

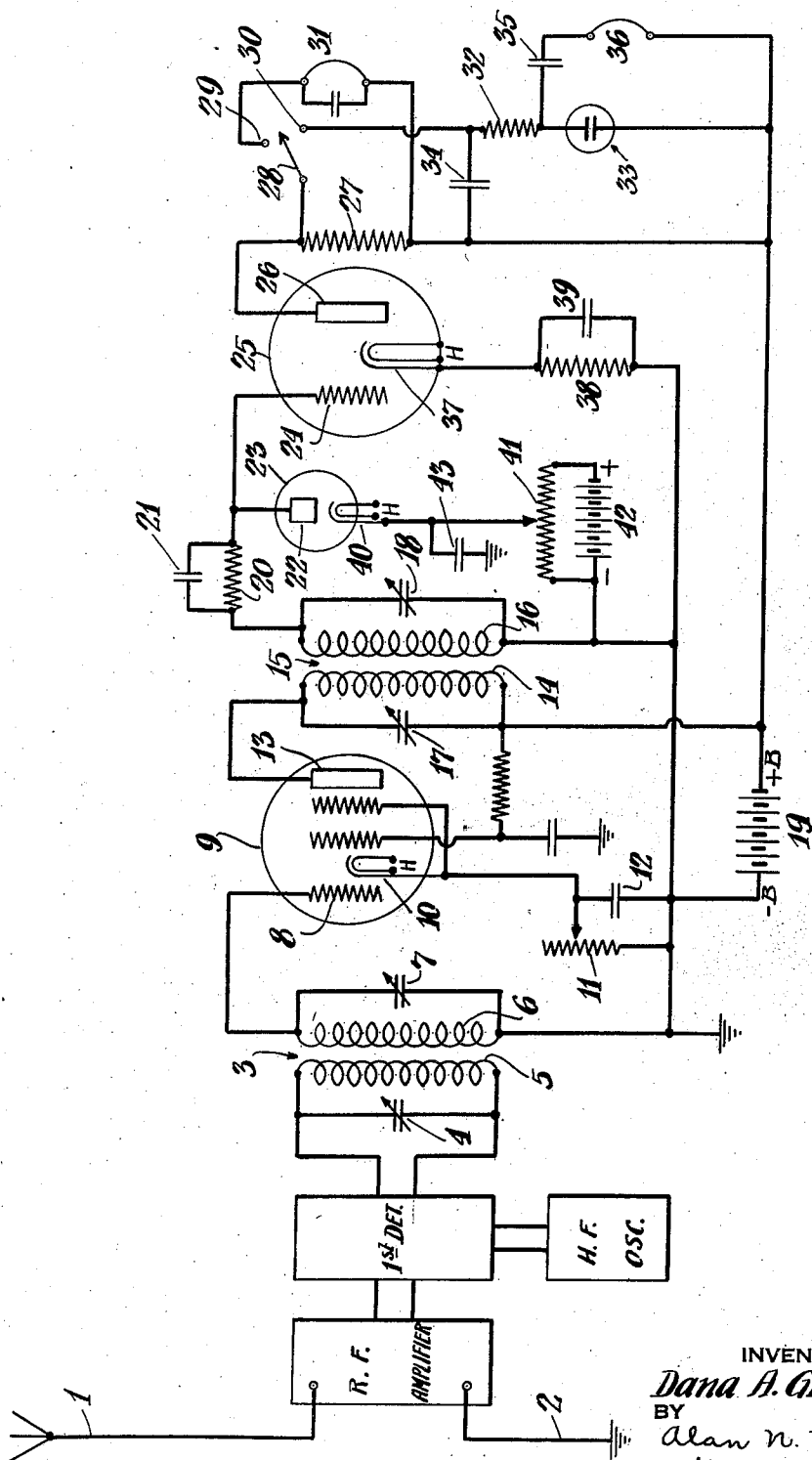
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RADIO AND TELEGRAPH RECEIVER

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RADIO AND TELEGRAPH RECEIVER

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My invention relates to radio and telegraphic receivers and more particularly to circuits for reducing noise interference such as static in these receivers.

