

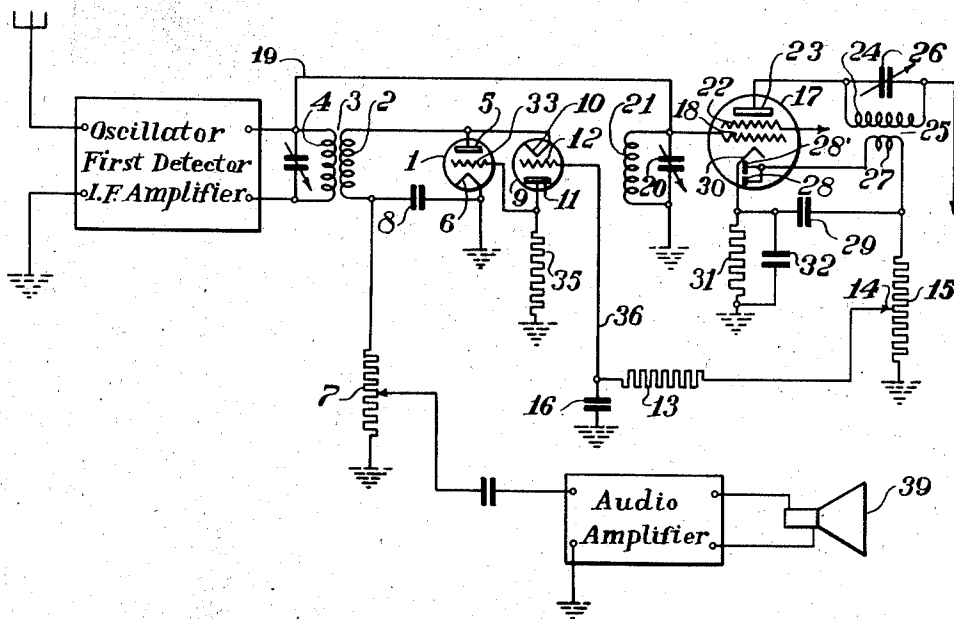
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R. C. DICKINSON

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RADIO RECEIVING SYSTEM

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WITNESSES:

Edward Michale
Mr. C. Groome

INVENTOR

Robert C. Dickinson.

BY

F. W. Lytle.
ATTORNEY

UNITED STATES PATENT OFFICE

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RADIO RECEIVING SYSTEM

Robert C. Dickinson, Wilkinsburg, Pa., assignor
to Westinghouse Electric & Manufacturing
Company, East Pittsburgh, Pa., a corporation
of Pennsylvania

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1 Claim. (Cl. 250—20)

This invention relates to radio receiving systems and more particularly to circuits for eliminating interference caused by static and similar transient surges affecting the receiver.

This application is a division of my application Serial No. 389,353, filed April 19, 1941, for Radio receiving systems and assigned to the Westinghouse Electric & Manufacturing Company, which claims certain subject matter herein disclosed.

The problem of interference due to certain high frequency discharges is an acute one and various methods have been proposed for its elimination or at least for lessening the undesirable effect produced thereby. The nature of the electrical disturbance varies with the source of the interfering radiation and those originating in the electrically charged atmosphere and reaching the receiver in the form of highly damped electromagnetic impulses are especially difficult to eliminate. Transients of this type are usually several times greater in intensity than the incoming carrier frequency energy and affect the demodulator of the receiver due to their highly damped characteristics by impact excitation.

The primary object of this invention is to cancel the effect of transient impulses reaching the demodulation circuit of the receiver by providing means for automatically controlling the output impedance of the demodulator tube upon sudden rise of input voltage and for a duration of time necessary for the decay of transient oscillatory currents.

Another object of this invention is to attenuate automatically the audio frequency energy derived from the demodulator of the receiving system whenever the rectified component of the carrier wave exceeds a predetermined level at a transient impulse rate.

