

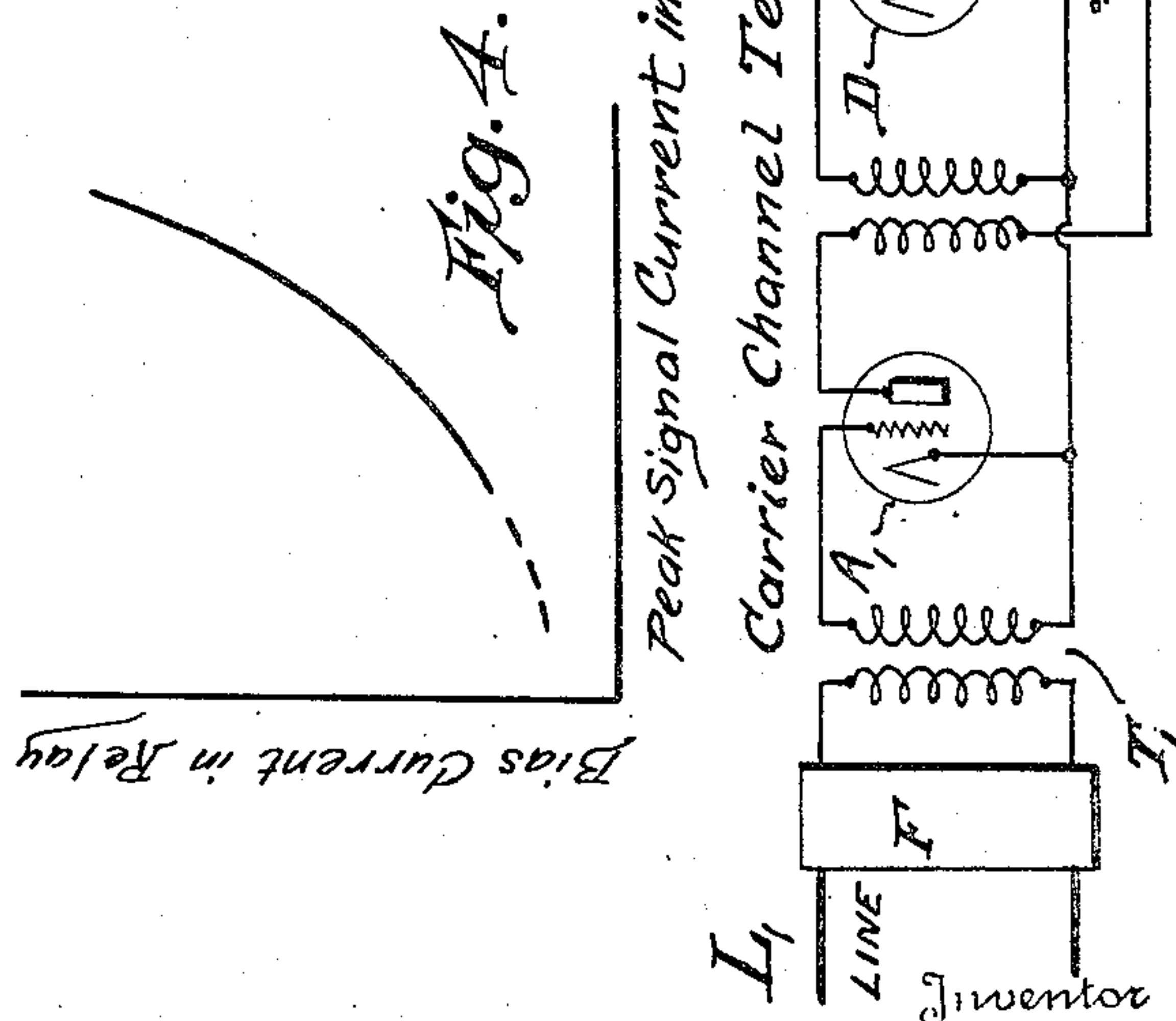