I am aware of a number of circuits proposed heretofore for reducing noise interference by limiting the amplitude of noise pulses to approximately that of the signal voltage being received. These circuits have been devised primarily for telephone reception and while they have some value in the reception of telegraph signals they do not produce optimum results. One of the principal reasons for their deficiency is that they permit the transmission of noise pulses that are below the amplitude of the carrier wave. This results in an audible reception of a certain amount of objectionable noise particularly during the inter-character spaces of telegraph signals.

The system of my invention overcomes many of the disadvantages and limitations of the prior art systems such as those mentioned above. It comprises a novel form of demodulator circuit that acts as a gate and effectively limits noise pulses which are in excess of the carrier amplitude, and in combination therewith a tone generating circuit that will not respond to noise voltages whose average energy content is appreciably below that of the carrier wave being received. Accordingly, my system provides for the efficient reception of radio and telegraphic signals without any undesirable interference by static or other noises regardless of their amplitude.

In accordance with one preferred embodiment of my invention a diode vacuum tube is used in the receiver to decrease the detecting efficiency of the detector when noise pulses greater than the carrier are received and thereby eliminates these noises, and a gaseous discharge tube is used to eliminate noise pulses of lesser amplitude than the carrier.

The novel features of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation will be easily understood from the following description taken in conjunction with the accompanying drawing which shows one illustrative and non-limiting embodiment of my invention as applied to a super-heterodyne radio receiver.

Referring now to the drawing, the signal is picked up by the antenna system 1, 2, is amplified by the radio frequency amplifier and is converted to intermediate frequency in the first de-

tector which is supplied with oscillating current by the high frequency oscillator, all in a manner well known in the art. The amplifier, detector and oscillator are of conventional type and are therefore shown diagrammatically, with identifying legends.

The signal, now converted to intermediate frequency, traverses primary winding 5 of the intermediate frequency transformer 3 and induces a corresponding voltage in the secondary winding 6. Both primary and secondary windings 5 and 6 are tuned by variable condensers 4 and 7, respectively. One end of secondary winding 6 is connected to the control grid 8 of a tetrode screen grid type of vacuum tube 9. The other end of winding 6 is grounded. The cathode 10 of the vacuum tube 9 is connected to a potentiometer 11 which is by-passed by a condenser 12. The potentiometer 11 serves as an intermediate frequency gain control.

The output circuit of tube 9 is completed from the anode 13 through the primary winding 14 of the intermediate frequency transformer 15 to the positive terminal of a B battery 19. The heater element H and the screen grid, S. G., of tube 9 are provided with necessary heater and screen potentials in the customary manner, the electrical connections to the voltage supply being omitted for sake of simplicity. The intermediate frequency output current of tube 9 flowing from the anode 13 through the primary winding 14 of transformer 15 causes an intermediate frequency voltage to be developed in secondary winding 16. Condensers 17 and 18 are used to tune the transformer 15 to the intermediate frequency. The lower end of winding 16 is connected to ground, as shown. The upper end of the winding 16 is connected to a time constant circuit having a resistance 20 and a condenser 21. This time constant circuit is connected also to the anode 22 of a diode tube 23 and to the grid 24 of a detector triode tube 25. The cathode 40 of diode tube 23 is connected to a potentiometer 41 which is connected in shunt with a bias battery 42. A condenser 43 connects this cathode to ground. Heater current is supplied by means, not shown, to the heaters H of diode tube 23 and triode tube 25.

The anode 26 of detector tube 25 is connected to a resistance 27 and to a switch 28 which may be closed, by moving upward to a contact 29 when radio signals are being received, or moving downward to a contact 30 when reception of telegraphic signals is desired. Resistance 27 is shunted by a condenser 34 when switch 28 is closed downward to contact 30. This resistance 27 is con-

nected at its lower end to the plus terminal of the B battery 19. The cathode 37 of detector tube 25 is connected to ground through cathode resistor 38 which is shunted by a condenser 39.

