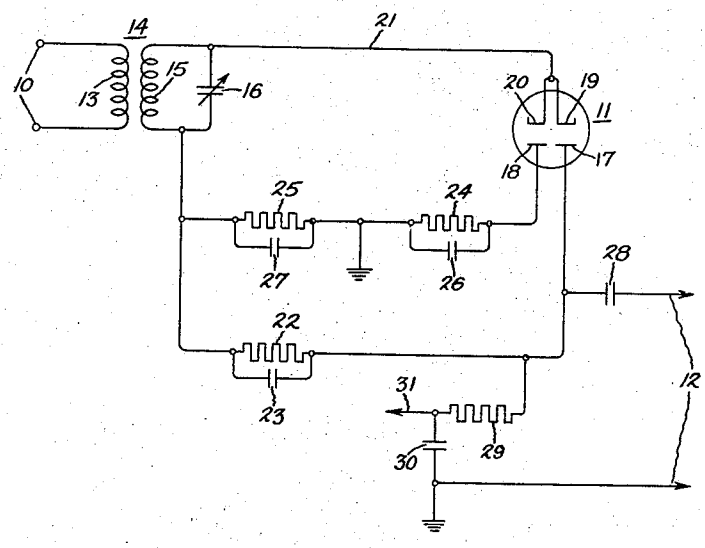
July 25, 1944. R. B. DOME 2,354,508

NOISE BALANCING

Filed Oct. 31, 1942



Inventor:
Robert B. Dome,
by Harry E. Dunham
His Attorney.

Patented July 25, 1944 2,354,508

UNITED STATES PATENT OFFICE

2,354,508

NOISE BALANCING

Robert B. Dome, Bridgeport, Conn., assignor to General Electric Company, a corporation of New York

Application October 31, 1942, Serial No. 464,029

7 Claims. (Cl. 250—20)

My invention relates to signal translating circuits and in particular to a system for eliminating transient noise peaks from such circuits.

It is an object of my invention to provide an improved noise limiting circuit which effectively discriminates between desired signals and undesired noise impulses impressed on the input of a radio receiving apparatus and which prevents such impulses from appearing in the output circuit of the apparatus.

In the usual type of receiving apparatus for amplitude modulated radio frequency waves it is customary to employ a diode rectifier in the detecting circuits for reproducing the audio signals from the modulated waves. It is a further object of my invention to provide an improved noise limiting system for such circuits which is relatively simple in operation, is inexpensive to construct, and may be easily applied to existing receivers.

The features of my invention which I believe to be novel are set forth with particularity in the appended claims. My invention itself, however, 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 the single figure of the drawing represents a portion of a receiver circuit embodying my invention.

The receiver circuits shown in the drawing comprise an input circuit 10 supplying modulated high frequency waves to the detector 11. The waves are demodulated and the modulating signals reproduced in the load circuit of the detector 11, the audio voltages developed therein being supplied over the leads 12 to succeeding stages of the receiver. The waves impressed across the input circuit 10 may be supplied from a receiving antenna or from an amplifier of a radio receiver. In the usual form of superheterodyne receiver, they are intermediate frequency waves supplied from the final intermediate frequency amplifier and are impressed on the primary winding 13 of input transformer 14 having a secondary winding 15 tuned, by means of capacitor 16, to the intermediate frequency.

The balanced detector 11 may comprise a twin diode type of electron discharge device having a plurality of anodes 17 and 18 and a plurality of cathodes 19 and 20. It will be realized of course that instead of having the twin diodes in a single envelope, two separate diodes or any other suitable type of rectifying device may be used. The cathodes 19 and 20 are connected together and are supplied with high frequency oscillations from the tuned secondary circuit of the transformer 14 by means of conductor 21. The diode comprising the anode 17 and the cathode 19 acts as a signal detector whose circuit extends from the anode 17 through a load resistor 22 and the high frequency by-pass capacitor 23 in parallel and the tuned secondary circuit of the transformer 14 to the cathode 19.

