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APPARATUS FOR REDUCING BIAS IN TELEGRAPH SIGNALS

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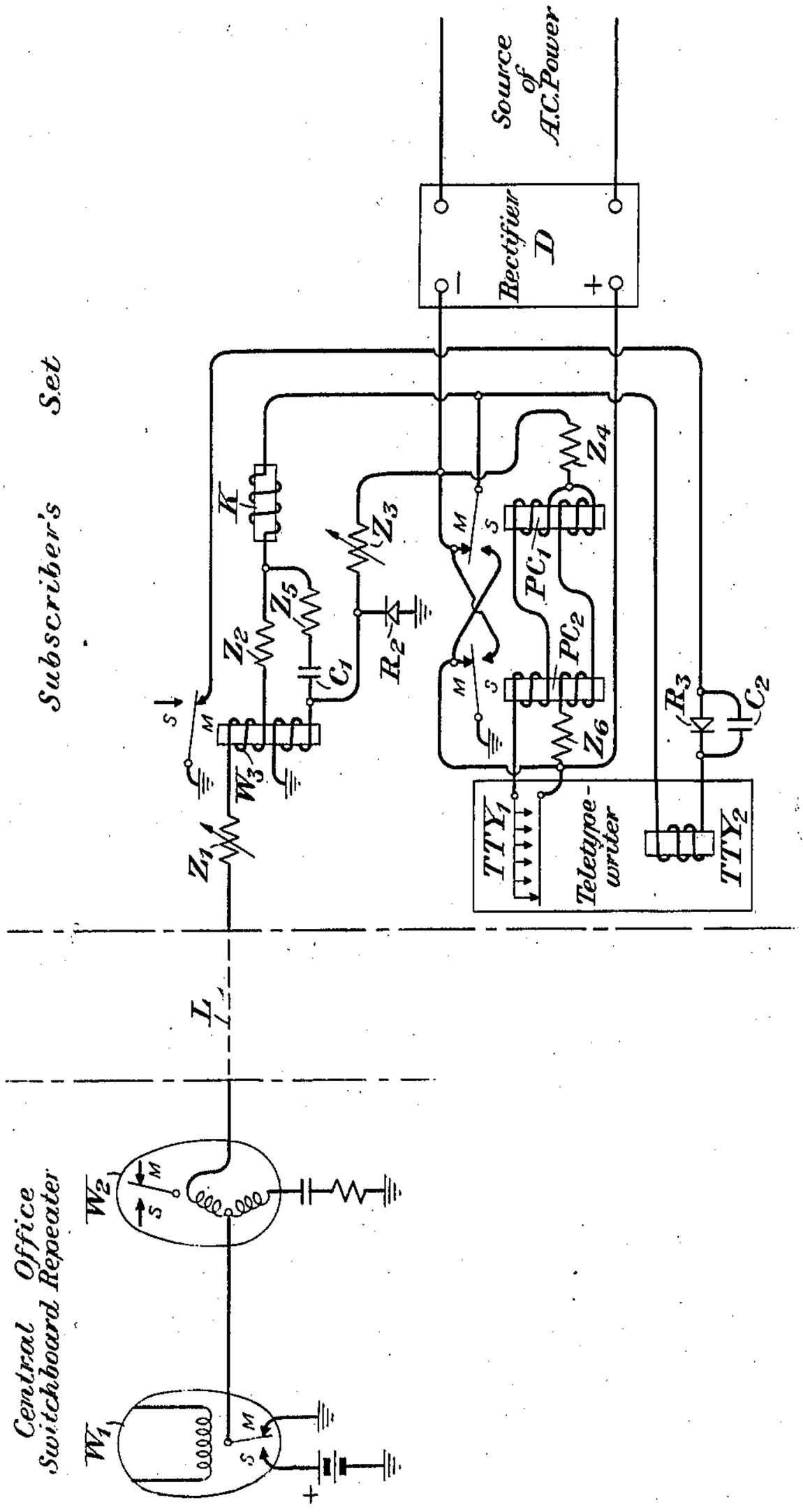

INVENTOR
K. W. Richards
BY Jefferson Ehrlich
ATTORNEY

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APPARATUS FOR REDUCING BIAS IN TELEGRAPH SIGNALS

Kenneth Watson Richards, Packanack Lake, N. J., assignor to American Telephone and Telegraph Company, a corporation of New York

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This invention relates generally to telegraph systems and, more particularly, to teletypewriter systems. This invention also relates to arrangements for reducing bias in the signals received in telegraph or teletypewriter systems.

