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AUTOMATIC CURRENT REGULATING DEVICE

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2 Sheets-Sheet 1

Fig. 1

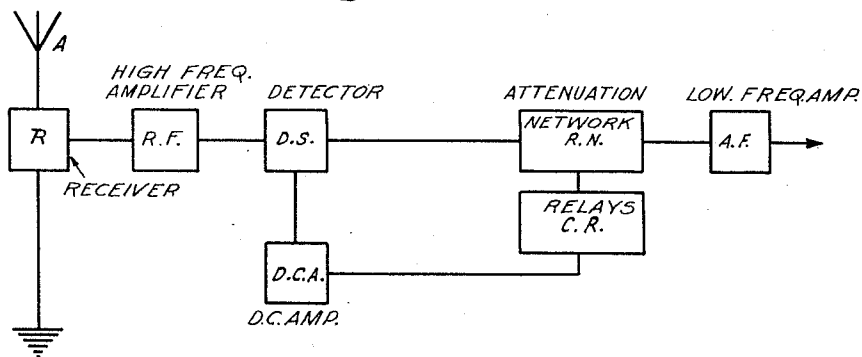


Fig. 2

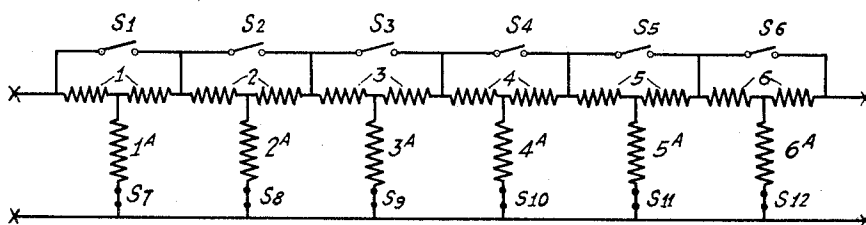
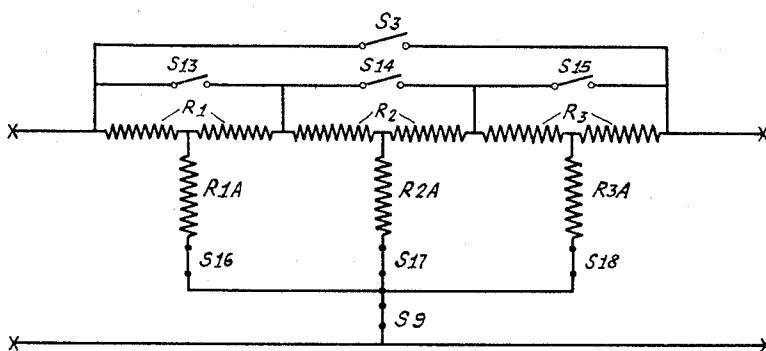


Fig. 2-a



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The diagram shows a relay circuit with a feedback loop. A DC source B is connected to a lamp L_1 and a relay coil WR . A switch S_1 is connected to the relay coil. A switch ST is connected to ground. A lamp L is connected to a potentiometer P and a power source B . The potentiometer P is connected to a feedback loop with resistors LR and VR . A meter MA is connected to the relay coil. The circuit is labeled "TO RELAY".

Diagram illustrating a radio receiver circuit, likely a superheterodyne or similar design, showing the following components and connections:

- High Freq. Amplifier (R.F.):** The input stage, connected to the antenna input.
- Vacuum Tube (V1):** The first vacuum tube, biased via a grid leak (resistor and capacitor) and a cathode resistor (C2) connected to a battery (Eb).
- Tuned Circuit (T2):** A coil (T2) in series with a capacitor (C1), forming a resonant circuit.
- Intermediate Frequency Stage (Ch1):** A coil (Ch1) in series with a capacitor (C3), forming another resonant circuit.
- D.C. Amplifier (D.C.A.):** A direct current amplifier stage that drives the relay.
- Relay (CR):** A relay controlled by the D.C.A. output, which switches the signal to the attenuation network.
- Attenuation Network (R.N.):** A network that provides variable attenuation to the signal.
- Batteries (Eb, EA):** Eb is the main power supply for the vacuum tube, and EA is a battery connected to the output of the D.C.A. through a capacitor (C3).