5 A telephone receiver 31 is connected in shunt with resistance 27, when switch 28 is pushed up to contact 29. When switch 28 is on contact 30 a connection is established through resistance 32 to a discharge tube 33. I have found a Gen-
10 eral Electric half watt neon lamp to be satisfactory for tube 33. This tube 33 is shunted by a condenser 35 in series with a telephone receiver 36.

The foregoing description identifies the integral parts and explains the electrical connections of a radio-telegraphic receiver system embodying some of the novel features of my invention. The operation of this system, with particular reference to the features of my present invention
20 will now be described.

The triode tube 25 operates as a biased detector, its cathode resistor 38 being used to bias the grid 24 down on the lower knee of the tube's characteristic curve, the value of bias being so selected
25 as to produce optimum detection efficiency. The gain of the receiver is adjusted by the gain control potentiometer 11 so that the desired signal voltage will be substantially less than the bias voltage on grid 24 of the triode detector tube 25.

30 Potentiometer 41 is adjusted to give the cathode 40 of diode 23 just sufficient positive bias to keep tube 23 non-conductive during the reception of signal representing voltages. When these adjustments have been made, detection of
35 received signals will take place in tube 25 in a well known manner and the diode 23 will remain non-conductive. Also, as the grid 24 is not driven into its conductive region no additional bias voltage will build up across the time
40 constant circuit 20—21.

If it is now assumed that a noise pulse of considerably greater amplitude than the signal is picked up by the antenna system and transmitted
45 through the receiver, the first positive half cycle will overcome the cathode bias of the diode tube 23 and electrons will flow from the cathode 40 to anode 22. This flow of electrons has two functions. In the first place, a damping action
50 results due to the low impedance presented by a conductive diode. This tends to prevent grid 24 of the detector tube 25 from moving further in a positive direction, which in turn prevents undue increase in the anode current of tube 25. In
55 the second place, electrons drawn from cathode 40 to diode plate 22 effect a negative charge on grid 24. This results in reducing the detecting efficiency of this tube until the charge has leaked off through resistance 20. I have found it advantageous to make resistance 20 about 100,000
60 ohms and capacity 21 about 0.0001 microfarad. Tests that I have made show that this time constant circuit 20—21 is important for satisfactory operation of my receiver. It is so regulated that the charge on grid 24 will leak off by the time the
65 noise pulse has ended. I believe that the beneficial results obtained when using this circuit can be attributed largely to the function of decreasing the detecting efficiency of tube 25 while the noise transient persists.

70 The circuit described just above performs especially the function of limiting noise pulses that have amplitudes in excess of the received carrier. Its operation may be observed by closing switch
75 28 to contact 29 and listening to the signal in telephone head set 31. If the circuit is adjust-

ed as outlined above and a radio signal is being received, very satisfactory noise limitation will be obtained. In practise the head set 31 may be replaced by any suitable type of loud speaker.

When carrier telegraph signals are to be received, switch 28 is closed to contact 30, thus connecting discharge tube 33 to the output of the detector tube 25. Tube 33 being of the usual gaseous discharge type, will remain non-conductive until the voltage across it reaches about 120
10 volts. It will then become conductive and will remain so until the extinction voltage, usually about 105 volts, is reached. Resistance 27 and B battery 19 are so related that in the absence of any signal the voltage drop across resistance 27
15 due to the anode current in tube 25 will be somewhat lower than the extinction voltage of tube 33.

If a carrier wave is now tuned in, the average impedance of tube 25 drops, increasing the voltage drop across resistance 27 until it reaches the amount required to initiate the gaseous discharge in tube 33. However, resistance 32 is relatively high, being of the order of 500,000 ohms,
25 and capacity 35 is about 0.002 microfarad, so that when tube 33 becomes conductive a voltage drop develops across resistance 32 and as soon as conductor 35 has sufficiently discharged, the voltage across tube 33 drops again below the extinction value and the tube becomes non-conductive. If the signal carrier is still present, the
30 voltage across tube 33 will again build up until this tube begins to conduct and the cycle will be repeated. The frequency of this recurring phenomenon is determined primarily by the values
35 of resistance 32 and capacity 35, though it also depends to some extent on the voltage drop available across resistance 27 and on the impedance of the telephone receiver 36. A proper selection of these factors will produce a pleasing tone,
40 substantially free of noise, in the telephone receivers as long as the carrier signal is being demodulated.