It has been found that in telegraph subscriber sets—which may include simple telegraph repeaters together with other equipment for receiving signals from and sending signals to the switchboard of a central office—there occur substantial voltage variations in the rectified power supplied to the apparatus. These voltage variations introduce bias in the signals received by the receiving relay from the line. It would, therefore, be desirable to have the telegraph subscriber sets and like equipment made substantially independent of such power voltage variations, and thereby substantially reduce the bias and the consequent distortion in the signals received by the system.

It is, therefore, one of the objects of this invention to reduce bias in the signals received over a telegraph circuit. This may be accomplished, according to the present invention, by so connecting a non-linear structure to the system that the effect of substantial voltage variations will be reduced and practically nullified.

In one specific embodiment of the invention to be described hereinafter for illustrative purposes, a structure having a non-linear characteristic will be connected to the bias winding of the receiving relay of the telegraph system, and it will be so arranged and proportioned that as the rectified voltage varies, the current traversing the bias winding of the relay will be adjusted automatically to substantially reduce the signal bias which ordinarily accompanies such voltage variations. This will then result in more accurate signals being received by the other equipment of the system.

This invention will be better understood from the more detailed description hereinafter following, when read in connection with the accompanying drawing showing one embodiment of the invention merely for the sake of illustration.

Referring to the drawing, there is shown a line L interconnecting a simple switchboard repeater circuit with a telegraph subscriber's set which is arranged for the transmission and reception of teletypewriter signals. The switchboard repeater circuit may include, among other things, a sending relay W_1 and a receiving relay W_2, the line winding of which is connected between the armature of the sending relay W_1 and the line L. The line L is shown connected at the subscriber's set to the rectifier D over a circuit which includes a variable resistor Z_1, the upper winding of a receiving relay W_3, another resistor Z_2, a coil K and the armature and marking contact M of a pole-changing relay PC_1 which extends to the negative terminal of the rectifier D. The positive terminal of the rectifier D is connected to ground through the armature and marking contact M of another pole-changing relay PC_2. The rectifier D may be of any well-known type, and is employed to convert alternating current supplied from a suitable source into a direct current potential which is intended to be approximately of the proper magnitude. The lower or bias winding of the receiving relay W_3 is connected in a circuit which includes a variable resistor Z_3, the rectifier D, the armature and marking contact M of the pole-changer PC_2 and ground. A non-linear device R_2—which may be a Rectox unit or a thermistor—is connected across the lower or bias winding of relay W_3. The device R_2 is preferably one of large impedance employed to prevent sluggish operation of relay W_3.

The teletypewriter apparatus at the subscriber's set includes, among other things, sending equipment designated TTY_1 and receiving equipment designated TTY_2. The sending equipment TTY_1 is connected to the negative terminal of rectifier D through the upper windings of the pole-changing relays PC_2 and PC_1 and the resistor Z_4. The other side of the teletypewriter equipment TTY_1 is connected to the positive terminal of rectifier D. The lower or bias windings of relays PC_1 and PC_2 are connected to rectifier D in a series circuit which includes impedances Z_4 and Z_6 in addition to these windings. As signals emanating from the sending equipment TTY_1 traverse the upper windings of relays PC_1 and PC_2, the armatures of these relays will reverse the potential supplied by rectifier D to line L in accordance with the signals, as will be pointed out hereinafter.

The receiving portion TTY_2 of the teletypewriter has its lower terminal connected to ground through a rectifier R_3 and the armature and marking contact M of the receiving relay W_3. The upper terminal of the teletypewriter receiving equipment TTY_2 is shown connected through the armature and marking contact M of the relay PC_1 to the negative terminal of the rectifier D, the positive terminal of which is connected to ground through the armature and marking contact M of the relay PC_2. The signals received over line L by the receiving relay W_3 will be re-

peated by the movement of the armature of relay W_3 between its M and S contacts to the teletypewriter receiving magnet equipment TTY_2. Signals transmitted from the sending equipment TTY_1 will result in the alternate application of opposing potentials supplied by rectifier D to the circuit of the magnet winding TTY_2 and rectifier R_3, as will be explained hereinafter.

