

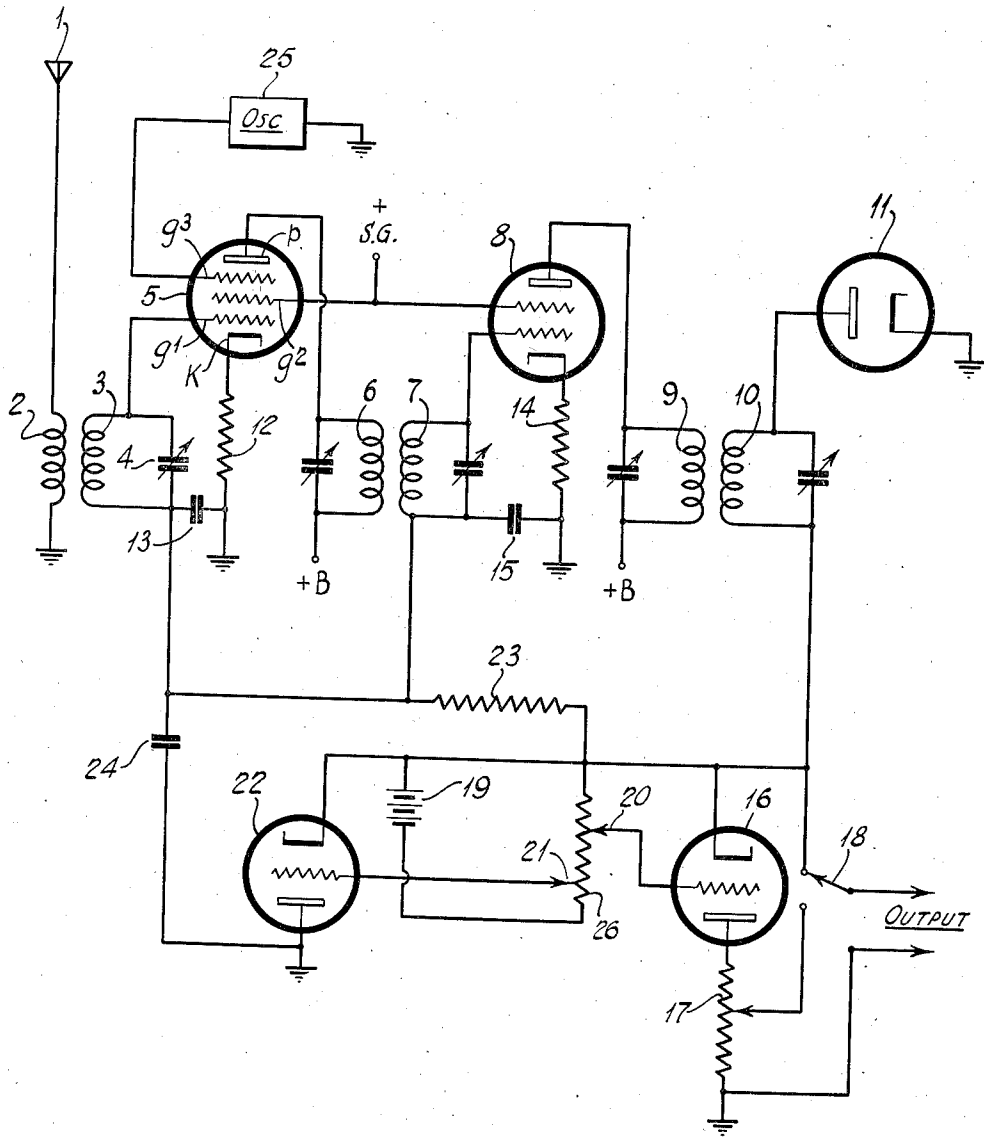
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GAIN CONTROL CIRCUIT FOR RADIO TELEGRAPH

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GAIN CONTROL CIRCUIT FOR
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This invention relates to automatic gain control systems and is particularly adapted for use with a radio receiver which is intended to receive interrupted carrier wave telegraph signals.

It is an object of my invention to provide an automatic gain control system whereby the gain of the receiver is adjusted to an optimum value during each signal impulse, that gain value 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 a manner that the 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 paralyzing the receiver circuit.

The invention will now be fully described, reference being made to the accompanying drawing, the sole figure of which shows a circuit diagram of a preferred embodiment.