The resistance 32 and capacity 34 perform an additional function of importance in filtering out
45 audio frequencies which are present in the plate circuit of tube 25, so that such audio frequencies will not reach the telephone receiver 36. In consequence, there will be substantially complete silence in this telephone receiver when no tone is
50 being generated by tube 33.

When an interrupted carrier such as a telegraph signal is being received, the tone generated by tube 33 will be heard during each dot and dash, and there will be complete silence between
55 telegraphic characters. This complete inter-character silence will be obtained instead of the usual noise interference. Where the noise interference is of lower amplitude than the received carrier, the gain control potentiometer 11 is adjusted so that the carrier signal will develop sufficient voltage drop across resistance 27 to trigger-off the tube 33, but the noise voltages being of lower value will not do so. When the noise voltages exceed the carrier in amplitude,
65 the limiting action of the detector described above reduces them to substantially carrier level in the detector output. Noise disturbances of this type would trigger-off tube 33 were it not for the fact that they are usually of short duration. This fact is taken advantage of by shunting resistance 27 with condenser 34, thus making it necessary for the noise voltage to persist over a definite period of time before the voltage drop
70 across resistance 27 builds up sufficiently to cause
75

tube 33 to discharge. Some care must be taken, however, not to make capacity 34 too large, or else the circuit may be slowed down to such an extent as not to respond properly to telegraphic dots.

If a telegraph signal is being received, and proper adjustments have been made, a tone generated by tube 33 will be heard in the telephone receiver 36. The duration of this tone will correspond to the telegraphic dots and dashes, and the tone will stop during the inter-character spaces. It is apparent that noise of any amplitude will not be heard during the dots and dashes, since audio frequency disturbances cannot pass the filter composed of resistance 32 and capacity 34. The problem therefore reduces to one of keeping the tone generator from operating during the spaces between dots and dashes. Low amplitude noise will not generate sufficient voltage across tube 33 to ignite it, and hence no tone will be generated and no noise heard in the receiver. High amplitude noise will be limited by the action of tube 25 and its associated gate circuit to little more than the amplitude of the signal carrier. If such noise pulses are of short duration they will not charge condensers 34 and 35 sufficiently to cause the voltage across tube 33 to reach the ignition point and hence the tone generator will not be triggered off. Of course, if noise currents of amplitude equal to or greater than that of the received carrier, and of very continuous nature were encountered, the tone generator would be triggered off and a false signal would result. It has been found in practice, however, that interference of this character is rarely if ever encountered.

While I have illustrated my invention in connection with a radio receiver of the superheterodyne type, it will be understood that its usefulness is not limited to such receivers. For example, it may be used with a tuned radio frequency receiver, and may also be used on a wire carrier telegraph circuit. Various modifications and changes may be made in the system and method of operation described hereinabove without departing from the scope of my invention. Some of the novel features of this invention are defined by the appended claims.

I claim:

1. A radio-telegraphic receiver for receiving carrier wave telegraphic signals accompanied by noise pulses of an intensity greater than and less than the carrier signal intensity and adapted to substantially reduce the audible interference normally caused by said pulses, comprising a negatively biased detector tube having an input and an output circuit, means included in said input circuit and actuated by excessive noise pulses for automatically increasing the bias of said detector so that the detecting efficiency of the tube is reduced and the noise pulses of greater intensity than the carrier substantially reduced, a tone generator connected to the output circuit of said tube for substantially reducing the noises of lesser intensity than the carrier, a source of potential connected to said tone generator, and means comprising a resistance and a capacity associated with said detector for controlling the potential applied to said tone generator whereby the inter-character spaces of said telegraphic signals will be substantially free of noise pulses.