The lower or bias winding of receiving relay W_3 carries a current of such magnitude as to maintain the armature of the relay W_3 on its marking contact when a teletypewriter marking signal is transmitted from the subscriber's set over the line L to the switchboard repeater circuit. When a spacing signal is transmitted from the subscriber's set, the bias winding of relay W_3 will carry practically no current, but the line current traversing the upper winding of relay W_3 will be in a direction to hold its armature on its contact M. However, when signals are received from the switchboard repeater circuit over line L, the current in the upper or main winding of relay W_3, will act to overpower the effect of the current in the lower or bias winding so that the relay W_3 will respond to the received signals and its armature will then repeat the received signals into the teletypewriter receiving equipment TTY_2.

The condenser C_1 and the resistor Z_5 are connected between the lower or bias winding of the relay W_3 and the left-hand terminal of the coil K so as to balance the line L in the manner of an artificial line against the effects of transient or other extraneous voltages. The lower windings of the pole-changing relays PC_1 and PC_2 are shown connected in series with each other and with a resistor Z_6, these windings being the usual bias windings for such relays.

When signals are transmitted from the teletypewriter sending equipment TTY_1 over the line L to the distant switchboard repeater circuit, the pole-changing relays PC_1 and PC_2 will respond to these signals, the armatures of these relays closing their marking contacts M with each marking signal and their spacing contacts S with each spacing signal. Each marking signal will cause the negative terminal of the rectifier D to be connected to the line L over a circuit which includes the marking contact M and armature of relay PC_1, coil K, resistor Z_2, the upper winding of relay W_3 and the resistor Z_1. At the same time the positive terminal of rectifier D will be grounded through the armature and marking contact M of relay PC_2. When the armatures of the relays PC_1 and PC_2 close their spacing contacts with each spacing signal coming from the teletypewriter equipment TTY_1, the voltage applied to line L at the subscriber's set will be reversed so that the positive terminal of the rectifier D will be connected to the line L over a circuit which includes the spacing contact S and armature of relay PC_1, coil K, resistor Z_2, the upper winding of relay W_3 and resistor Z_1. At the same time the negative terminal of the rectifier D will be grounded through the armature and spacing contact S of the relay PC_2. Thus marking and spacing signals transmitted from the subscriber's set over line L will result in the alternate application of oppositely poled potentials to the line L which will in turn move the armature of the relay W_2 at the switchboard circuit between its M and S contacts in accordance with these signals.

Signals transmitted by the sending equipment TTY_1 of the subscriber's set will also be recorded by the teletypewriter receiving equipment TTY_2 to provide the home copy. Each marking signal will cause the negative terminal of the rectifier D to be connected through the marking contact M and armature of relay PC_1 to the upper terminal of the winding of the magnet of the receiving equipment TTY_2, the lower terminal of which is connected to ground through the rectifier R_3 and the armature and marking contact M of relay W_3. The positive terminal of the rectifier D will at the same time be connected to ground, as already described. Hence each marking signal will result in a flow of current through the magnet of the receiving teletypewriter equipment TTY_2. Each spacing signal will reverse the polarity of the rectifier D with respect to the magnet winding of the receiving teletypewriter equipment TTY_2, but the rectifier R_3 will be poled so as to oppose the flow of such current. Hence for each spacing signal there will be an absence of current in the winding of the magnet of the receiving teletypewriter equipment TTY_2. Thus home copy of the transmitted signals will be supplied by alternately reversing the potential supplied by rectifier D to the circuit of the receiving magnet TTY_2 and rectifier R_3, and the receiving apparatus will register the signals.

Signals way be received at the subscriber's set from line L in the usual way. The sending relay W_1 will move its armature between its M and S contacts so as to apply to the line L either ground or the positive potential of, for example, a battery as shown in the drawing. The potential of the battery may exceed that derived from the rectifier D. All such signals from the switchboard circuit will, as already explained, cause the armature of the relay W_3 to move between its M and S contacts, and hence the signals will be repeated to the receiving teletypewriter equipment TTY_2.

It has been pointed out that the lower or bias winding of the relay W_3 is connected to the rectifier D through a series circuit which includes an impedance Z_3. The non-linear device R_2 is shown bridging the bias winding relay W_3. With changes in voltage supplied by the rectifier D due, for example, to changes in the voltage of the source of commercial A. C. power, this non-linear network will change in impedance and, therefore, change the current through the bias winding of relay W_3. As the voltage supplied by the rectifier D increases, the impedance of the device R_2 will be reduced, and conversely, as the voltage supplied by rectifier D is reduced, the impedance of the non-linear device R_2 will be increased. The non-linear device R_2 is of such impedance that with changes in the terminal voltage of rectifier D within certain limits, the bias current will change non-linearly to reduce bias in the signals received. In one arrangement conforming to this invention, the rectifier R_2 circuit served to maintain the bias current in the lower winding of relay W_3 at approximately half the sum of the marking and spacing currents in the upper winding of relay W_3 and hence signal bias was practically eliminated.

