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NOISE-LIMITING CIRCUIT FOR CARRIER WAVE COMMUNICATION SYSTEMS

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FIG. 1.

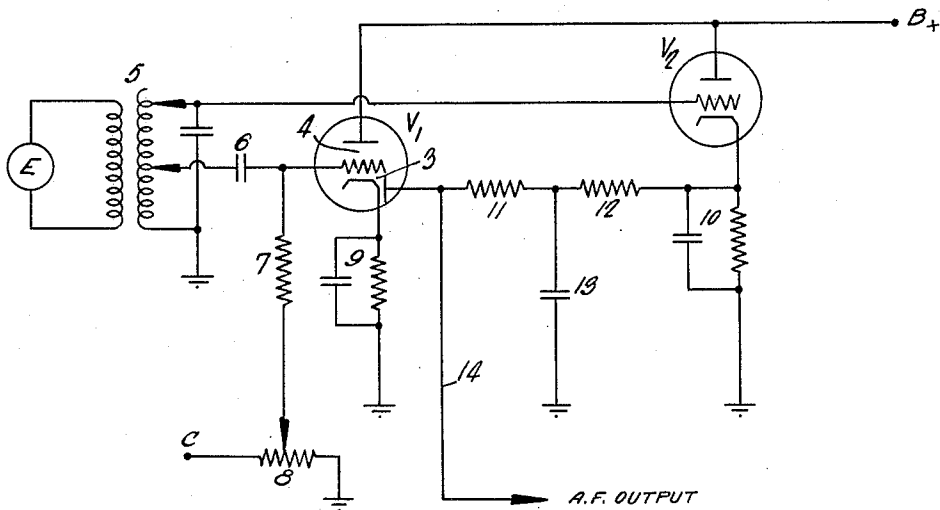
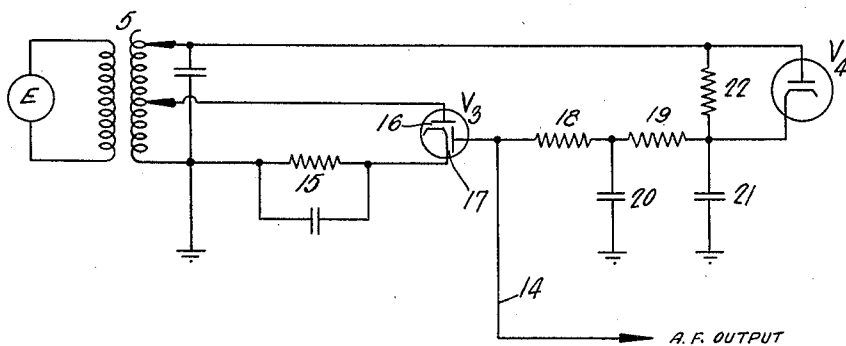


FIG. 2.



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NOISE-LIMITING CIRCUIT FOR CARRIER
WAVE COMMUNICATION SYSTEMS

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8 Claims. (Cl. 250—20)

This invention relates to noise limiting circuits and has for its general object to provide improved means for limiting the amplitude of interfering noise pulses or signals in carrier wave communication systems and the like.

A more specific object of the invention is to provide an improved signal amplitude limiting circuit which discriminates sharply against all noise pulses and the like which exceed a predetermined level relative to the average carrier level.

Another object of the invention is to provide an amplitude limiter whose limiting level is automatically maintained substantially constant relative to the average carrier amplitude regardless of relatively large changes in the strength of the received carrier signals.

A further object of the invention is to provide a demodulator circuit employing a diode serially connected in the demodulated signal output circuit with means provided to render the diode path non-conducting in the presence of high amplitude noise pulses.

The invention employs a carrier signal demodulation circuit having signal amplitude-limiting means which are automatically self-adjusting in response to the average carrier level. A transmission path employing these means serves to discriminate against all noise pulses or signals which exceed a predetermined level relative to the average carrier level. Such a discriminating means is particularly desirable where the desired signals are accompanied by high amplitude noise pulses, where the carrier level is not maintained perfectly constant at the demodulator, or where the desired signals are of low signal strength.

More particularly, by the present invention there is provided in an electrical wave transmission system, a source of combined modulated carrier signals and interfering noise pulses, a first space discharge means and load therefor responsive to a part of said carrier signal for demodulating said signal, means including a series-connected diode for deriving the demodulated signal from said first space discharge means, a second space discharge means and load therefor responsive to a greater part of said carrier signal for deriving a rectified voltage therefrom, and means for applying said rectified voltage to an element of said series connected diode as a bias or delay voltage, whereby the path through said diode is maintained conducting for demodulated signal amplitudes not greater than

a predetermined multiple of the average carrier level, but is rendered non-conducting for signal amplitudes greater than said predetermined level.

The invention may be understood by reference to the accompanying drawing, wherein:

Fig. 1 is a schematic representation of a preferred embodiment of the invention; and

Fig. 2 is another embodiment thereof.

