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TRANSMISSION REPEATING SYSTEM FOR RADIO AND CARRIER TELEGRAPH SYSTEMS

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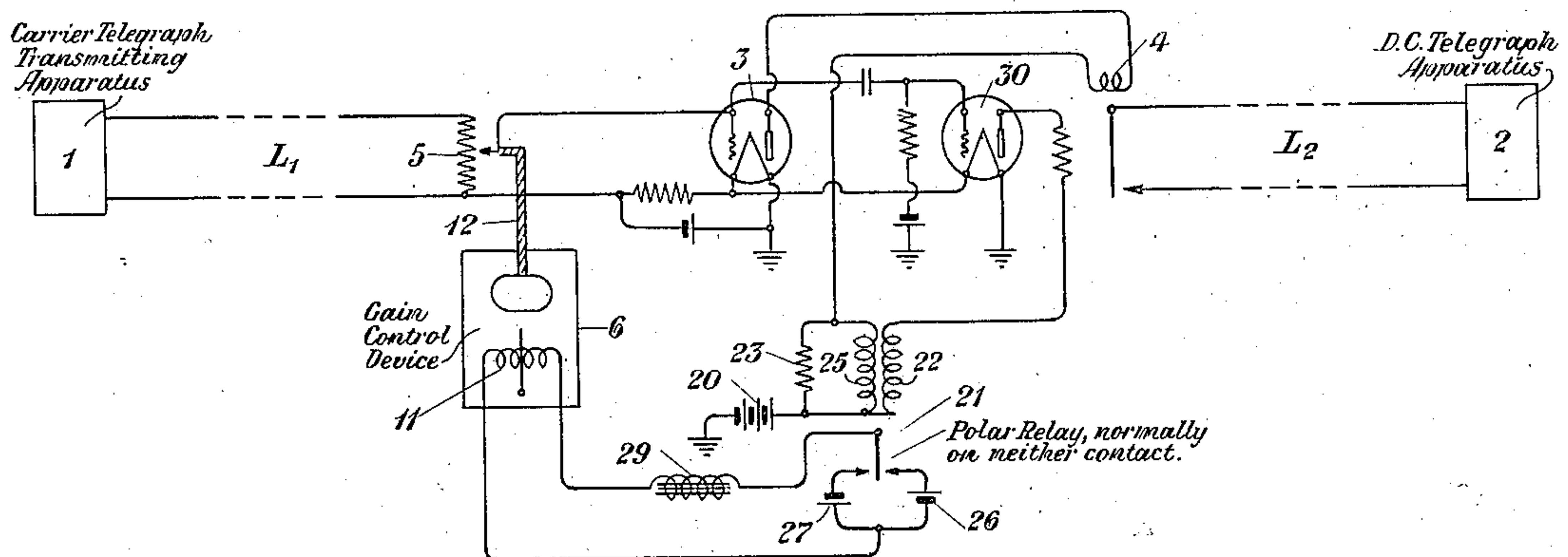


