORRECTION.

Patent No. 2,207,587. July 9, 1940.

IRA J. KAAR.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, first column, line 10, for the word "not" read --now--; line 18, for "an" read --and--; page 2, first column, line 35, for "duing" read --during--; page 3, second column, line 40, claim 9, after "wave" insert a comma; page 4, second column, line 19, claim 15, for "combintion" read --combination--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 3rd day of September, A. D. 1940.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)