In Fig. 1, E represents a source of modulated carrier signals which may be accompanied by noise signals. The modulated carrier is rectified or detected by means of any suitable non-linear device such as the triode section 4 of the space discharge device V₁. The detector shown in this particular embodiment is of a type known in the art as the "infinite impedance diode detector", but more accurately described as a degenerative plate-circuit detector. In this type of detector a shunt combination 9 of capacity and resistance is usually placed in the cathode circuit of a triode as shown. This combination may then be employed as both an output load and a grid biasing means. A suitable positive potential B₊ may be applied directly to the detector plate. The resistance and capacity values employed in the circuit 9 are not critical. However, a 100 micro-microfarad condenser and a 0.1 megohm resistor have given good results with a plate potential of 250 volts. The grid leak 7 may be of the order of one megohm. Only a part of the available radio frequency voltage is supplied to this detector, which may be coupled to the secondary of the transformer 5 by means of the condenser 6. The demodulated signal voltage may be derived from the output load circuit 9. As will be explained presently, the anode of the diode section 3 of V₁ is, under conditions of no noise signals, maintained positive with respect to the said cathode, and hence the audio frequency output may be derived from the load by means of the lead 14.

The triode V₂ and its associated circuits form a second infinite impedance detector. The input to this detector, however, is a larger part of the available R. F. voltage than that supplied to V₁, and preferably the ratio of these voltages may be of the order of 2:1 or more. In this case, the rectified voltage across the load 10 will be about double that across the load 9. The voltage across the load 10, which may have constants similar to those of the load 9, will consist largely of two components, a direct current component whose magnitude is proportional to the strength of the carrier signal E, and an alternating cur-

rent component corresponding to the modulation frequencies carried by the signal E. The stronger the carrier signal E, the greater will be the direct current component, and the more positive with respect to ground will become the cathode end of the load 10. By means of an audio frequency filter which may include the resistor 12 and the condenser 13, the D. C. component of the rectified voltage may be derived from the load 10 and may be applied to the anode of diode 3, as a basis or polarizing voltage, by way of the isolating resistor 11. Hence if the relative outputs of the two detectors are so adjusted that the maximum modulation frequency excursions of the cathode of V₁ just fail to drive the said cathode positive with respect to the anode of diode 3, then it will be seen that the demodulated signal may be derived from the detector load circuit by way of the serially connected diode and lead 14. On the other hand, noise pulses whose amplitude is greater than that of the desired signal, may drive the cathode positive with respect to the diode anode, the diode being thus rendered non-conducting, thereby breaking the circuit for the duration of the pulse, and effectively limiting the amplitude of noise pulses to a predetermined value relative to the desired signals.

If desired, the circuits may be adjusted to limit the percentage of modulation which may be transmitted through the system. Thus if the rectified carrier from V₂ is only 50% greater than that from V₁, then the system may be adjusted to discriminate against signals which are modulated to an extent greater than approximately 50% and so on.

If desired, a potentiometer 8 connected across a suitable voltage source C may be used to make the no-signal potentials of the two cathodes equal, that is, to provide the small signal adjustment of the limiter action. The large signal adjustment may be made by a proper location of the taps on the secondary of transformer 5.

As has been indicated, the invention is by no means limited to any particular type of rectifier or detector; thus in the embodiment of Fig. 2 there is illustrated an alternative form of the invention which employs two diode rectifiers, one being section 16 of V₃ and the other the diode V₄, in place of the infinite impedance type detectors of Fig. 1. Otherwise the circuits and actions are in general similar to those described above. By an appropriate selection of tap positions on the transformer 5 the D. C. component of the rectified output of V₄ may be made any desired multiple of the maximum desired signal voltage appearing between ground and the cathode of V₃. An audio output may again be derived from the cathode of V₃ by way of the diode path 17 and the lead 14. It will be noted that the load resistor 22 of the rectifier V₄ is not connected directly in parallel with the condenser 21, as in the load of the triode V₂, although for D. C. and audio frequencies the resistor 22 and condenser 21 are effectively so connected. The rectified output appears across the resistor 22 and hence also across condenser 21, the D. C. component of this output being impressed on the anode of diode section 17 by way of a suitable transfer means such as the audio frequency resistance-condenser filter, 19-20, and the isolating resistor 13.

It will be understood that the scope of the invention is not limited to the specific embodiments illustrated, since various modifications are readily

possible in accordance with the principles herein disclosed.

I claim:

1. In a signal amplitude limiting circuit, a source of carrier signals, a first space discharge means and load therefor responsive to a part of said carrier signal for demodulating said signal, means including a series-connected diode for deriving the demodulated signal from said first space discharge means, a second space discharge means and load therefor responsive to a greater part of said carrier signal for deriving a rectified voltage therefrom, and means for applying said rectified voltage to an element of said series-connected diode as a bias voltage, whereby the path through said diode is maintained conducting only for demodulated signal amplitudes not greater than a predetermined multiple of the average carrier level.

