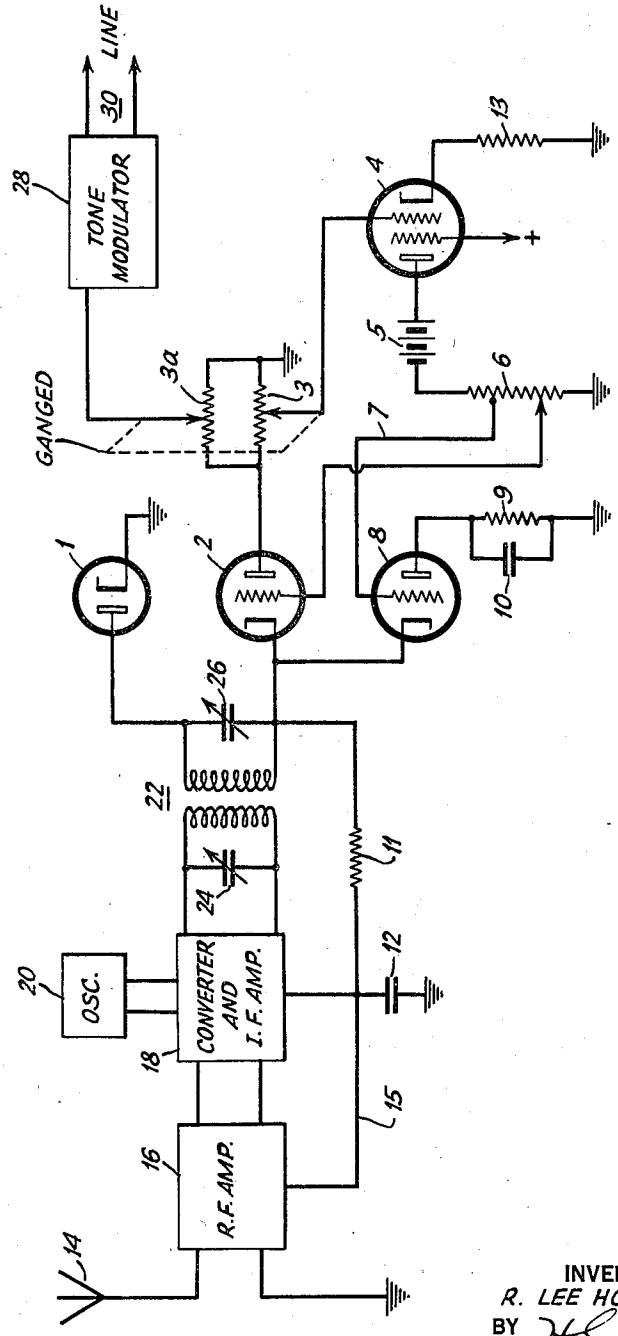
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AUTOMATIC GAIN CONTROL SYSTEM

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AUTOMATIC GAIN CONTROL SYSTEM

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4 Claims. (Cl. 250—20)

This invention relates to automatic gain control systems and is particularly adapted to a radio receiver which is arranged to respond to interrupted carrier wave telegraph signals.

It is an object of my invention to provide an automatic gain control system wherein, during each signal impulse, the gain in the receiver is adjusted to an optimum value, that gain being retained during a space interval until the next succeeding impulse.

It is another object of my invention to provide an automatic gain control system which produces almost instantaneous adjustment of the gain to a new level in response to a change in the incoming signal level.

It is another object of my invention to control the gain in an interrupted carrier wave receiver in such manner that tube noise currents in the receiving circuits will be substantially eliminated.

It is another object of my invention to provide a system comprising a plurality of discharge tubes operative to so influence an automatic gain control circuit that incoming static impulses are prevented from reaching a utilization device.

Other objects and advantages of my invention will be made apparent in the description to follow. This description is made with reference to the accompanying drawing, the sole figure of which shows a preferred circuit arrangement.

