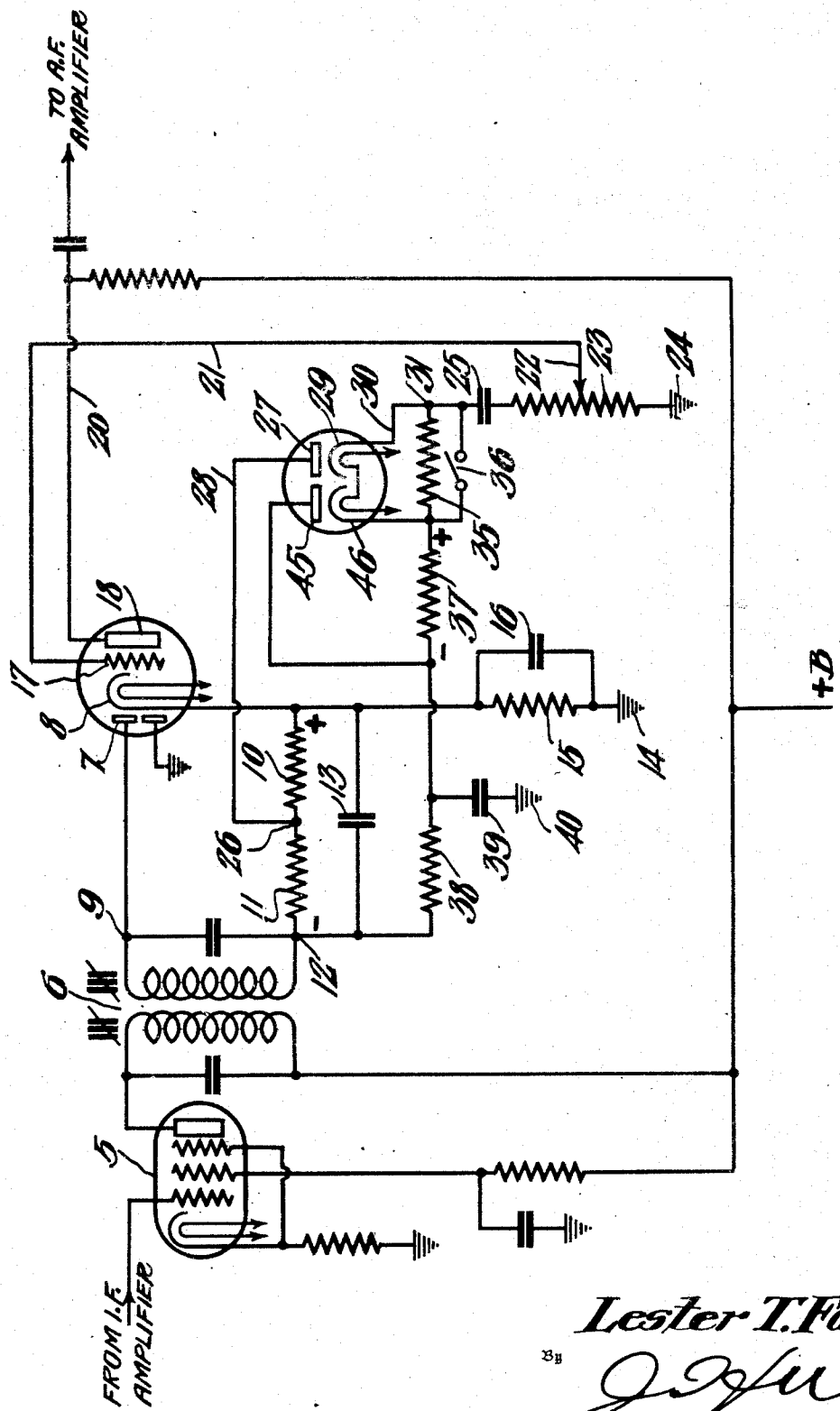
Nov. 10, 1942. L. T. FOWLER 2,301,620

NOISE LIMITER CIRCUIT

Filed May 31, 1941



Inventor

Lester T. Fowler

By

Attorney

Patented Nov. 10, 1942 2,301,620

UNITED STATES PATENT OFFICE

2,301,620

NOISE LIMITER CIRCUIT

Lester T. Fowler, Oaklyn, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application May 31, 1941, Serial No. 395,919

8 Claims. (Cl. 250—20)

This invention relates to a noise limiter circuit for a radio signal receiving system of the type comprising a series connected diode rectifier in a signal transmission path, and automatic level setting or bias potential control means for establishing the limiter operating level.

Noise limiter circuits of this type for reducing noise impulses in radio receiving systems and the like are well known, the type to which the invention relates more particularly, being shown for example in the U. S. Patent to Kaar, 2,207,587. In the system disclosed, a series type noise limiter diode rectifier is provided with means for applying a biasing potential thereto from the audio frequency detector load resistor. However, because of the contact potential effect, both diode rectifiers, used in the detector circuit and as a limiter, remain in a conducting condition in the absence of a carrier wave, and consequently substantially no limiter action is provided in response to noise impulses without the carrier wave.