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AUTOMATIC CURRENT REGULATING DEVICE

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This invention relates to automatic limiting and regulating devices, for use in electrical signalling, and while not confined to application thereto, is especially suitable for limiting or regulating the intensity of signals transmitted over a land line from the output side of a wireless or other telephone or telegraph receiver.

In cases in which signals received by radio telegraphy or telephony are amplified and then re-transmitted over a land line or the like, considerable difficulty is experienced especially when using short waves for instance in the case of telephony, owing to the large fluctuations liable to occur in the intensity of received signals. For example, the amplitude of the low frequency component of speech signals at the output end of an amplifier associated with a wireless receiver, may vary between 1 and 50 milliamperes, and it will readily be appreciated that so large a variation is very serious, since it may cause overloading of repeater valve in the land line and give rise to distortion in other ways. Moreover, such large variations are greatly in excess of the limits for commercial telephony.

Briefly the object of this invention is to provide a device which will automatically control within definite limits the signals to be transmitted.

Another object of this invention is to provide an automatic limiting device which will be sensitive and instant in operation.

According to this invention an automatic limiting and regulating device comprises signal intensity reducing means and means controlled by the intensity of the signals to be limited, for varying the attenuation or weakening properties of the said intensity reducing means.

In one way of carrying out the invention, as applied to a wireless receiver and amplifier re-transmitting signals over a land line, the signals from the last stage of the wireless receiver which last stage may, for instance, comprise two valves in push-pull connection are amplified by means of a low frequency amplifier and re-transmitted through an interposed continuation or artificial line over

a land line. This interposed line may conveniently comprise a plurality of resistances in series parallel arrangement.

Bridged across two points in the interposed line is a plurality of resistances in series and a plurality of high speed mechanical relays are associated with said resistances in such manner that upon operation of one or more of the said relays, one or more of the said resistances, will be short-circuited. The resistances are so proportioned, and the whole arrangement is such that the attenuation or weakening properties of the interposed continuation or artificial line are variable for example, between 5 and 50 transmitting units by varying the amount of resistance effectively shunted across the said continuation line.

The relays are arranged to be actuated by different amplitudes of current, and their operative windings are connected so as to be influenced by the intensity of signals in the output side of the wireless receiver. For example, the first relay may be adapted to be operated by a strength of 1 milliampere, the second by 3 milliamperes, the third by 5 milliamperes, and so on.

In one arrangement of relays, each relay is provided with two windings, one a signal energized winding, and the other a constant supply winding. The latter windings are connected in parallel across any convenient source of electrical energy, and, if desired, each winding may be connected in series with a regulating resistance whereby the sensitivity, speed of response, or setting of the associated relay may be adjusted.

The signal energized windings are connected in series across the output side of a direct current amplifier, whose input side is supplied from the last stage of the wireless receiver. It will be appreciated, therefore, that the amount of resistance in shunt across the interposed continuation or artificial line will depend upon the amplitude of the received signals.

Instead of the resistances which are shunted by the relays being arranged in shunt, they may be arranged in series in the interposed continuation or artificial line.

The employment of an artificial line in the first modification herein described has the advantage that the relay contacts are substantially prevented from transmitting disturbance to the line.

Other advantages will become apparent from the following specification when read in connection with the drawings in which:

Figure 1 shows in schematic form a general arrangement for receiving signals by wireless and retransmitting them over a land line.

Figure 2 shows in diagrammatic form an attenuation network, such as that incorporated in the arrangement of Figure 1.

Figure 2a shows in detailed diagrammatic form one of the resistance units incorporated in the arrangement of Figure 2,

Figure 3 shows in diagrammatic form a relay arrangement for varying the attenuation properties of the network shown in Figure 2 in accordance with the strength of the received signals, and

Figure 4 shows in diagrammatic form an arrangement for supplying current for the control of the relays incorporated in the apparatus described with reference to Figure 3.

Referring to Figure 1, A is an aerial associated with R, a supersonic heterodyne receiver (any other suitable kind of radio receiver may, of course, be employed), followed by RF, a high frequency amplifier which in turn feeds DS a detector separator adapted to separate the direct current component of rectified high frequency current from the low frequency alternating current caused by demodulation. The apparatus constituting the detector separator will be described in further detail later.