2. In a signal amplitude limiting circuit, a source of carrier signals, a first diode detector and load therefor responsive to a part of said carrier signal for demodulating said signal, means including a series-connected diode for deriving the demodulated signal from said detector, a second diode detector and load therefor responsive to a greater part of said carrier signal for deriving a rectified voltage therefrom, and means for applying said rectified voltage to an element of said series-connected diode as a bias voltage, whereby the path through said series-connected diode is maintained conducting only for demodulated signal amplitudes not greater than a predetermined multiple of the average carrier level.

3. In a signal amplitude limiting circuit, a source of carrier signals, a vacuum tube detector having an audio-frequency output circuit, means for supplying to said detector a part of the carrier signal voltage from said source, means including a series-connected diode for deriving an audio frequency signal from said output circuit, a space discharge means and load therefor for rectifying a larger part of said carrier signal voltage, means for deriving a rectified voltage from said load, and means for applying said rectified voltage to an element of said series-connected diode as a bias voltage, whereby the path through said diode is maintained conducting for demodulated signal amplitudes not greater than a predetermined multiple of the average carrier level, but is rendered non-conducting for signal amplitudes greater than said predetermined level.

4. In a signal amplitude limiting circuit, a source of carrier signals, a first space discharge means and load therefor responsive to a part of said carrier signal for demodulating said signal, means including a series-connected diode for deriving the demodulated signal from said first space discharge means, a second space discharge means and load therefor responsive to a greater part of said carrier signal for deriving a rectified voltage therefrom, and means comprising an audio frequency filter and isolating impedance for applying said rectified voltage to an element of said series-connected diode as a bias voltage, whereby the path through said diode is maintained conducting for demodulated signal amplitudes not greater than a predetermined multiple of the average carrier level, but is rendered non-conducting for signal amplitudes greater than said predetermined level.

5. In a signal amplitude limiting circuit, a source of carrier signals, a first degenerative plate-circuit detector, a second degenerative

plate-circuit detector, means for supplying to the input electrode of said first detector a part of the voltage output of said carrier signal source, means for supplying to the input electrode of said second detector a larger part of said voltage output, means comprising a diode connected to the load circuit of said first detector for deriving a demodulated signal from said load circuit, means for deriving a filtered and rectified voltage from the load circuit of said second detector, and means for applying said last-mentioned voltage to an element of said diode as a bias voltage, whereby the path through said diode is maintained conducting for demodulated signal amplitudes not greater than a predetermined multiple of the average carrier level, but is rendered non-conducting for signal amplitudes greater than said predetermined level.

6. In a signal amplitude limiting circuit, a source of carrier signals, a first degenerative plate-circuit detector, a second degenerative plate-circuit detector, means for supplying to the input electrode of said first detector a part of the voltage output of said carrier signal source, means for supplying to the input electrode of said second detector a larger part of said voltage output, means comprising a diode connected to the load circuit of said first detector for deriving a demodulated signal from said load circuit, means for deriving a filtered and rectified voltage from the load circuit of said second detector, means for applying said last-mentioned voltage to an element of said diode as a bias voltage, whereby the path through said diode is maintained conducting for demodulated signal amplitudes not greater than a predetermined multiple of the average carrier level, but is rendered non-conducting for signal amplitudes greater than said predetermined level, and means for adjusting the no-signal load voltage of at least one of said degenerative plate-circuit detectors.

7. In a signal amplitude limiting circuit, a source of modulated carrier signals, said source comprising a tuned resonant circuit, a first degenerative plate-circuit detector, a second

degenerative plate-circuit detector, means for supplying to the input electrode of said first detector a part of the voltage output of said carrier signal source, means for supplying to the input electrode of said second detector a larger part of said voltage output, means comprising a diode connected to the load circuit of said first detector for deriving a demodulated signal from said load circuit, said diode having an anode and a cathode, said cathode being common to the cathode of said first detector, means for deriving a rectified signal voltage from said second detector, and means including reactive elements for filtering said rectified signal voltage and for applying said filtered voltage to the anode of said diode as a bias voltage, whereby the path through said diode is maintained conducting for demodulated signal amplitudes not greater than a predetermined multiple of the average carrier level, but is rendered non-conducting for signal amplitudes greater than said predetermined level.

8. In a signal amplitude limiting circuit, a source of modulated carrier signals, a vacuum tube having at least a cathode, a grid, and an anode, connections between said grid and said signal source, connections between said cathode and said signal source, said last-named connections including a cathode load comprising a resistor shunted by a condenser, connections between said anode and a source of anode voltage, means for adjusting the direct current bias between said cathode and said grid, a diode having a cathode and an anode, there being a connection between said diode cathode and said triode cathode, connections for deriving a demodulated signal from said cathode load by way of said diode anode, and auxiliary means, including a rectifier whose output is proportional to the average amplitude of said carrier signal, for maintaining said diode anode positive with respect to said diode cathode only when said carrier signals do not exceed a predetermined modulation percentage.

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