Referring to the drawing, I show an antenna 1 for collecting electromagnetic wave energy. This antenna is connected through coupling coil 2 and thence to ground. Electromagnetic wave energy flowing through coupling coil 2 induces signal currents in the tuned circuit comprising the transformer secondary 3 and the adjustable capacitor 4 in shunt therewith. Applied to the suppressor grid *g3* of converter tube 5 is the energy from a local oscillator 25. The local oscillations beat with the incoming signal to produce an intermediate frequency of a desired value. This intermediate frequency energy is transferred to the control grid of an amplifying tube 8 by way of an intermediate frequency transformer which is included in tuned circuits 6 and 7. The intermediate frequency energy being amplified by amplifier tube 8 is coupled by tuned transformer windings 9 and 10 to a diode rectifier tube 11. Parts 12 and 13 represent a bias resistance and a radio frequency bypass condenser respectively, as do parts 14 and 15.

A triode tube 16 is connected in series with the output of a rectifier tube 11 and a resistor 17. The output terminating resistance of rectifier tube 11 includes the transformer secondary

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winding 10, the space path through triode tube 16 and resistance 17. A bias battery furnishes a potential gradient in a potentiometer 26, and adjustable taps 20 and 21 on this potentiometer may be set to maintain suitable threshold biases on the grids of tubes 16 and 22 respectively. The tap 21 biases the grid in tube 22 more negatively than the bias which is applied to the grid of tube 16 through tap 20. Resistor 23 and capacitor 24 constitute the time constant device for this AVC system.

Output potentials derived from the rectifier tube 11 may be taken either from the cathode of tube 16 or from a suitable point on the potentiometer 17 in the anode circuit of tube 16. The polarity of the output potential depends upon the setting of a double pole switch 18. By means of the circuit arrangement shown and described it is, therefore, possible to control any desired translating device such as a keyer tube, a balanced modulator, or a recorder.

In operation the signal wave energy is amplified by vacuum tube 5 and heterodyned with the local oscillations to produce an intermediate frequency, which is further amplified by intermediate frequency amplifier tube 8, output from which is rectified by the rectifier tube 11. The triode tube 16 has applied thereto a low bias potential sufficient to render this tube non-conductive to very low strength signals and tube noise currents. When signal energy passes through tube 16 and resistance 17 the full voltage across tube 16 and resistance 17 is applied to the AVC circuit. The application of this AVC voltage reduces the gain of the receiver during a single impulse and the gain remains at that particular gain value since the control grids of vacuum tubes 5 and 8 are isolated until rectifier tube 16 is again conductive. If the next succeeding signal impulse be stronger than the preceding impulse, the gain of the receiver will be lowered still further, whereas, if the following signal impulse be less in value than the preceding impulse, the gain of the receiver will be increased and will retain this gain value as heretofore mentioned until another impulse causes tube 16 to again be conductive to reset the gain level of the receiver at a new level depending upon the strength of the incoming signal.

The action of the tube 22 in this AVC circuit is as follows: If very strong signal currents, or heavy atmospheric impulses are received, tube 22 becomes conductive since a slightly more negative bias is applied thereto, than is applied to the grid of rectifier tube 16, creating a bypass circuit

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which prevents the grids of amplifier tubes 5 and 8 from becoming blocked. Another effect present is that the AVC circuit is momentarily drained of electrons when tube 22 suddenly becomes conductive, causing the gain of the receiver to slightly increase as a result of a strong static impulse, whereas, in normal AVC practice the gain of the receiver would be greatly reduced and the time constant circuit would be overloaded with voltage possibly producing dropouts of one or more subsequent signal impulses.

The time constant circuit 23, 24 is preferably small in value in order to provide substantially instantaneous gain compensation. This arrangement has proven very practical when receiving telegraph signals under conditions such that the strength of the incoming signals varies over a very wide amplitude range. Since the rate of gain compensation can be extremely fast it naturally follows that the rectified signal energy available at switch 18 remains relatively constant though the input signal may be fading over a very wide range.

It will be appreciated that this method of automatic gain control may be used in conjunction with a diversity receiving system which is at present in wide usage for short wave, long-distance radio telegraph-telephone reception.

Further, this method of automatic volume control may be utilized in a conventional all-wave broadcast receiver and will be found particularly useful in establishing a maximum volume at which positive limiting results, thereby preventing heavy atmospheric noises from exceeding the maximum level of modulated waves as received. This is accomplished by adjusting rectifier tube 22 to be conductive at approximately 6 to 10 decibels below the maximum modulation level.

Various modifications and applications will be suggested by this disclosure to those skilled in the art. The scope of the invention is to be understood, therefore, as comprehending embodiments other than that which is herein illustratively shown and described.

