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LIMITER CIRCUIT FOR FREQUENCY MODULATION RECEIVERS

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Fig. 1.

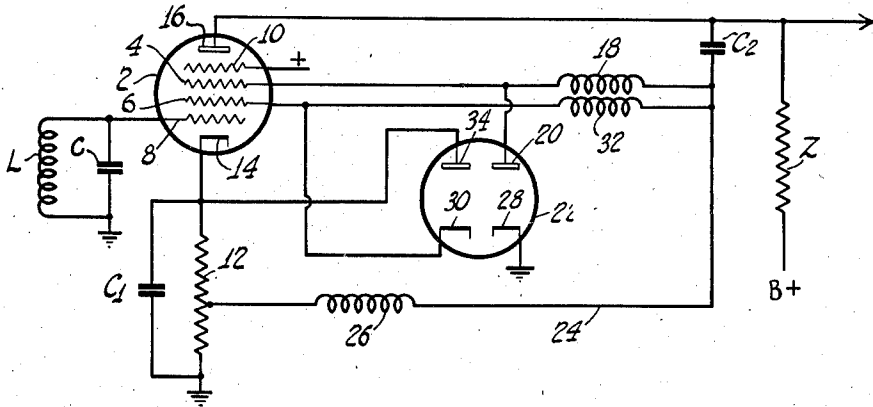
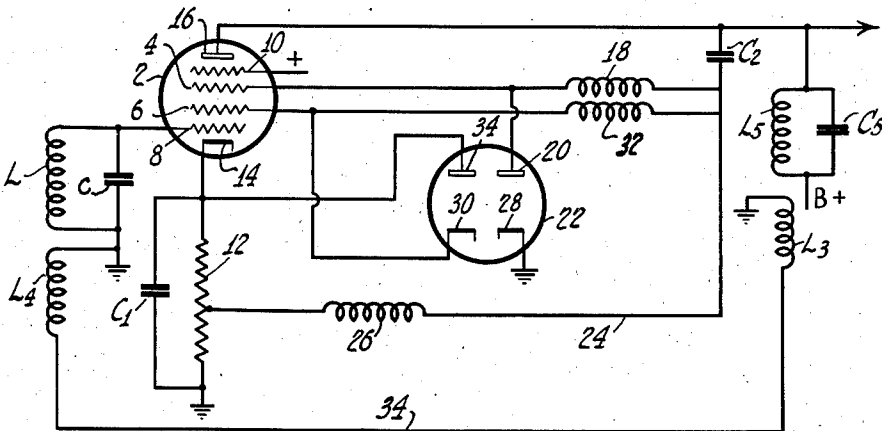


Fig. 2.



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LIMITER CIRCUIT FOR FREQUENCY
MODULATION RECEIVERS

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425,843. Divided and this application Decem-
ber 31, 1942, Serial No. 470,780

4 Claims. (Cl. 178-44)

The present invention relates to radio reception and more particularly to the reception of frequency modulated waves and comprises a novel limiter circuit for incorporation into radio receivers of this general type. In frequency modulated radio reception, as distinguished from amplitude modulated radio reception, the receivers should respond only to the rate of change of angle of the incoming wave, that is, to the relative frequency variation of the wave and should not be responsive to excessive amplitude variations of the wave. Accordingly, receivers of this type include in one form or another a device for suppressing amplitude variations above a predetermined value, which excess variations are caused by static or noise impulses. Such devices are known as "limiters" and consist principally of one or more radio frequency amplifier stages operated under conditions of poor efficiency so that the gain per stage is necessarily low and the stage will overload when a signal of any magnitude is applied to it. Usually these stages include resistor-condenser networks in the amplifier tube grid return. Various disadvantages are inherent in the above type of limiter. It is not able to follow rapid impulses because of the time consumed in discharge of the condenser through the resistances, and hence is not effective to suppress short duration impulse noises. Also, there is a tendency, after becoming severely overloaded, for the limiter output to diminish instead of remaining constant.

An object of the present invention is thus to overcome these difficulties by providing a limiter circuit that will completely suppress all excessive amplitude variations, and which will be inherently rapid in response and hence will suppress noise impulses of short, as well as long, duration.

In the limiter of the present invention, the resistance-condenser network is omitted and a feedback is provided between output and input utilizing non-linear impedances as a cyclical voltage gate for insuring degeneration of the amplifier tube when the amplitude variations exceed a predetermined value.

According to the invention, the non-linear impedances are used to pass current to thwart degeneration of the input voltage until the output voltage exceeds a certain value after which time no current is fed back through the impedance and degeneration of the input voltage results.

For a better understanding of the invention, reference may be had to the accompanying drawing of which:

Fig. 1 is a diagrammatic circuit drawing of a

limiter circuit embodying the invention and utilizing a pair of diodes as a cyclical voltage gate; and

Fig. 2 is a circuit drawing similar to Fig. 1 but including a regenerative link for neutralizing the small amount of degeneration occurring when the diodes are conducting.