The low frequency alternating current output from the detector separator is fed through an attenuation network RN, thence through a low frequency amplifier AF if desired, to a land line (not shown). The direct current output from the detector separator is passed through a direct current amplifier DCA to actuate a series of controlling relays at CR adapted to vary the attenuation constants of the network RN.

The relays at CR are connected in series and arranged to be actuated one after another with increasing values of direct current fed to them, the successive actuation of the relays serving to vary step-by-step the attenuation constants of the network RN. It will be seen that the strength of current actually fed to the relays will be proportional to the amplitude of the received carrier wave, and, assuming that this amplitude varies proportionally with the amplitude of the low frequency alternating current output from the detector separator as will generally be the case, the apparatus can be so adjusted that the attenuation constants of the network RN will be varied

in accordance with the amplitude of the signals supplied thereto.

Referring to Figure 2, which shows diagrammatically the relay apparatus indicated by RN in Figure 1, together with the associated relay contacts, the network comprises a plurality (in this case six) of resistance units 1, 1A; 2, 2A; 3, 3A; 4, 4A; 5, 5A; 6, 6A. Associated with each unit is a pair of relay contacts S1, S7; S2, S8; S3, S9; and so on. Each pair of contacts is associated with one of the relays at CR (Figure 1), the arrangement being such that when one of each pair of contacts is closed, the other of that pair is opened, and vice versa.

Preferably the resistance value of each of the resistance units incorporated in the network RN is readily adjustable.

Figure 2a shows an arrangement whereby this may be effected.

Referring to this figure, a resistance unit, for example, the unit 3, 3A of Figure 2, comprises three series resistances R1, R2, R3, and three parallel resistances R1A, R2A, and R3A, together with switches S13, S14, S15 and S18. All the resistances are of equal value and it will be seen that by manipulating the switches S13, S14, S15, S16, S17, S18, the resistance value of the unit may be adjusted over a wide range.

Figure 3 shows the circuits associated with one of the control relays, say, the first relay. The other control relays are similarly arranged but are not illustrated for the sake of clearness in the diagram. The output from the direct current amplifier is passed to the main winding CW of the control relay and then through the main windings of all the other relays in series. The control relay is arranged to make or break a circuit passing from a main supply B, through an indicating lamp L, relay switch winding WR, control relay contact CW1 and control relay armature to earth. The relay switch winding WR actuates relay contacts S1, S7, associated with the resistance units 1, 1A (see also Figure 2).

For purposes of ready adjustment, each control relay is provided with a response adjustment winding, such as ACW, energized from a variable tapping upon a potentiometer P through a variable resistance VR. A limiting resistance LR is connected in series with the resistance VR and is bridged by a pair of normally closed relay contacts VR1S adapted to be opened by the winding WR when control relay CW is actuated. The resistance LR is necessary to the proper functioning of the apparatus and is of such value as to permit the control relay to close and open at substantially the same values of rising and falling current respectively. As is well known, the majority of relays having closed at a given value of current, will remain closed for a considerably less value of cur-

rent. MAS is a double pole socket into which a milliammeter MA may be plugged to facilitate adjustment.

The operation of the device shown in Fig. 3 is as follows: When the current in the winding CW is not sufficient to overpower the steady spacing current passing through the winding ACW, which current value can be regulated by means of both the potentiometer P, working in series with the lamp L in any electrical main circuit available and the series resistance VR; the tongue of the armature of the relay moves to the left and bears on contact 1CW which lights the controlling lamp L1. No current passes in the winding WR of the auxiliary relay and in that position contact VR1S and S1 are closed and contact S7 is open, thus removing completely the attenuation line constituted by the resistance 1 and 1A from the main line circuit and short circuiting the resistance LR in the electrical biasing circuit to the winding ACW of the main relay.

