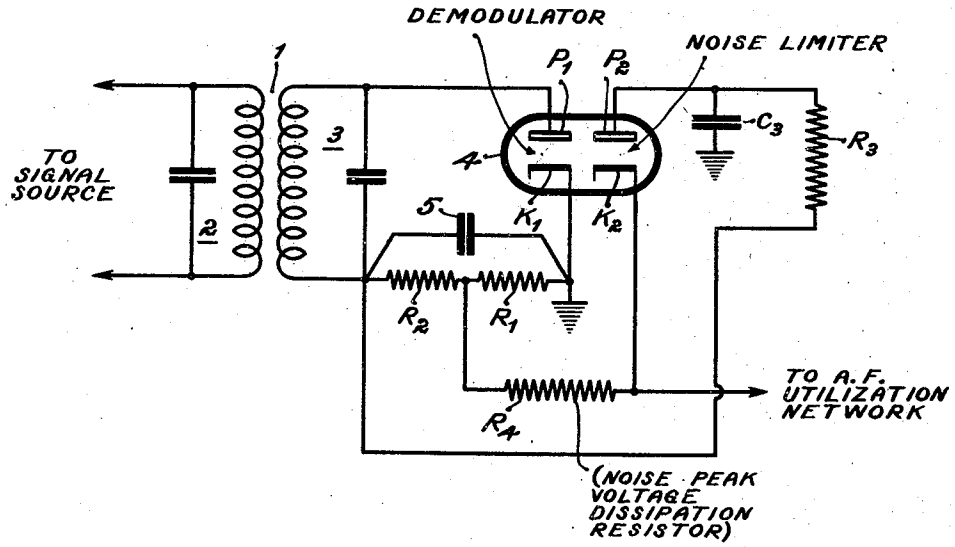
Sept. 12, 1944. L. E. THOMPSON 2,357,983

NOISE LIMITER CIRCUIT

Filed Feb. 25, 1943



INVENTOR
LELAND E. THOMPSON

BY H. S. Brower

ATTORNEY

Patented Sept. 12, 1944 2,357,983

UNITED STATES PATENT OFFICE

2,357,983

NOISE LIMITER CIRCUIT

Leland E. Thompson, Merchantville, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application February 25, 1943, Serial No. 477,052

6 Claims. (Cl. 250—20)

My present invention relates to noise limiter circuits, and more particularly to an improved noise limiter of the diode type.

The main object of my invention is to provide a noise limiter of the diode type, wherein the diode is shunted across a portion of the demodulator load in a manner such that the limiter diode becomes conductive to short circuit the load solely when the energy applied to the demodulator exceeds a predetermined peak value, say 100% modulation of the applied carrier. My improvement comprises a resistor between one of the shunting diode elements and an intermediate point of the load. The resistor has a magnitude such that it functions to dissipate therethrough practically all of the shunting diode space current when the latter becomes conductive thereby greatly to improve limiting of noise peaks.

Still other objects of the invention are to improve the action of noise limiter circuits, and more especially to provide a simple and economical noise limiter circuit which is reliable and efficient in operation.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims; the invention itself, however, as to both its organization and method of operation will best be understood by reference to the following description, taken in connection with the drawing, in which I have indicated diagrammatically a circuit organization whereby my invention may be carried into effect.

Referring, now, to the signal demodulator circuit shown in the drawing, the reference numeral 1 designates the input transformer of the demodulator. The transformer has its primary and secondary windings each resonant to the operating signal frequency. Numerals 2 and 3 designate respectively the primary and secondary tuned circuits. The signal source which feeds the tuned circuit 2 may be the intermediate frequency (I. F.) amplifier of a superheterodyne receiver, if desired. It is not necessary to disclose the networks preceding transformer 1, because those skilled in the art of radio communication are fully aware of the construction of a superheterodyne receiver.