It is therefore an object of this invention to provide an improved series diode noise limiter circuit which responds to weak noise impulses and noise impulses in the absence of a carrier wave, thereby to provide effective overall limiting under all conditions of operation.

The present system is particularly useful in preventing noise between carrier waves in tuning a receiving system through a predetermined frequency band such as the present broadcast band.

It is also an object of this invention to provide an improved series type noise limiter system in which the contact potential of a limiter diode rectifier is neutralized in the absence of a carrier wave and compensated or neutralized automatically without interfering with the normal reception of a carrier wave or signal.

It is also a further object of this invention to provide a noise limiter circuit which is not only effective in the absence of a carrier wave but also involves a minimum number of circuit elements, whereby it is applicable to commercial receiving systems.

The invention is particularly applicable to diode rectifier circuits involving the second or audio-frequency detector of a superheterodyne or other signal receiving system having the usual output load resistor, and the invention will be described, by way of example, in connection with such a receiving system. For a further understanding of the invention, attention is now directed to the accompanying drawing, together with the following description, and the scope of the invention is pointed out in the appended claims.

Referring to the drawing, the figure is a schematic circuit diagram of a portion of a radio signal receiving system embodying the invention and including an intermediate frequency amplifier output stage 5 coupled through a suitable intermediate frequency coupling transformer 6 to a second or audio frequency detector comprising a diode rectifier having an anode 7 and a cathode 8. The anode 7 is connected with the high potential terminal 9 of the transformer 6 while the cathode 8 is connected through an output load resistor 10—11 to the low potential output terminal 12 of the transformer 6. The resistors 10 and 11 are provided with an intermediate frequency bypass capacitor 13 thereby completing the usual diode rectifier circuit.

The cathode 8 is also connected to chassis or ground, as indicated at 14, through a bias resistor 15 provided with an audio frequency bypass capacitor 16. This is for the purpose of providing a biasing potential for an amplifier control grid 17 common to the cathode 8 in the same envelope with the diode rectifier anode 7, the amplifier output anode being indicated at 18. This amplifier represents any suitable audio frequency amplifier stage for the detector and is coupled to any suitable utilization circuit through an output circuit indicated at 20.

The control grid 17 is connected through a lead 21 with a suitable volume control potentiometer 22—23, one side of which is connected to ground or chassis 24 while the high potential terminal is coupled through a coupling capacitor 25 with a tap 26 on the detector output resistor 10—11.

Interposed in this connection is a series limiter diode rectifier comprising an anode 27 connected through a lead 28 with the terminal 26 and a cathode 29 connected through a lead 30 with a terminal 31 to which the coupling capacitor 25 is connected, thereby completing the circuit between the signal utilization means comprising the amplifier stage and the detector output load resistor 10—11.

The cathode 29 of the series limiter diode rectifier is connected with the terminal 12 of the transformer 6 which is also connected to the outer terminal of the resistor section 11 of the detector output resistor, through a series regulating resistor 35 shunted by a suitable switch 36, a potential source represented by a resistor 37 and a filter resistor 38 provided with a bypass capacitor 39 to ground or chassis as indicated at 40.

Since the cathode 8 is connected to the outer

terminal of the resistor section 10 and to ground 14, audio frequency signals are derived from the resistor section 10, with the output circuit represented by the potentiometer 23 connected substantially in parallel therewith through the coupling capacitor 25, the series limiter diode rectifier 27—29 and the ground connections 24—14.

In the presence of a carrier wave, the limiter diode rectifier 27—29 is maintained in an operating and automatic level setting condition by the signal current flow through the other or current supply section 11 of the output resistor, current flowing from the terminal 26 to the anode 27, through the rectifier to the cathode 29, thence through the resistors 35, 37 and 36, and back to the source at the terminal 12.

A signal peak or noise pulse exceeding a predetermined percentage modulation such as 100% for example, causes the anode 27 of the limiter diode rectifier 27—29 to become negative with respect to its cathode 29, thus interrupting the current and opening the output circuit, thereby providing cut-off of the peak or noise pulse. The percentage modulation at which the noise limiter operates is determined in part by the ratio of the resistor sections 10 and 11. In the present example these may be considered to be of the order of 100,000 and 150,000 ohms, respectively. The filter resistor 38 may have a value of 1 megohm with a bypass capacity at 39 of .1 mfd.

In the absence of a carrier wave, the limiter diode rectifier is rendered non-conducting or open, by reason of the voltage existing across the source 37, having a polarity as indicated, with respect to the polarity of the output resistor 10—11. The potential of this source may be supplied by the contact potential of a third diode rectifier comprising an anode 45 and a cathode 46 connected across the resistor 37. This provides an initial negative voltage on the limiter diode anode 27. Therefore weak noise pulses, in the absence of a carrier wave will be suppressed since the contact potential of the diode rectifier 45—46 is in effect connected in opposition to that of the limiter diode rectifier 27—29. In the present example the contact potential of the control diode 45—46 is generated across the resistor 37 and this voltage is applied to the limiter diode through the resistors 38, 11 and 35. The latter resistor may be omitted as by closing the switch 36, in which case the limiter action is more effective in that when a noise pulse causes the limiter diode 27—27 to become non-conducting, the diode 45—46 is conducting because it is then subjected to its own contact potential only, and the low impedance of the last-named diode provides a short-circuit effect across the signal output potentiometer 23 from the high side thereof at terminal 31 to ground 24 through the capacitor 39. In the presence of signal current the diode rectifier 45—46 is cut off because of the voltage drop through the resistor 37. The control diode is thus of low resistance at one phase of the operation and of infinite resistance during another phase of the operation, as desired, for effective control of the limiter action.