The non-linear device R_2 may comprise, for example, a large number of copper oxide disks of small diameter, or it may comprise one or more elements of "thyrite" or one or more thermistors of well known type. It is a structure which while carrying current undergoes impedance changes with changes in the voltage of rectifier D, thereby changing the current in the bias winding of relay W_3 according to a predeter-

mined relationship. This predetermined relationship involves a current in the bias winding of relay W_3 which is closely equal to one-half the sum of the marking and spacing currents in the upper or main winding of relay W_3, as already noted hereinabove.

In place of impedance element such as R_2 in shunt with the bias winding of relay W_3, the impedance of element R_2 varying negatively with changes in the rectified voltage, a non-linear impedance element may be connected in series with the bias winding of relay W_3, the series impedance element varying positively with changes in the rectified voltage. Such a non-linear series impedance may be employed in addition to impedance Z_3 or the impedance Z_3 may itself comprise the positive non-linear series element, if so desired. The positive non-linear series element will therefore vary in the same direction as the current in the bias winding changes. The positive non-linear impedance element will preferably be so proportioned as to maintain the current in the bias winding at substantially one-half the algebraic sum of the marking and spacing line currents flowing through the upper winding of relay W_3.

The rectifier R_3 is shown shunted by a condenser C_2. This is optional in the system, but it may be added for the purpose of by-passing transients and other extraneous voltages around the rectifier.

Although the invention has been described as applied to an arrangement employing a rectified source of power voltage, it will be understood that the invention may also be applied to circuits having batteries or generators or the like for supplying the necessary D. C. voltage to the local circuits.

While this invention has been shown and described in certain particular embodiments merely for the purposer of illustration, it will be understood that the general principles of this invention may be applied to other and widely varied organizations without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. In a signaling system, the combination of apparatus for maintaining a predetermined ratio between the currents supplied to first and second circuits, the first circuit being supplied with current from a first source of potential while both circuits are simultaneously supplied with current from a second source of rectified variable potential, said apparatus including an impedance element connected in series between said second circuit and said second source, and an impedance device having a non-linear impedance characteristic connected across said second circuit.

2. In a signaling system, the combination of a source of rectified potential the magnitude of which varies, a first circuit connected to said source, a second circuit supplied with current from said source, and means for maintaining a predetermined ratio between the currents traversing said first and second circuits while the magnitude of said potential varies, said means including an impedance device connected serially between said second circuit and said source, and a non-linear impedance device also connected to said second circuit.

3. In a signaling system, the combination of apparatus for maintaining the currents traversing first and second circuits in a predetermined ratio, said apparatus including a source of rectified potential connected to said first circuit, the potential of said source being variable, an impedance interconnecting said second circuit and said source, and a non-linear device having a negative impedance coefficient connected across said second circuit.

4. In a telegraph system, the combination of a line over which signals may be transmitted, a relay having first and second windings, a source of rectified potential, the first winding of said relay being connected between said line and said source of rectified potential so that signals received over said line may be registered by said relay, an impedance element connected in a series circuit including said second relay winding and said source of rectified potential, and a non-linear device having a negative impedance charactertistic connected across the circuit of said source of rectified potential and said impedance element.

5. Apparatus for regulating the current in a translating device having first and second circuits so that the current in the second circuit is a predetermined ratio of the sum of the currents in both circuits, the second circuit being connected to a source of variable rectified potential, comprising an impedance element connected in series with said source of variable potential and said second circuit, a non-linear device connected in shunt across the circuit of said source of potential and said impedance element, said non-linear device being reduced non-linearly in impedance as the potential of said source increases and increased non-linearly in impedance when the potential of said source is reduced.

6. A telegraph station comprising a line over which telegraph signals may be transmitted, a receiving relay at said station including first and second windings, sending apparatus at said station, a source of variable rectified potential connected through said first winding to said line, said source of potential being also connected to said sending apparatus, means responsive to signals from said sending apparatus to alternately reverse the potential of said source applied through said first winding of said receiving relay to said line, receiving apparatus controlled by the armature of said receiving relay, a non-linear device, an impedance connected in series with said second winding of said receiving relay and said source of potential, the non-linear device being connected in shunt across the circuit of said source of potential and said impedance, the impedance of said non-linear device varying inversely with variations in the potential of said source.

KENNETH WATSON RICHARDS.