The limiter circuit of Fig. 1 includes the multi-element radio frequency amplifier tube 2 having two grids 4 and 6 in addition to the control grid 8 and usual screen grid 10. A suitable input circuit for the tube 2 is indicated as the conventional tuned circuit having the inductance L bridged by the condenser C, the circuit being grounded at one end and connected to the control grid 8 at the other end. A resistor 12, grounded at one end and connected at its other end to the cathode 14 of the tube 2 and bridged by condenser C₁ serves as a bias for the control grid. Grid 4 is connected to the plate 16 of tube 2 through a radio frequency impedance 18, specifically shown as an inductance, and a blocking condenser C₂. This grid 4 is also connected with an anode 20 of one of a pair of diodes forming the cyclical voltage gate of the feed-back. The diodes are shown as elements of a tube 22, such as a 6H6. A lead 24, containing a radio frequency choke 26, is connected at one end to a center tap of the resistance 12 and at its other end to the grid 4 and anode 20 through the inductance 18. The cathode 28, forming the diode with anode 20, is grounded and hence a positive potential corresponding to the potential drop across half of the resistance 12 is impressed across the diode. Grid 6 of tube 2 is connected directly to the cathode 30 of the other diode and through a radio frequency choke 32 and the condenser C₂ with the plate 16 of tube 2. Anode 34 of this diode is connected to the cathode 14 of tube 2 and hence a positive potential corresponding to the potential drop across the other half of resistance 12 is impressed across this diode.

The radio frequency impedances 18 and 32 have magnitudes high in comparison to the impedance of the diodes during their respective conducting cycles but low in comparison with the respective grid impedances of the tube 2. Thus the circuit including impedance 18 and the diode comprising the anode 20 and cathode 28 is a voltage divider for potential fed to the grid 4 of tube 2 while the impedance 32 and the other diode is likewise a voltage divider for potential fed to the grid 6 of tube 2. If the resistance 12 is designed for a potential of say 3 volts, then with

the connections above described the potential across each diode will be one and one-half volts and the full three volts across resistance 12 serves as a bias for the signal grid 8 connected to the tank circuit LC.

During operation of the above described circuit, when the input voltage does not exceed the predetermined value, the diodes of the tube 22 are conducting and hence degenerative potentials are not applied to the grids 4 and 6 of tube 2. During any cycle, however, if the peak voltage is such that the voltage across the impedance Z of the output circuit overrides the biasing voltage across either diode, then that diode becomes non-conducting and substantially the full output voltage is applied as a degenerative potential to the corresponding grid. Thus the diodes operate as a cyclical voltage gate to instantly limit the voltage gain of the amplifier 2 to the value determined by the constants of the circuit.

In the above described circuit of Fig. 1 there will necessarily be a small amount of degeneration present even when the diodes are conducting as the impedances of the diodes, when conducting, are not entirely zero. In order to neutralize such degeneration, a small amount of "in phase" voltage may be fed back to the input circuit, and such an arrangement is illustrated in Fig. 2.

The circuit of Fig. 2 differs from that of Fig. 1 only in the addition of a regenerative link 34 including the inductances L_3 and L_4 inductively coupled respectively with the inductances L_5 and L_1 in the output and input circuits; the output impedance being shown as including the tuned circuit L_5 , C_5 .

The operation of the circuit of Fig. 2 is the same as that of Fig. 1 except that the regenerative feed-back neutralizes the small degenerative effect occurring when the diodes pass current.

From the above description of the circuit diagrams of Figs. 1 and 2 it will be apparent that the invention provides an efficient and rapidly operating limiter circuit for receivers of frequency modulated radio waves. Degeneration of the radio frequency amplifier input is insured whenever the output voltage exceeds the threshold value and this degeneration is controlled by a cyclical voltage gate in the feed-back circuit which opens at output voltages below the threshold value to pass current for thwarting degeneration. The particular cyclical voltage gate or non-linear impedance illustrated in the drawing is a pair of diodes but obviously other devices, such as crystal detectors or rectifiers, could be substituted therefor.

This application is a division of my copending

application Serial No. 425,843, filed January 7, 1942.

I claim:

1. A limiter circuit for radio receivers comprising an amplifier having a cathode, a control grid and at least two other grids, an input circuit connected to said control grid, an output circuit having an impedance therein, said other two grids being connected with said output circuit through separate radio frequency impedances for reception of degenerative potentials therefrom, non-linear impedances oppositely connected with said last mentioned grids serving together with said radio frequency impedances as current dividers for thwarting degeneration during passage of current therethrough, and means for applying potential differences across said non-linear impedances in their current carrying directions whereby they become non-conductive only when the voltage impressed thereupon from the output circuit overrides said potential differences.

2. A limiter circuit according to claim 1 wherein said non-linear impedances comprise a pair of diodes, the anode of one of which is connected to one of said grids of the amplifier and the cathode of the other of which is connected to the other of said grids and wherein said means for applying potential differences to said impedances comprises a voltage divider connected at one end to the cathode of the amplifier, and to the anode of the last mentioned diode, grounded at its other end and connected at its midpoint through a radio frequency choke and through the radio frequency impedances with said grids of the amplifier, the cathode of said first mentioned diode being grounded.

3. The limiter circuit according to claim 1 wherein the output and input circuits each includes an inductance and wherein a regenerative feed back circuit couples said inductances together for suppressing degeneration due to the impedance of said non-linear impedances during conduction.

4. A limiter circuit for radio receivers comprising in combination, an amplifier, input and output circuits connected therewith, feed-back means connecting said circuits for impressing degenerative potentials on the input circuit when the output voltage exceeds a predetermined value, said feed-back means including a pair of diodes biased to become non-conductive when the output voltage exceeds the predetermined value, and a regenerative link between said output and input circuits to compensate for the impedance of said diodes when conducting.

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