Referring to the drawing, I show a receiving antenna 14 which may be of any suitable type. This antenna feeds signals into a radio frequency amplifier 16. Output from the amplifier 16 is then fed to a converter and intermediate frequency amplifier 18 which is preferably of the heterodyne type and is operated in conjunction with an oscillator 20. The output from the intermediate frequency amplifier 18 is in circuit with the primary of transformer 22, this primary being tuned to the intermediate frequency by means of a capacitor 24. The secondary of transformer 22 is also tuned by means of capacitor 26.

In order to transmit the incoming signals over a wire line, it is common practice to rectify and tone-modulate these signals. For controlling a tone-modulator 28, I preferably provide a circuit which includes a diode rectifier 1 and a control tube 2, these tubes being in circuit with the secondary of the transformer 22. The cathode of the diode tube 1 is grounded. The anode of tube 1 is connected to one terminal of the secondary in transformer 22, the other terminal thereof being connected to the cathode of tube 2. The anode circuit for tube 2 includes two parallel disposed potentiometers 3 and 3a so that with a ground connection at the terminals of these potentiometers remote from the anode of tube 2 a closed direct current path is provided for the rectified potentials which are built up in the secondary of transformer 22. The tap on potentiometer 3a is coupled to the input circuit of the tone-modulator 28. This tone-modulator has output leads 30 which may be connected to a wire line and thence to any desired terminal equipment.

The tube 2 is controlled by a reversing tube 4 which is preferably of the tetrode type. The control grid of tube 4 is connected to the adjustable tap on potentiometer 3. The cathode is grounded through a cathode resistor 13. The anode has an independent direct current supply source 5, the negative terminal of which is connected through a potentiometer 6 to ground. A suitable screen grid potential is impressed upon the screen grid of this tube.

An automatic gain control circuit 15 is shown connected to the units 16 and 18 for controlling the space path impedances of the amplifier tubes therein. This gain control circuit has associated therewith the usual time constant elements consisting of resistor 11 and capacitor 12. The values of elements 11 and 12 are preferably chosen such that a time constant of from $\frac{1}{20}$ to $\frac{1}{100}$ second is obtained. The values of elements 9 and 10 are preferably chosen to produce a delay action of from 1 to 10 seconds, depending upon working conditions. The control potentials for the circuit 15 are derived from the secondary terminal of transformer 22 which is directly connected to the cathode of tube 2. When no signal is present, the tubes 2 and 8 are blocked, and consequently the automatic gain control circuit 15 is isolated from ground.

In order to render the automatic gain control circuit substantially insensitive to very abrupt strong static impulses, when such impulses greatly exceed the amplitude of the telegraph signals, a leakage path is provided through a so-called drainage tube 8. This tube has a cathode connected in parallel with the cathode of tube 2. The anode of the tube 8 is connected to ground through a resistor 9. This resistor is in parallel with a by-pass condenser 10. Tube 8 is controlled, however, by a voltage developed across resistor 6 and is substantially biased to cut-off except when tube 4 becomes blocked. The operation of tube 8 is, therefore, rendered effective only in response to these strong atmospheric or static impulses.

The taps on potentiometer **3** and **3***a* are preferably operated in tandem to insure maintenance of a safe operating ratio between the circuits of the tone-modulator **28** and the reversing tube **4**. This arrangement has been found desirable in fixing the level above the signal value so that the action of the drainage tube **8** will prevent paralyzing the receiver in response to static crashes.

The mode of operation of my invention will be well understood by those skilled in the art in view of the foregoing description. It may be pointed out particularly, however, that an important feature of the invention resides in the arrangement of the connections between the tubes **2**, **4** and **8** so that the value of the potential applied to the automatic gain control circuit **15** upon reception of each impulse has a durable effect throughout normal spacing periods. However, if a strong static impulse appears, that is, one of much greater amplitude than that of the signals, then an excessively negative potential applied to the circuit **15** is permitted to drain off to ground through the tube **8**, since this tube is rendered conductive by the blocking of tube **4**. The time constant circuit **9**, **10** permits the tube **8** to drain off the unwanted negative potential on the gain control circuit very rapidly and also prevents such circuit from being overdrained. It will thus be seen that the paralyzing of the receiver by static crashes is substantially prevented.