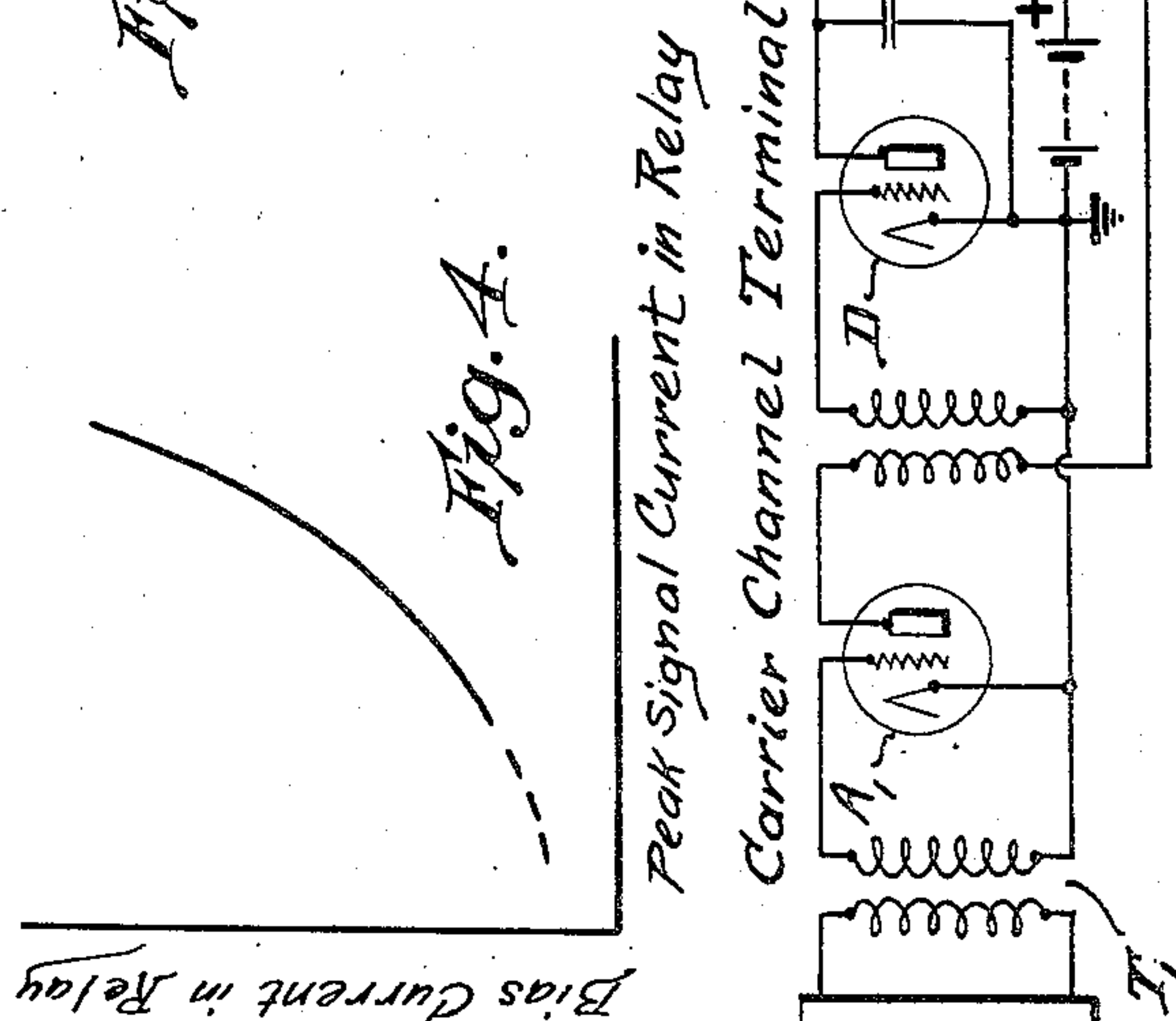
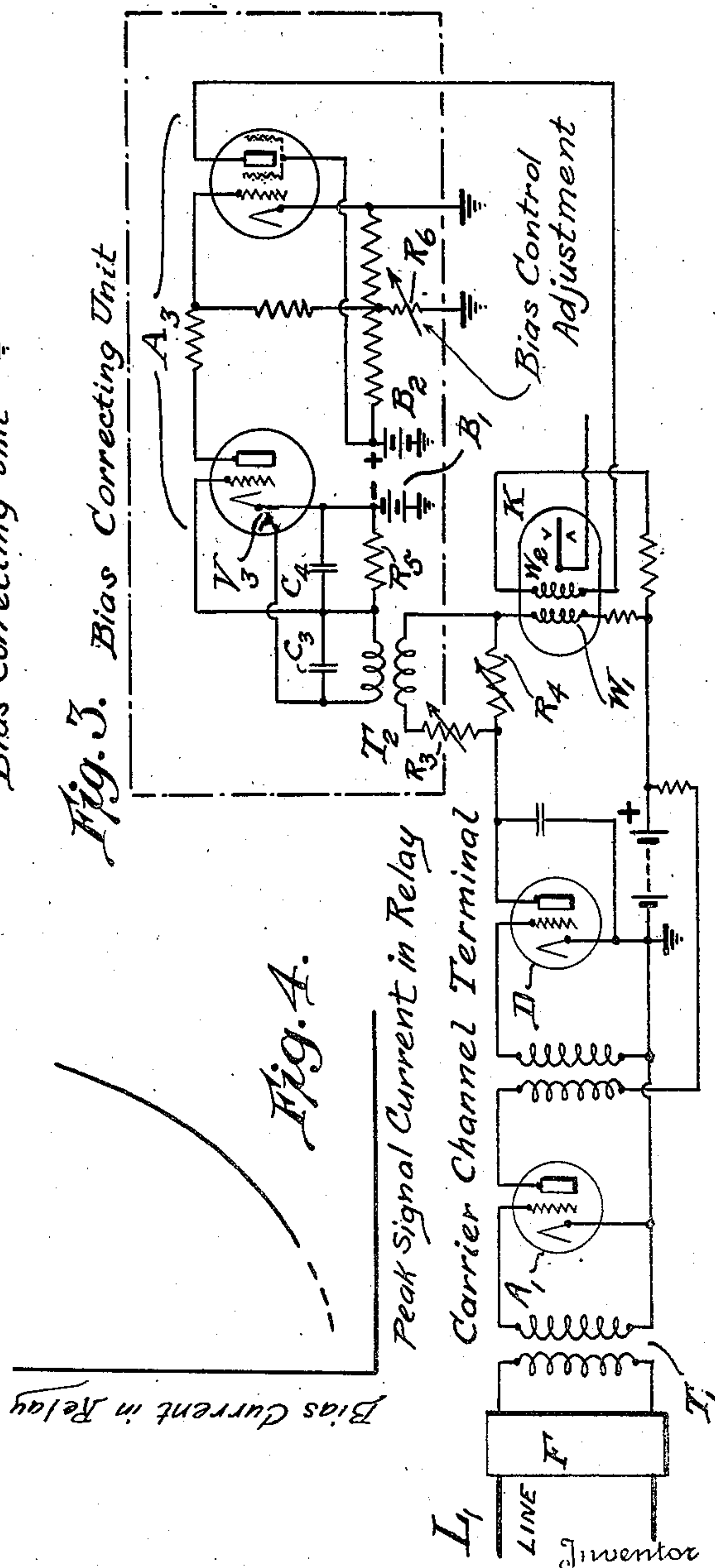