I claim:

1. In an interrupted carrier wave receiver an automatic gain control circuit comprising means for rectifying the output from said receiver, a first electron discharge tube the space path of which is in series with said rectifying means, said tube having a cathode, an anode and a control grid, a load resistor connected between said anode and ground, a second electron discharge tube the space path of which is connected in shunt between the cathode of the first said tube and ground, said second tube having a cathode, an anode and a control grid, means for maintaining different threshold biases on the grids of said tubes whereby the first said tube is rendered non-conductive in the presence of signal and noise energy below a predetermined level, and the second tube is held non-conductive in the presence of rectified signal energy within a normal volume range, and a time constant circuit comprising series resistance and shunt capacity so connected as to supply gain control potentials to the amplifier stages of said receiver, said potentials being subject to the limiting action of said discharge tubes.

2. In an interrupted carrier wave receiver having amplifier stages, an automatic gain control circuit comprising series resistance and shunt capacity in circuit with rectifying means coupled to a particular stage of said receiver, said circuit being operative to apply gain control potentials

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to the input circuits of said stages, a load resistor and electronic switching means in series with said rectifying means whereby said gain control circuit is rendered effective to adjust the gain in said receiver to a desired value in the presence of marking signals and to hold that gain adjustment during carrier wave interruptions of normal spacing signal duration, an electronic limiter device connected in shunt with said load resistor and switching means, said limiter device being operable in the presence of peak impulses due to static and other excessive wave energy, and threshold biasing means for so controlling the conductivity of said switching means and of said limiter device respectively, that said gain control circuit is rendered relatively insensitive to noise energy of low amplitude and also to static crashes of relatively high amplitude.

3. Apparatus for automatically controlling the gain in the amplifier stages of an interrupted carrier wave receiver comprising a gain control circuit having time constant elements in shunt with a unilateral impedance of the triode discharge tube type, means including a rectifier for supplying rectified output energy from said amplifier stages to said gain control circuit, means operative in response to the reception of moderate strength static crashes and other interference waves of moderate amplitude for causing said rectified output energy to automatically control the gain of the receiver, and means operative to increase the gain of the receiver when receiving strong static or other interfering potentials, this means comprising an auxiliary discharge tube rendered conductive by said strong interfering potentials, thereby to shunt to ground a portion of said rectified output energy along with a portion of the charge previously stored in said time constant circuit.

4. An automatic gain control circuit for use in a radio telegraph receiver, said circuit having a rectifier coupled to a certain stage of the receiver, a load in series with the rectifier, said load including two discharge tubes which are mutually in parallel, a negative biasing means so connected between the cathode and control grid of each one of said tubes that one tube conducts rectified signal energy within a normal range of amplitudes and the other tube conducts only in the presence of peak wave impulses and strong atmospherics, and a time constant device composed of resistance and capacity forming part of said gain control circuit and arranged for co-operation with said load to control the gain in said receiver.

5. Apparatus for automatically controlling the gain in the amplifier stages of an interrupted carrier wave receiver, said apparatus comprising a rectifier circuit coupled to a particular stage of said receiver, said circuit including the space path of an electron discharge tube having a cathode, an anode and a control grid, negative biasing means connected between the cathode and control grid of said tube, means including a time constant circuit in shunt with the space path of said tube, said means having resistance and capacitance for prolonging the gain control effects through space intervals between the marking signal elements, and means responsive to static impulses and high amplitude signals which tend to paralyze the receiver for reducing the bias that would otherwise be derived from said negative biasing means, whereby said tube is caused to compensate for excessive gain control action.

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6. Apparatus in accordance with claim 5 wherein said bias reducing means includes a second electron discharge tube the space path of which is in series with a resistor, this tube and resistor being in shunt with the space path of the first said tube and the second tube being operatively biased to supply substantially instantaneous adjustment of the gain control potential to a new level in response to a change in the incoming signal level.

7. Apparatus for automatically controlling the gain in the amplifier stages of an interrupted carrier wave receiver, comprising a gain control circuit having time constant elements in shunt with a unilateral impedance of the triode dis-

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charge tube type, said circuit being operative to reduce the gain in said amplifier stages in response to the reception of moderate strength static crashes and other interference waves of moderate amplitude, means occasionally operative to increase the gain in said amplifier stages, this means comprising an electron discharge device the space path of which is connected in shunt with said time constant elements, and means operative upon reception of strong static or other noise energy for reducing the impedance of said space path, thereby to effect said gain increase.

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