The circuit for the detector comprising the anode 18 and the cathode 20 consists of two resistors 24 and 25 by-passed respectively by means of capacitors 26 and 27, capacitor 26 being an audio frequency by-pass capacitor and capacitor 27 being a radio frequency by-pass capacitor. Resistor 24 is relatively large compared to resistor 25; for example, the former may be 10 megohms and the latter 100,000 ohms. Thus, resistor 24 and capacitor 26 and resistor 25 and capacitor 27 form two impedance networks in the load circuit of the diode 18, 20, the former having a relatively long time constant and the latter a relatively short time constant. The common point of these two networks is directly connected to ground potential. Preferably, the resistor 22 is of substantially the same magnitude as resistor 25 and capacitor 23 substantially equal to capacitor 27. Since capacitor 27 is directly connected to ground, capacitor 23 may be made slightly greater than capacitor 27 to compensate for the added capacitance across capacitor 27 due to the capacity of transformer 14 to ground, this latter capacity acting in shunt with capacitor 27.

The operation of the circuit of the diode detector 17, 19 is well known to those skilled in the art and will not be detailed here. Briefly, this detector is effective to demodulate the carrier wave impressed upon the transformer 14. Demodulation products are developed across the diode load resistor 22. Detector 18, 20 operates in a similar manner to demodulate the carrier waves impressed upon the transformer 14. Since resistor 24 and capacitor 26 are both large with respect to resistor 25 and capacitor 27, in normal noise-free signal reception, capacitor 26 is maintained charged at substantially the peak of the radio frequency signal waves and follows the envelope of the wave. Both the audio frequency voltages and the unidirectional potentials developed across resistor 25 are negligible, the unidirectional potential across resistor 25 being in the order of 1 per cent of the unidirectional potential across resistor 24, since resistor 24 is approximately 100 times as large as resistor 25.

Since the voltage across resistor 22 is approximately equal to the sum of the voltages across resistors 24 and 25 in series, the audio frequency voltages across resistor 22 are approximately 100 times as large as those appearing across resistor 25. The audio potentials appearing between anode 17 and ground may, therefore, be supplied to succeeding stages of the receiver through coupling capacitor 28 and leads 12. This potential comprises the sum of the potentials across resistor 22 and resistor 25 in series, the potential across resistor 25 being of opposite polarity to that developed across resistor 22 and approximately one per cent thereof. The audio potential supplied to the succeeding stages is therefore approximately 99 per cent of the audio potential output of diode 17, 19. This 99 per cent of the usual output potential is scarcely distinguishable from the normal potential.

The direct current component of the demodulated signals appearing across resistors 22 and 25 in series may be used likewise for automatic gain control. The potentials between anode 17 and ground are supplied through a suitable audio removing filter, consisting of the series resistor 29 and the shunt capacitor 30, to conductor 31 and applied to the gain control connections of preceding stages of the receiver, not shown. The arrangement and operation of the gain control connections will readily be understood by those skilled in the art without elaboration. The potentials are applied to control electrodes of one or more of the tubes preceding the detector to vary the receiver gain in accordance with the strength of the received signals, as is well understood in the art.

If a sharp noise transient voltage is impressed across the input terminal 10, this noise voltage, when it appears in the tuned secondary circuit of transformer 14, is rectified by diode 17, 19 and a certain voltage is developed across resistor 22. The noise voltage is likewise rectified by diode 18, 20. Capacitor 26, being large, acts as a short-circuit for such a transient. Consequently, a noise voltage is developed across resistor 25 which is of substantially the same magnitude as the voltage developed across resistor 22. These voltages across resistors 22 and 25 are connected in series and appear with opposite polarity in that series connection. As a result, they effectively cancel each other so that substantially zero noise appears across the audio output terminals 12.