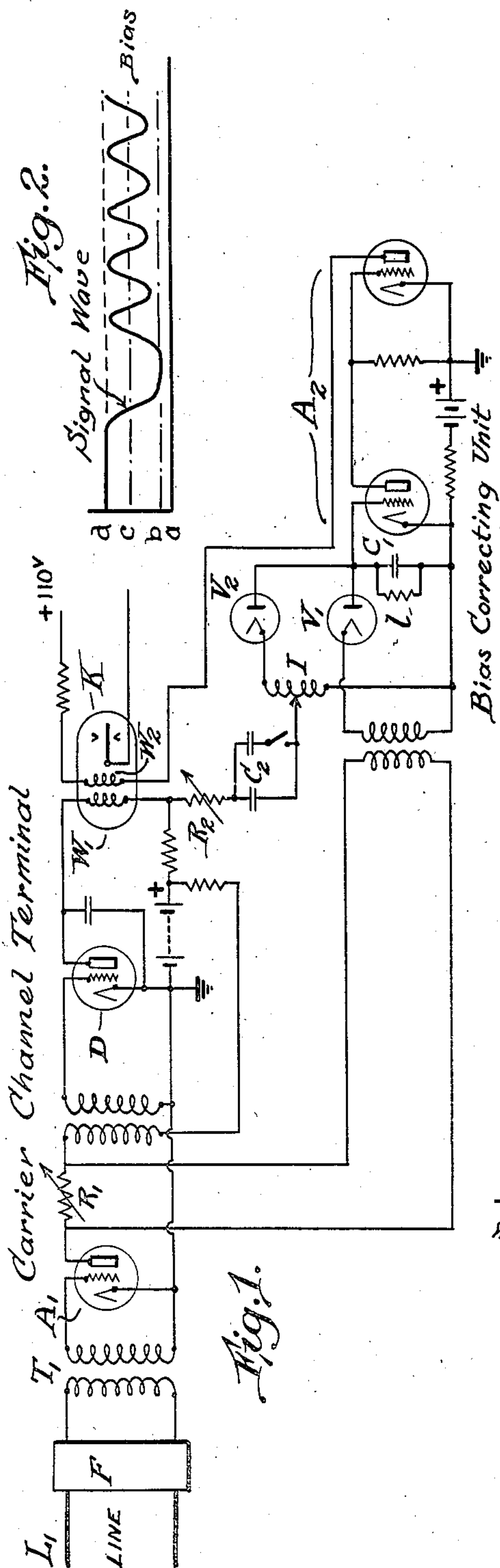
July 8, 1941.