2. A radio-telegraphic receiver for receiving carrier wave telegraphic signals accompanied by noise pulses of an intensity greater than and less than the carrier signal intensity and adapted to

substantially reduce the audible interference normally caused by said pulses, comprising a negatively biased detector tube having an input and an output circuit, means connected to said input circuit and actuated by excessive noise pulses for automatically increasing the bias of said detector so that the detecting efficiency of the tube is reduced and the noise pulses of greater intensity than the carrier substantially reduced, a gaseous discharge tube connected to the output circuit of said detector tube, said gaseous discharge tube supplying a pleasing tone during the reception of telegraphic signals and supplying no tone during inter-character spaces.

3. In a radio receiver, a vacuum tube detector for the reception of high frequency signal waves comprising an anode, cathode, and grid electrode, input and output circuits for said detector, biasing means connected to said cathode for establishing the normal point of operation of said tube in the vicinity of the negative bend of its grid voltage-plate current curve, a diode tube having its anode connected to the grid of said detector tube, adjustable means for biasing the cathode of said diode positive with respect to its anode whereby said diode will remain inoperative during the reception of normal signals but will become conductive when excessive noise pulses are being received, means connected to the grid of said detector comprising a resistance shunted by a capacity for accumulating a negative charge during the reception of excessive noise pulses and means for applying such additional negative bias to the grid of said detector tube to decrease the sensitivity thereof during reception of noise impulses.

4. In a radio receiver, a vacuum tube detector normally biased to operate in the vicinity of the negative bend of its grid voltage-plate current characteristic curve, an input circuit for said detector, a diode tube and a resistance shunted by a capacity connected to the diode and to said input circuit for simultaneously damping said circuit and altering the bias of said detector during the reception of excessive noise pulses, and means for preventing the damping of said circuit and alteration of said bias during the reception of normal signal voltages.

5. In a radio receiver, a signal wave detector, an output circuit for said detector, filtering means in said output circuit adapted to substantially remove audio frequency fluctuations from the output current of said detector, a tone generator in said output circuit adapted to be actuated by the rectified output of said detector and means for preventing the operation of said tone generator when the output of said detector falls below a predetermined minimum.

6. In a radio receiver, a signal wave detector, an output circuit for said detector, filtering means in said output circuit adapted to substantially remove audio frequency fluctuations from the output current of said detector, means for limiting the rectified output current of said detector to an approximate predetermined maximum value, a tone generator in said output circuit adapted to be actuated by the rectified output of said detector and means for preventing the operation of said tone generator when the output of said detector falls below a predetermined minimum.

7. In a radio receiver, a vacuum tube detector for the reception of high frequency signal waves comprising an anode, cathode, and grid electrode, input and output circuits for said detector, bias-

ing means connected to said cathode for establishing the normal point of operation of said tube in the vicinity of the negative bend of its grid voltage-plate current curve, a diode tube having
5 its anode connected to the grid of said detector tube, adjustable means for biasing the cathode of said diode positive with respect to its anode whereby said diode will remain inoperative during the reception of normal signals but will become
10 conductive when excessive noise pulses are being received, means connected to the grid of said detector comprising a resistance shunted by a capacity for accumulating a negative charge during the reception of excessive noise pulses, means
15 for applying such additional negative bias to the grid of said detector tube to decrease the sensitivity thereof during reception of noise impulses,

filtering means in said output circuit adapted to substantially remove audio frequency fluctuations from the output current of said detector, a tone generator in said output circuit adapted to be
5 actuated by the rectified output of said detector, and means for preventing the operation of said tone generator when the output of said detector falls below a predetermined minimum.

8. A radio telegraphic receiver as defined in claim 1 and characterized further by the use of an
10 additional means that is connected to the said means for automatically altering the detector bias and prevents that means from altering the bias during the reception of noise pulses of an
15 intensity less than the carrier signal intensity.

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