It is thus seen that my invention provides a detector circuit in which, while noise transients are effectively balanced out, substantially normal audio potentials are supplied for the succeeding stages of the receiver.

Merely for the purposes of illustration, the following data is given for a particular radio receiving apparatus embodying my invention. These values were found to give satisfactory results in a particular case although they are not to be regarded as necessarily applicable to all embodiments of my invention.

Resistors 22, 25	ohms	100,000
Resistor 24	megohms	10
Capacitors 23, 27	mmf	180
Capacitor 26	mfd	0.5
Tube 11		Type 6H6

While I have shown a particular embodiment of my invention, it will of course be understood that I do not wish to be limited thereto since various modifications may be made, 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. The combination in a noise reducing system for signal modulated carrier wave receivers, of a detector for the received carrier wave having a load impedance upon which the detected signal and noise voltage appear, a second impedance in series with said load impedance, means to reproduce upon said second impedance said signal and noise voltage in opposed relation to the voltage on said load impedance, said noise voltage being reproduced with substantially equal intensity on said two impedances and said signal voltage being reproduced with substantially smaller intensity on said second impedance than on said load impedance, and a signal responsive means connected across said two impedances in series.

2. In a translating circuit for a carrier wave receiver, the combination with a first impedance upon which the demodulation voltage of said carrier wave and an undesired noise voltage appear, of means for producing in series with said voltages demodulation and noise voltages of opposite polarity, said means comprising a second impedance having a long time constant and connected in series with said first impedance, said opposed noise voltage being of an intensity substantially equal to the noise voltage across said first impedance and said opposed demodulation voltage being substantially smaller than the demodulation voltage across said first impedance.

3. In a carrier wave receiver, the combination of an impedance upon which the demodulation voltage of said carrier wave and an undesired noise voltage appear, a resistance connected in series with said impedance, and means to reproduce on said resistance said demodulation and noise voltages in opposed relation to the voltages on said impedance, said opposed noise voltage being of substantially equal intensity to the noise voltage on said impedance and said opposed demodulation voltage being substantially smaller than the demodulation voltage on said impedance.

4. In a translating circuit for signal modulated carrier waves subject to noise impulses, the combination with means for rectifying said waves, of means including a load circuit connected across said rectifying means for reproducing said signals from said waves, and means including a path connected in parallel with said load circuit for eliminating said noise impulse from said translating circuit, said path comprising a pair of impedances having long and short time constants respectively, the common point of said impedances being connected to a point of fixed potential and said impedance having a short time constant being connected in series with said load circuit between said rectifying means and said point.

5. In a noise eliminating system for high frequency receivers, the combination of a pair of paths each comprising means to rectify the received high frequency oscillations and to produce unidirectional signal voltages varying with variations in intensity of the received oscillations, a signal circuit connected across one of said paths and a portion of the other of said paths in series, said one of said paths and said portion of said other path having substantially equal impedances therein, and an impedance having a relatively long time constant in the remainder of said other path.

6. In a translating circuit for signal voltages

subject to undesired noise transients, the combination of a pair of parallel paths, one of said paths and a portion of the other of said paths being connected in series for the translation of said signals, and means in the remainder of said other path for causing said noise transients to appear in said portion with a magnitude substantially equal to and a polarity opposite to that of the noise transients in said one path.

7. In radio receiver, the combination with a source of signal modulated carrier waves subject to noise impulses, of a pair of parallel paths connected to said source, a rectifier in each of said paths, the first of said paths and a portion of the second of said paths being connected in series between said source and a point of fixed potential for the translation of signal voltages, impedances of substantially equal magnitude and sign connected respectively in said first path and said portion of said second path, and a long time constant network connected in the remainder of said second path, said network presenting a path of low impedance to noise impulses appearing in said receiver and said noise impulses producing voltages of substantially equal magnitudes and opposite polarity across said equal impedances in said series circuit.

ROBERT B. DOME.