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2,248,857

AUTOMATIC BIAS CORRECTOR

Filed Sept. 20, 1938



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2,248,857

AUTOMATIC BIAS CORRECTOR

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Application September 20, 1938, Serial No. 230,882

11 Claims. (Cl. 178—66)

This invention relates to communication systems and particularly to a method of maintaining unbiased reception under conditions of varying received signal levels.

In the operation of carrier telegraph channels over long circuits, it is common for the received levels to vary due to varying line attenuation. Line attenuation is affected by weather conditions and by faults in the wires or in the numerous electrical connections which are found in all long circuits. Other causes of varying received signal levels are inconstant amplifier battery voltages and varying generator outputs.

The principal object of our invention is to provide suitable methods and means for causing the receiving relay to invariably produce unbiased signals regardless of variations in the conditions affecting the characteristics of the transmission circuit. A further object is to provide a bias correcting means which is not dependent upon the operation of any moving part such as the armature of the receiving relay. Other and further objects will be clear from the description of the invention hereinafter given.

In carrier telegraph circuits the receiving apparatus generally comprises a receiving filter followed by an amplifier and a detector having in its plate circuit a polar relay equipped with a second or biasing winding for the purpose of securing polar operation of the relay contacts on the unidirectional plate current of the detector tube. This biasing winding normally produces a flux in the relay, which is approximately half of the full marking flux, to produce unbiased signals. It is apparent that with the biasing current fixed, any variation in the maximum level of the detector plate current will result in the production of biased signals from the relay contacts. Our invention provides a device for auxiliary connection to carrier telegraph terminal circuits for the purpose of preventing biased signals by maintaining an equality of fluxes or a proportionality of currents in the operating and biasing coils of the relay.