Various modifications of my invention will suggest themselves to those skilled in the art in view of the foregoing description. Among such modifications it is apparent that the system can be advantageously applied in diversity receiving systems. The scope of the invention is, therefore, defined by the claims to follow.

I claim:

1. An automatic gain control device for a radio telegraph receiver comprising two time constant circuits, one being relatively fast and the other being relatively slow in action, means for applying a gain reducing potential across the fast-action time constant circuit in response to signals the amplitude of which increases up to a predetermined limit, means including a two-stage discharge tube circuit arrangement for causing the slow-action time constant circuit to prevent the application of a receiver-paralyzing voltage across said fast-action time constant circuit in the presence of static crashes the amplitude of which is above said predetermined limit, the tube in the second stage of said two-stage arrangement having its space path in circuit with said slow-action time constant circuit, and the first tube of said two-stage arrangement constituting means operative in the absence of signals for substantially blocking the second stage tube.

2. In an automatic gain control circuit for an interrupted carrier wave receiver, means for rectifying an output current from said receiver, a variable impedance in series with said rectifying means, a time-constant circuit connected between a terminal of said variable impedance and points of gain control in said receiver, a resistive connection from another terminal of said variable impedance to a utilization device, means including a discharge tube the space path impedance of which is increased in response to signals for controlling the value of said variable impedance, and means including a second discharge tube effectively in shunt with said variable impedance and said resistive connection thereto for rapidly dissipating negative charges above a predetermined value in said time constant circuit, said second discharge tube being controlled in an opposite sense in respect to the first mentioned discharge tube.

3. An automatic gain control circuit for an interrupted carrier wave receiver comprising means including two discharge tubes having their space paths connected in series, and being fed with received signal energy, for adjusting the gain in said receiver, one of said tubes being a diode, the other being a triode, a pair of parallel-connected impedances connected to the anode of said triode discharge tube, one of said impedances having in circuit therewith a utilization device, a third and a fourth discharge tube, the third discharge tube being controlled by a signal voltage across the other of said impedances and being biased to cut-off by that signal voltage when in excess of a predetermined value, an input circuit for said fourth tube which includes an impedance common to the output circuit of said third tube, a connection common to the cathodes of said fourth tube and of the triode first mentioned through a time constant circuit to points of gain control in said receiver, and an impedance in the output circuit of said fourth tube providing rapid dissipation of a strong impulse through said fourth tube and an appreciable delay action in the re-setting of the gain control voltage in response to signals, whereby said gain control voltage is rendered relatively unresponsive to carrier wave interruptions during normal spacing periods.

4. In a radio telegraph receiver, a gain control device comprising an output transformer the secondary of which has its two terminals connected to ground through the respective space paths of a pair of discharge tubes, the first of said tubes being a diode the cathode of which is grounded, the second of said tubes having at least a cathode, an anode and a control grid, the cathode being connected to said transformer secondary and the anode-to-ground circuit thereof being constituted as a potentiometer; a third discharge tube having a control grid connected to a tap on said potentiometer and having an output circuit which includes a direct current source, a grounded cathode resistor, and a potentiometer connecting the negative terminal of said source to ground; a gain control circuit for said receiver having a time constant device adjusted for relatively fast gain reduction and relatively slow gain recovery, said gain control circuit being connected to the cathode of said second tube, and means including a fourth discharge tube the space path of which provides a variable impedance circuit for the dissipation to ground of an occasional highly negative potential at the cathode of the second tube, said fourth tube having a control grid connected to a tap on the potentiometer which is in the output circuit of said third tube, whereby the third and fourth tubes are constituted as cascaded stages under control of potential variations which appear at the tap on the first said potentiometer.

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