When the current flowing in the winding CW rises to a value sufficiently high to overcome the antagonistic electrical and mechanical margin of the relay including the field of winding ACW the tongue of the relay armature moves to the right from contact 1CW to contact CW1. The effect of this is to switch off the controlling lamp L1 and to send a current in the winding WR of the auxiliary relay. This results in that contacts VR1S and S1 are opened and contact S7 closed. This results in introducing the attenuation element constituted by the resistances 1 and 1A, into the circuit and simultaneously decreases the electrical biasing current in the main relay circuit including winding ACW by introducing in said circuit the resistance LR. The elements 1 and 1A in the line limit the amplitude of the current sent out over the line.

To briefly repeat the operation of the limiting device:—When the armature of the main relay is in center position with respect to windings CW and ACW normal current is coming in and being amplified and sent out over the line. The switches VR1S and S1 are in their upper position, i. e. closed because WR is not energized. The resistance LR is short circuited, likewise the limiting elements 1, 1A. Switch S7 is open.

The same conditions prevail when the armature of the relay is in contact with the contact 1CW due to the fact that the current in CW is below normal and the current in ACW drives the armature to the left. In the latter position a lamp L1 is energized.

When the armature of the relay is in the right hand position due to the fact that the current in CW is above normal and the field thereof overcomes the field of ACW, WR is energized and pulls down the movable contacts of switches VR1S, S1, and S7. The

switches VR1S and S1 are open. LR is in series with ACW and 1, 1A is introduced into the line by the closing of S7 and opening of S1.

Figure 4 shows in diagrammatic form the detector separator indicated at DS in Figure 1.

Referring to Figure 4, V1 is a thermionic valve which is adjusted by means of the grid bias battery Eb, to rectify and demodulate the signals. T2 is an output transformer, C1 a bye-pass condenser for the high frequency current; C2 and C3 are condensers of such size as to let pass both high and low frequency current; Ch1 is a choke adapted to let pass direct current but to stop high and low frequency alternating current and EA is an anode battery.

Although for the purpose of illustration I have fully shown and described the at present preferred form of my invention and the operation thereof, it will be clearly understood that I do not limit myself thereby except as marked out in the following claims.

I claim:

1. An automatic limiting and regulating device, suitable for use in signalling systems and comprising signal intensity reducing means, means for varying the attenuation or weakening properties of the intensity reducing means comprising a plurality of relays energized by currents substantially proportional to the intensity of the signals to be limited and regulated and adapted to be actuated in succession by rising values of said intensity, so that the attenuation or weakening properties of the said intensity reducing means are varied according to variations in the said signal intensity, a winding associated with each of said relays in such a manner that its response to the energizing currents may be adjusted, a resistance in series with each of the response adjusting windings and means for short-circuiting said resistances except when their appropriate relays are actuated.

2. In apparatus for automatically limiting and regulating the amplitude of current over a signalling channel, the combination of an incoming line, signal detecting means connected thereto, an outgoing line, signal intensity reducing means, interposed between said detecting means and said outgoing line, said reducing means including a network comprising a plurality of resistance units, each unit including a plurality of resistances some of which are arranged to be connected in series with said outgoing line and others of which are adapted to be connected in parallel with said line, switching means connected with said resistances and with said line, and relay means connected with said switches and actuated by current from said detecting means to vary progressively the number of said resistances interposed in said line by said switches.

3. An automatic amplitude limiting and regulating device to be used in signalling apparatus including, signalling receiving means followed by signalling detecting means, amplifying means, and signalling intensity reducing means, interposed between said detecting means and said amplifying means, means for varying the attenuation or weakening properties of the intensity reducing means including a plurality of relays, and means for diverting a direct current component from the output circuit of said detecting means to energize and actuate said relays progressively in accordance with the amplitude of the received signal.

4. In radio apparatus for automatic signal amplitude control, a signal transmission line, means associated therewith for receiving a signal, means for demodulating said signal, means for selecting a direct current component from the energy resulting from said demodulation comprising a path for the passage of the direct current component from the output of said demodulating means, and means in said path to prevent current at the signal frequency from flowing therein, a plurality of relays each including a winding connected with said path, said relays being adapted to be actuated by variations in the amplitude of said direct current component, a resistance net work arranged to be connected between the output circuit of said demodulating means and the outgoing line, and a plurality of switches associated with said resistances and actuated by said relay windings to alter the amount of resistance connected in said line.

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