In the accompanying drawing,

Figure 1 is a circuit diagram illustrating one embodiment of our invention;

Figure 2 is a circuit diagram to illustrate that when a succession of short or "A. C." signals are received, the resulting biasing current is somewhat lower than the proper value as produced by the longer signals which have had time to build up to the full amplitude;

Figure 3 is a circuit diagram of another arrangement embodying our invention;

Figure 4 shows a curve illustrating the relation existing between current in the biasing winding of the relay and the peak signal current in the arrangement of Fig. 3.

In the embodiment of our invention illustrated in Fig. 1, the carrier telegraph terminal is equipped with an auxiliary arrangement in which a portion of the amplified carrier current voltage is rectified and applied to the grid of a vacuum tube amplifier which in turn controls the biasing current. The carrier current signals incoming over the line L_1 pass through the filter F , transformer T_1 and amplifier A_1 . The voltage across the resistance R_1 is transmitted to the bias correcting unit and the rectified voltage from the rectifier V_1 is then applied to the grid of the first tube of the amplifier A_2 . Across the grid circuit of said first stage of the amplifier, there is provided a condenser C_1 and a leak l for the purpose of sustaining grid voltage during non-signaling periods. The second tube of the amplifier A_2 , directly coupled to the first, serves primarily to invert the sense in which the amplifier functions. This is made necessary since if thermionic rectifiers are employed, the anode must be connected adjacent to the grid and the plate current of the first tube is therefore a minimum when the signal voltage is a maximum. As is well known, the phase of the signal current in a resistance coupled amplifier is reversed in alternate stages.

When properly adjusted, the circuit just described provides a substantially constant current in the biasing winding W_2 of the relay K , while the circuit is in the marking condition or is carrying signals interrupted at a fairly rapid rate. Should the signalling circuit remain open for several seconds, the bias current will decrease at a slow rate toward a relatively low value but is quickly restored upon receipt of the initial signals. This arrangement is sufficient to maintain a proper bias current for ordinary random signals of varying length. However it sometimes occurs that an extended succession of short signals or "A. C." may be received particularly during test or "line up" periods. Since it is customary to operate carrier telegraph channels at such a speed that the shortest or dot signals do not have time to build up to full amplitude as do the longer signals, a succession of "A. C." signals will produce a biasing current somewhat lower than the correct value. This is illustrated in Fig. 2. It is seen here, that for long signals, a signal wave reaches certain maximum and minimum values, but for short signals

these values are not reached, although a practically identical value of bias current is required for both conditions.

It will be evident that a low value of current in the bias winding of the relay due to A. C. signals will not be sufficient to correctly operate the relay and cause it to produce unbiased signals. In order to prevent a wrong value of bias current from this cause, an additional feature is provided in the bias correcting unit or device. This comprises a second input circuit including a rectifier V_2 , which is supplied with demodulated telegraph signals from the output of the detector D. This circuit, comprising a resistance R_2 , capacity C_2 and inductance I , is broadly tuned to the maximum telegraph speed of the channel and during periods when A. C. is being received, an additional voltage is thereby furnished to the bias regulator in order to maintain a value of bias current somewhat higher than that determined by the carrier frequency level of the A. C. signals alone.

In the embodiment of our invention illustrated in Fig. 3, we have shown a carrier channel terminal of conventional type with a bias corrector unit which may conveniently be integrally associated with the terminal. In this case the relay bias is controlled by the peak level of the detected signals only. The rectifying element is included as a part of the first amplifier stage tube of the correcting unit.

Referring to the arrangement shown in Fig. 3, in the output circuit of the detector tube D, a transformer T_2 and a regulating resistance R_3 are serially included. The purpose of the resistance R_3 is to adjust the frequency characteristic of the transformer so that the peak secondary voltage is substantially constant in amplitude over a range of frequencies up to the highest telegraph frequency at which the channel is being worked. This factor eliminates the need for the auxiliary A. C. circuit employed in the arrangement of Fig. 1. The resistance R_4 is for the purpose of maintaining the proper voltage output from the secondary side of this transformer as the resistance R_3 is varied. On the secondary side of this transformer there is included a rectifying element V_3 inclosed within the tube of the first amplifier stage of the corrector unit. The condenser C_3 serves merely to by-pass any current of the carrier frequency which may have passed through the transformer. The unidirectional currents, flowing through the rectifier V_3 , charge condenser C_4 to a value proportional to the peak secondary voltage. This voltage is impressed on the grid of the first tube of the corrector to produce a substantially constant output current. Resistance R_5 serves to slowly dissipate the charge on C_4 so that its potential closely follows the transformer secondary peak voltage.