A further object of this invention is to provide a control circuit connected to the demodulator portion of the receiver which produces a rectifier signal voltage whereby the effective impedance and hence the voltage output of the demodulator is decreased and the provision of means associated with the control circuit for initiating its action upon signal voltages exceeding a predetermined level and duration of time.

Additional objects and advantages will be apparent from the following description of the invention, defined in particularity by the appended claim, and taken in connection with the accompanying drawing wherein the single figure represents schematically the demodulator portion

of a radio receiving system, together with the control circuit in accordance with this invention.

Referring to the figure, the various portions of the receiving system herein shown as being of the superheterodyne type are indicated by conventional squares and only the modulator portion is shown in detail, to which the present invention is directed. The receiver may be of any conventional form inasmuch as this invention is applicable to the demodulator portion of any receiving system as long as it operates as a linear rectifier of the carrier frequency energy producing a rectified signal voltage.

The system herein shown employs the superheterodyne principle wherein the received carrier frequency energy is converted to an intermediate frequency, the latter being fed to the demodulator tube 1, which, acting as a half-wave rectifier, is connected in series with the secondary winding 2 of the intermediate frequency transformer 3, the received energy being applied to the primary winding 4 thereof. The anode 5 of the demodulator tube 1 is connected to the high potential terminal of the secondary winding 2 and the cathode 6 of the tube 1 is grounded. Between ground and the other terminal of the secondary winding 2 is placed the load resistance 7. The intermediate frequency component of the signal voltage is by-passed by a condenser effectively in parallel with the resistance 7. The audio frequency component of the rectified signalling energy is taken off from a potentiometer which is the load resistance 7 of the diode 1 by a sliding contact thereof which connects to the input circuit of the audio frequency amplifier. In parallel with the demodulator tube 1 is connected the control tube 9 in such manner that the cathode 10 thereof connects with the anode 5 of the tube 1 and the anode 11 of the tube 9 directly to the grid of tube 1 and also to the cathode of tube 1 through a resistor 35 and the common ground connection. The control element or grid 12 of the tube 9 is connected in series with resistor 13 to the sliding arm 14 of a potentiometer 15. The grid 12 is also by-passed to ground by condenser 16. The potentiometer 15 forms the load resistance of another rectifier shown here in the form of a dual purpose tube, one portion of which comprises a multi-electrode amplifier, the other being a dual anode diode rectifier. The amplifier portion of the dual purpose tube 17 includes the control grid 18 which is connected to the input circuit of the demodulator portion of the re-

ceiver by means of conductor 19, coupling condenser 20, and the input impedance 21 in the form of a radio frequency choke coil connected between grid 18 and ground. The screen electrode 22 is indicated to receive proper operating potential and the anode electrode 23 is connected to the primary winding 24 of a transformer 25, which is tuned to the intermediate frequency, of the signalling energy by condenser 26. The free terminal of the primary winding 24 is indicated to receive the required operating potential for the anode 23. The secondary winding 27 of the transformer 25 is connected between the parallel rectifier anodes 28 and 28' and one terminal of the potentiometer 15, the other terminal thereof being grounded. Condenser 29 serves to by-pass the intermediate frequency voltage to ground, the cathode 30 of the tube 17 being grounded through bias resistance 31, and by-passed by condenser 32 in shunt therewith.

In the operation of the circuit herein described, assuming that the condition of tube 9 is such which will not allow thermionic conductivity, a steady signal modulated at the rate of audio frequencies will be rectified by the tube 1 producing a rectified signal voltage across the load resistance 7 thereof. The audio frequency component of the signal is further amplified by the audio frequency amplifier in order to be reproduced in the speaker 39.