It is to be understood that the invention is not limited to utilization in the demodulator stage of a superheterodyne receiver, since it may be applied to a receiver of the tuned radio frequency amplifier type, or even a receiver adapted to receive angle modulated carrier wave energy, such as frequency modulated, or phase modulated, carrier wave energy. Of course, in the latter two cases the demodulator network would be arranged for the particular reception involved, but that would not in any way affect the functioning of the noise limiter circuit to be hereinafter described.

Assuming for the purposes of the present application that I. F. energy is transmitted to the input transformer 1, the demodulator tube as indicated by reference numeral 4 is shown as being of the 6H6 type. Of course, there may be employed separate diode tubes, if desired. The plate, or anode, P_1 of the demodulator diode is connected to the high potential side of the resonant secondary circuit 3. The cathode K_1 is connected to ground. The low potential side of the tuned circuit 3 is connected to the grounded cathode through a load resistor which is shown as comprising the resistive sections R_2 and R_1. In shunt with the entire load resistor there is arranged a carrier bypass condenser 5. Audio frequency voltage developed across the load resistor is taken off through a path which includes the resistor R_4. This resistor functions as a noise peak voltage dissipation resistor.

The noise limiter diode has its anode P_2 connected to the anode end of resistive section R_2 through a path which includes resistor R_3. Condenser C_3 connects the anode end of R_3 to ground. The network C_3—R_3 provides a time delay network to retard the development of negative potential on the anode P_2. The cathode K_2 is connected to the right-hand end of resistor R_4. It will, therefore, be seen that the cathode of the noise limiter diode returns to an intermediate point on the load resistor of the demodulator diode. This intermediate point becomes less negative than the anode end of resistive section R_2 upon the impression of signal energy upon input circuit 3. Furthermore, it will be noted that the audio frequency utilization network is connected to the cathode of the noise limiter diode, and that the resistor R_4 is arranged in series with the space current path of the noise limiter diode.

In the past it has been proposed to shunt the load resistor of a demodulator circuit with a diode which became conductive only in response to the application of noise voltages, exceeding 100% modulation, to the demodulator input circuit. However, in those prior circuits the cathode of the noise limiter diode returned directly to the intermediate point of the demodulator load resistor. According to my invention, the short circuiting action of the limiter diode, or stated another way the limiting action thereof, is

very much improved by inserting the resistor R_4 in series with the noise limiter diode. The magnitude of R_4 may be large compared to the resistence of the noise limiter diode. R_4 may have a value of between 220,000 ohms and 1 megohm.

The action of the present circuit is as follows: The modulated carrier wave energy is applied to input circuit 3, and is rectified by the diode P_1—K_1. The rectified voltage appears across R_2—R_1 in the usual manner. The direct current voltage developed across section R_1 is applied through resistor R_4 to cathode K_2. The voltage across R_1 may be one-half the total voltage across R_1 and R_2 in series. This total voltage across the entire demodulator load resistor is applied to anode P_2. It will, therefore, be seen that normally the anode P_2 is more negative than cathode K_2, and, therefore, the limiter diode will be nonconductive for normal signal reception.

The resistance R_3 and condenser C_3 have their constants so chosen that the voltage applied to the anode P_2 cannot change suddenly. In other words the network R_3—C_3 has a delaying action insofar as the development of voltage on P_2 is concerned. An interfering peak of noise impulse, therefore, does not change the direct current potential on P_2. It increases the negative potential applied to cathode K_2 so that the diode P_2—K_2 becomes conductive. Most of the diode space current produces a potential across R_4. That is to say, the resistor R_4 functions to dissipate substantially all of the space current of diode P_2—K_2. Hence, the cathode end of resistor R_4 remains at a substantially limited value of potential during the duration of the noise peak. For this reason, a highly improved limiting action is secured. The elements P_1 and K_1 can be interchanged, provided elements P_2 and K_2 are similarly interchanged.

In the prior circuits of this general type the noise limiter diode did not effectively short R_1, because the diode has some internal resistance. R_1 and R_2 could be made very large with some benefit in limiting, but then the audio characteristic would be deficient in high audio frequencies because of bypass condenser 5. Accordingly, R_4 is added, and the voltage peak due to noise is divided between the resistance of diode P_2—K_2 and R_4. If R_4 is of large value, only a small voltage will appear across diode P_2—K_2 and pass to the audio network.