With the rectifier V_3 connected as shown, a high potential input voltage produces a low current output which is the reverse condition of that desired. Accordingly, a second amplifier tube is employed for the purpose of inverting this current relation so as to supply a bias current to the receiving relay K which is continuously proportional to the signal currents traversing the main line winding of the relay. The particular combination of resistances and potentials employed may vary depending upon the types of tubes used and the available potentials. The arrangement shown employs positive and negative grounded batteries B_1 and B_2 of approximately 110 volts in

conjunction with two standard types of vacuum tubes.

When installing the bias corrector unit, adjustments of resistances R_3 , R_4 and R_5 , are made to adapt the system for proper functioning under the particular signal speed, tubes, potentials, relays, and other conditions of the particular circuit. After initial adjustments, the ordinary "line up" procedure involves only the adjustment of resistance R_5 to provide unbiased signals for the particular working speed of the channel.

In general, it has been assumed that the flux produced by the biasing winding of the relay should be approximately half the peak flux produced by the main line winding at all times, that is, that a linear relation existed between the two. It is found in practice, however, that this relation is not entirely linear but, due to peculiarities of the detector tube and relay, this relation is somewhat as indicated in Fig. 4. It becomes desirable then to introduce into the bias control circuit an element having similar characteristics. This is accomplished in the arrangement of Fig. 3, by employing a tetrode tube in the final stage of the amplifier A_3 . As is well known, a low impedance connection for the screen element of this tube to a positive potential somewhat higher than that of the plate, will produce a curved relation between input potential and output plate current. It is found in practice that an excellent match is obtained between characteristics of the tube and of the relay. A further advantage in the use of the tetrode tube lies in the fact that its plate current is independent of plate voltage within certain limits. It is observed that the biasing winding of the relay K is closed through the plate circuit of the final tube of the amplifier. This biasing winding is subject to transient currents superimposed upon the steady biasing current and produced by the flow of signal currents in the main line winding W_1 , as a result of transformer action between the windings in the relay. These transients constitute a signal loss and in limiting them by virtue of the high apparent impedance of the biasing circuit this loss may be very largely reduced.

It has been found in practice that the system described in Fig. 3 provides substantially unbiased signals through all ordinary variations in received signal level. During long non-signalling periods the bias current will drop somewhat below the signal current value but it instantly steps upward to normal value upon the resumption of signalling. The value of the minimum current and the rate of increase may be so adjusted that no loss results to the initial signal in types of signalling where this feature is important. In general, a compromise adjustment is sought which will avoid initial loss to signals and at the same time will not render the system unduly susceptible to heavy interference currents which may exceed the normal signalling levels.

The bias correcting device described herein has been found quite effective in preventing circuit interruptions due to wide variations in received levels. While an individual corrector for each channel is indicated in the drawing, it is possible to serve the relays of adjacent channels with biasing current from the same source.

We claim:

1. The method of continuously maintaining the proportionality of a direct current flowing through one winding of a polar relay and the maximum amplitude of signaling current flowing through another winding of said relay in

carrier telegraph circuits, which consists in controlling the amplitude of the current flowing in said first winding by the received carrier signaling currents when the signals are of maximum length and supplementing said control by demodulated telegraph signals when minimum length signals are received.

2. The method of continuously maintaining the proportionality of a direct current flowing through one winding of a polar relay and the maximum amplitude of signaling current flowing through another winding of said relay in carrier telegraph circuits, which consists in controlling the amplitude of the current flowing in said first winding by the conjoint operation of the received carrier signaling currents and demodulated telegraph signals.