Thus it will be seen in the present system, an initial control voltage is provided in the D. C. supply or control circuit for the limiter diode to oppose and neutralize the voltage supplied by the contact potential of the noise limiter diode rectifier and thus permits the noise limiter to be effective in the absence of a carier wave. It will be noted that the limiter diode contact potential does not apply a similar control to the control diode, for the reason that the resistors 38—11—35 are in the limiter diode circuit along with the resistor 37, while the latter resistor alone provides the full potential drop in circuit with the control diode.

I claim as my invention:

1. The combination with a carrier wave signal conveying circuit, of a signal detector having an output impedance, a limiter diode rectifier connected with said impedance, means providing an alternating current signal output path through said limiter from a portion of said impedance, means providing a direct current control path through said limiter from a second portion of said impedance, and a diode control rectifier connected in said last named control path for neutralizing the contact potential of said limiter, whereby noise pulse limiting is effective in the absence of a carrier wave.

2. The combination of a carrier wave signal conveying circuit, of a signal detector having an output impedance, a limiter diode rectifier connected with said impedance, means providing an alternating current signal output path through said limiter from a portion of said impedance, means providing a direct current control path through said limiter from a second portion of said impedance, a diode control rectifier connected in said last named control path for neutralizing the contact potential of said limiter, whereby noise pulse limiting is effective in the absence of a carrier wave, and means in circuit with said rectifiers for limiting the control effect of the limiter diode contact potential on said control diode.

3. The combination with a carrier wave signal conveying circuit, of a signal detector having an output impedance, a limiter diode rectifier connected therewith, means providing an alternating current signal output path through said limiter from a portion of said impedance, means providing a direct current control path through said limiter from a second portion of said impedance, a diode control rectifier connected in said last control path for neutralizing the contact potential of said limiter, whereby noise pulse limiting is effective in the absence of a carrier wave, and means including a shunt potential drop producing resistor for said control rectifier for establishing a cut-off potential drop for said rectifier in the presence of a received carrier wave.

4. The combination with a signal detector having a signal output load impedance, of a limiter diode rectifier, a signal output circuit coupled to said load resistor through said limiter diode rectifier, a direct current control circuit for said last named rectifier including a filter network and at least a portion of said output load resistor, a control diode rectifier connected in said last named circuit and polarized to neutralize the contact potential of said limiter diode rectifier in the absence of a carrier wave.

5. The combination with a carrier wave signal conveying circuit, of a signal detector having an output impedance, a limiter diode rectifier connected with said impedance, means providing an alternating current signal output path through said limiter from a portion of said impedance, means providing a direct current control path through said limiter from a second portion of said impedance, and means in said last control path including a second rectifier for neutralizing the contact potential of said limiter whereby noise pulse limiting is effective in the absence of

a carrier wave, and means for cutting off the control rectifier in the presence of signals.

6. The combination with a signal detector, of a signal input circuit therefor, an output load impedance for said detector having a terminal connected to ground and having a tap thereon, an audio frequency output circuit connected between said tap and ground, a series limiter diode rectifier in said last named connection between said tap and the high potential side of said output circuit, a circuit connection between a second terminal of said output impedance and the output side of the limiter diode rectifier to provide automatic level setting therefor, said connection comprising a pair of series connected resistors, an audio frequency bypass capacitor connected between the junction of said last named resistors and ground, and a control diode rectifier connected between said junction and the high potential side of the audio frequency circuit and limiter rectifier.

7. In a radio signal receiving system, a detector circuit comprising a diode rectifier and signal input circuit for the rectifier, a signal output circuit for the rectifier including an output load resistor, an audio frequency output circuit connected with said output load resistor, a series diode rectifier limiter in said output circuit, means for deriving a controlling potential for said limiter rectifier from said output load resistor including a circuit connection providing a direct current path from said load resistor through said limiter rectifier, a control rectifier connected serially in said last named circuit to provide contact potential in opposition to the contact potential of the limiter rectifier, a resistor connected in shunt with said control rectifier, and a filter connected between said last named rectifier and the diode output resistor, whereby in the absence of a carrier wave, low amplitude noise pulses are cut off from said audio frequency output circuit.

8. In a signal detector having an output impedance, a signal output connection including a series diode limiter for deriving output signals from a portion of said impedance, a control circuit for said limiter including a second portion of said output impedance, a control diode rectifier having a polarity such that in the absence of a carrier wave signal the contact potential of the limiter rectifier is neutralized by the contact potential of said control rectifier, means in circuit between said last named rectifiers for limiting the control effect of the limiter diode contact potential on said control diode, and means responsive to rectified signal current for cutting off said control diode rectifier.

LESTER T. FOWLER.