However, the control tube 9 in a state of conductivity, will offer a low impedance path for currents in the output circuit and thereby attenuate to a marked extent the signal level due to the fact that its space current path is effectively in parallel with the output circuit of the demodulator including the secondary winding 2 of I. F. transformer 3 and the load resistance 7. In order that the control tube 9 shall not impede normal receiving conditions, the intermediate frequency voltage is utilized as a source of steady biasing potential for the grid 12 of the tube 9. This is accomplished by the combined amplifying and rectifying action of tube 17, the input circuit thereof being energized through condenser 20 by the intermediate frequency voltage which, in the output circuit of this tube, is impressed upon the secondary winding 27 of the transformer 25 in an amplified form, and then rectified by the diode portion of the tube appearing in the form of a unidirectional voltage across the potentiometer 15. By adjusting the sliding arm 14 of the potentiometer 15, a desired magnitude of bias voltage can be obtained for the grid 12 of the tube 9 in order to counterbalance any tendency of conductivity which proper polarity of signal voltage between cathode 10 and anode 11 of the demodulator voltage would otherwise cause. Since no current flows through anode 11 to resistor 35, the grid 33 of tube 1 is at the same potential as its cathode 6, and the tube 1 acts as a simple rectifier. Therefore, if the moving arm 14 is set so that the negative grid voltage upon the grid 12 of tube 9 is just sufficient to cause anode current cut-off, the output impedance of the demodulator circuit will be free from attenuation, and the signal will be heard undiminished. If an impulse of stray stronger than the signal is now received, the resulting voltage impulse will tend to increase the voltage between cathode 10 and anode 11 of tube 9. Similarly, this impulse will

increase the bias voltage produced across the control rectifier load resistance 15, tending to maintain the grid 12 sufficiently negative to counterbalance the tendency of conductivity created by the rise of anode potential in tube 9. However, due to the time delay of the resistance capacity combination in the grid circuit of tube 9 comprising the resistor 13 and condenser 16, this impulse will be discharged to ground through the anode 11 before the grid 12 becomes sufficiently negative to reestablish the condition of balance and non-conductivity of the tube 9. Current flow through tube 9 causes resistor 35 to impress a negative voltage on grid 33 of tube 1 which will result in an attenuation of the signal in the output of demodulator tube 1. Furthermore, the anode resistance of the tube 9 is of low value compared to the resistance 7 and the voltage appearing across the output circuit of the demodulator is momentarily reduced to a very low value. Stable conditions are reached after the passage of the transient impulse and the signal is again detected and passed to the audio frequency amplifier in a normal manner.

Another utilitarian feature of this circuit arrangement may be found in the elimination of inter-channel noise. The negative voltage of the grid 12 will vary with the steady signal strength with the corresponding fluctuation in the positive anode voltage of the tube 9, so that the latter will be maintained slightly above cut-off. It is thus apparent that with no signal, the tube 9 acts as a low impedance shunt across the rectifier 1, which substantially silences the receiver when no signal is present.

I claim as my invention:

In a demodulation system, a high-frequency signal input and a signal output circuit, a demodulator tube connected to said output circuit having anode, cathode and grid electrodes, producing a rectified signal voltage, an impedance element between said grid and said cathode, said grid being thereby biased with respect to said cathode, means for altering the condition of said grid whereby the signal output of said demodulator is attenuated, comprising a vacuum tube having anode, cathode and control electrodes connected to said output circuit and energized by said rectified signal voltage in proper polarity of thermionic conductivity, said impedance element being in series with the space current path of said vacuum tube, and said current producing a voltage drop thereacross, and means for controlling the space current of said tube comprising a source of unidirectional voltage varying in accordance with the high-frequency signal voltage in said input circuit, a circuit interconnecting the control electrode of said vacuum tube and said source including a time delay network, said circuit being so adjusted that said unidirectional voltage maintains the grid electrode of said vacuum tube at a potential of space current cut-off within signal input levels of normal magnitude and frequency range, said time delay network having such characteristics as to introduce sufficient lag in the application of said unidirectional bias voltage at signal magnitude beyond modulation voltage intensities as to cause instantaneous conductivity of said vacuum tube attenuating thereby the rectified signal voltage of said demodulator tube.

ROBERT C. DICKINSON.