While I have indicated and described a system for carrying my invention into effect, it will be apparent to one skilled in the art that my invention is by no means limited to the particular organization shown and described, but that many modifications may be made without departing from the scope of my invention, as set forth in the appended claims.

What I claim is:

1. In a radio signalling system, a rectifier having a cold electrode and a cathode, a signal input circuit and a load resistor connected between said cold electrode and cathode, a noise limiter diode having its anode connected to a point of said load resistor which assumes an increased negative potential in response to impression of signals upon said input circuit, a time delay network comprising a resistor in series between said diode anode and said load point, a condenser connected from the anode end of the delay resistor to ground, a second resistor connecting the diode cathode to a second point of the load resistor which assumes a less negative potential than said first point, an audio output circuit connected to said diode cathode, and said second resistor having a magnitude such that space current flow through said diode is dissipated substantially entirely through said second resistor.

2. In a radio signalling system, a rectifier having a cold electrode and a cathode, a signal input circuit and a load resistor connected between said cold electrode and cathode, a noise limiter diode having its anode connected to a point of said load resistor which assumes an increased negative potential in response to impression of signals upon said input circuit, a second resistor connecting the diode cathode to a second point of the load resistor which assumes a less negative potential than said first point, an audio output circuit connected to said diode cathode, means connected to the diode anode for retarding the development of negative potential thereof, and said second resistor having a magnitude such that space current flow through said diode is dissipated substantially entirely through said second resistor.

3. In a radio signalling system, a rectifier having a cold electrode and a cathode, a signal input circuit and a load resistor connected between said cold electrode and cathode, a noise limiter diode having its anode connected to a point of said load resistor which assumes an increased negative potential in response to impression of signals upon said input circuit, a time delay network comprising a resistor in series between said diode anode and said load point, a condenser connected from the anode end of the delay resistor to ground, a second resistor connecting the diode cathode to a second point of the load resistor which assumes a less negative potential than said first point, an audio output circuit connected to said diode cathode, and said second resistor having a magnitude such that space current flow through said diode is dissipated substantially entirely through said second resistor, said first point of the load resistor being the end thereof, and the second point being the midpoint of the load resistor.

4. In combination with a demodulator of the type comprising a diode having a signal input circuit and a load resistor connected in series between the diode anode and cathode, a noise limiter diode having its anode connected to the anode end of the load resistor, a second resistor connecting the limiter diode cathode to the midpoint of the load resistor, a delay network connected with the anode of the limiter diode for retarding the development of negative potential thereof, said second resistor having a value such that space current through the limiter diode is substantially dissipated, and an audio output connection to the limiter diode cathode.

5. In a signalling system, a rectifier having at least a cold electrode and a cathode, a signal input circuit and a load resistor connected in series between said cold electrode and cathode, a noise limiter diode having its anode connected to a point of said load resistor which assumes an increased negative potential in response to impression of signals upon said input circuit, a time delay network comprising a resistor in series between said diode anode and said load point, a condenser connected from the anode end of the delay resistor to ground, a second resistor connecting the diode cathode to a second point of the load resistor which assumes a less negative potential than said first point, a rectified signal output circuit connected to said diode cathode, said second resistor having a magnitude such

that space current flow through said diode is dissipated substantially entirely through said second resistor, said magnitude being a value in excess of 200,000 ohms.

6. In combination with a demodulator of the type comprising a diode having a signal input circuit and a load resistor connected in series between the diode anode and cathode, a noise limiter diode having its anode connected to the anode end of the load resistor, a second resistor connecting the limiter diode cathode to the midpoint of the load resistor, a delay network connected with the anode of the limiter diode for retarding the development of negative potential thereof, said second resistor having a value chosen from a range of between 220,000 ohms and 1 megohm whereby space current through the limiter diode is substantially dissipated, and an audio output connection to the limiter diode cathode.

LELAND E. THOMPSON.