3. The method of continuously maintaining the proportionality of a direct current flowing through one winding of a polar relay and the maximum amplitude of signaling current flowing through another winding of said relay in carrier telegraph circuits, which consists in controlling the amplitude of the current flowing in said first winding by augmenting the normal current flowing in said first winding under the control of rectified components of the demodulated telegraph signals.

4. In a signaling system in which the strength of the received signals incoming over a line is subject to change from time to time, a relay having first and second windings each capable in the absence of the other, of operating its armature in mutually opposite directions, means for impressing unidirectional pulses corresponding to telegraph signals through the first winding, a source of direct current connected to the second winding, an amplifier having its input connected to receive incoming signaling currents and its output connected to said second winding and a rectifier associated with the input of said amplifier acting continuously under control of the received signaling currents to maintain proportionality between the currents flowing in the first and second relay windings.

5. In a signaling system in which the strength of the received signals incoming over a line is subject to change from time to time, a relay having two opposed windings, namely, an actuating winding connected to receive telegraph signal impulses from said line and a biasing winding connected to a source of direct current and capable in the absence of the other winding of operating the armature, an amplifier having its output connected in series with said biasing winding and a rectifier connected to the input of said amplifier and connected to receive said signal impulses, to thereby vary the current flowing in the biasing winding in a manner corresponding to the variations in the strength of the telegraph signal impulses.

6. In a signaling system in which the strength of the received signals incoming over a line is subject to change from time to time, a relay having two opposed windings, an actuating winding connected to receive telegraph signal impulses from said line and a biasing winding connected to a source of direct current, an amplifier having its output connected in series with said biasing winding, a transformer having its primary winding connected to receive detected telegraph

signal impulses and its secondary connected to the input of said amplifier, and means to adjust the frequency characteristic of said transformer so that the peak secondary voltage is substantially constant in amplitude over a range of frequencies covering the highest frequency of the received telegraph signal impulses.

7. In a signaling system in which the strength of the received signals incoming over a line is subject to change, a relay having two opposing windings one of which is connected to receive telegraph signals from said line, a source of direct current connected to the other relay winding, an amplifier having its output in series relation with said source of direct current and said relay winding, and means resonant to a predetermined frequency of signal impulses acting to automatically control the amplification of the amplifier to thereby maintain equality of fluxes produced by the currents flowing in said relay windings.

8. In a system for the prevention of bias in signals transmitted over a carrier telegraph channel which result from changes in the transmission equivalent of the line, a polar relay having an actuating winding connected to receive signal impulses, and a biasing winding in opposing relation to said actuating winding, means for transmitting unidirectional telegraph signal impulses to said actuating winding, a source of direct current normally supplying current to said biasing winding, an amplifier having its output circuit connected to said biasing winding, means for rectifying a portion of the telegraph signal impulses and applying the resulting direct current impulses to the input of said amplifier to thereby maintain a proper current through the biasing winding.

9. In a system for the prevention of bias in signals as set forth in claim 8, means in the bias control circuit having characteristics which operate to correct any departure from a linear relation between the fluxes produced by the currents in the opposing relay windings.

10. In a system for the prevention of bias in signals as set forth in claim 8, said biasing current being substantially independent of voltage changes in said output circuit.

11. In a system for the prevention of bias in signals transmitted over a carrier telegraph channel which result from changes in the transmission equivalent of the line, a polar relay having a first winding connected to receive signal impulses and a second biasing winding in opposing relation to the first winding, means for transmitting unidirectional telegraph signal impulses to the first winding, a source of direct current connected to said biasing winding, an amplifier having its output circuit connected to said biasing winding, means for applying a rectified portion of the carrier telegraph signals to the input of the amplifier when the received signals are of maximum amplitude and means for automatically adding thereto a rectified portion of the demodulated telegraph signals when they are of minimum amplitude to thereby maintain a correct unbiased operation of the relay armature under varying conditions affecting the reception of signals.

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