Fig. 1

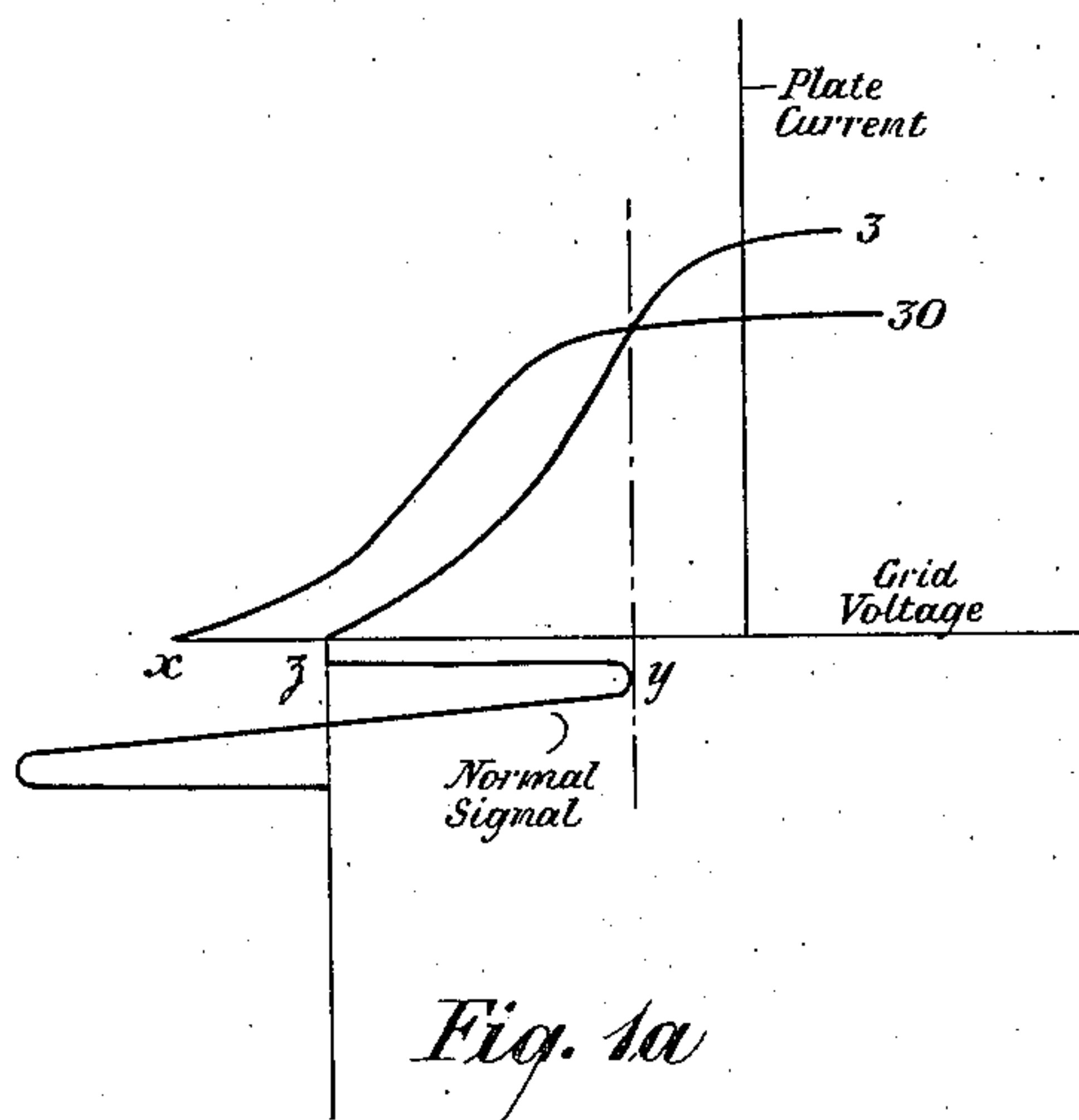


Fig. 1a

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TRANSMISSION REPEATING SYSTEM FOR RADIO AND CARRIER TELEGRAPH SYSTEMS.

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This invention relates to a transmission regulating system for radio and carrier telegraph systems, and particularly to a system of the type in which the gain of the amplifier is varied by and in accordance with changes in the signaling current itself to compensate for changes in the line characteristics.

In high frequency telegraph systems, which term is intended to include both radio and carrier systems, it has been customary to employ means for automatically changing the gain of the amplifiers in the circuit to compensate for changes in its transmission equivalent. Heretofore it has been customary to transmit a control current consisting of a single frequency, lying outside of the band of signaling frequencies, and to utilize this control current to operate the regulating device, by means of which the amplifier gain is varied. This control current, which is termed in the art a "pilot channel," utilizes a portion of the frequency spectrum that might otherwise be employed for the transmission of signals. Consequently, if the regulation of the amplifier gain can be effected by changes in the signal voltages themselves, the use of a pilot channel is rendered unnecessary and a saving will result.

In the copending application of R. W. Deardorff, Serial No. 138,977, filed Oct. 1, 1926, there is described a system by means of which the amplifier gain of a radio or carrier telegraph system may be varied in accordance with changes in the voltage of the signaling channels themselves to compensate for changes in the transmission equivalent of the system, the regulator utilizing three vacuum tubes which are acted upon by the signal voltage itself, which tubes serve to operate a gain control device in the input of the amplifier.

The present invention is a modification of that disclosed by Deardorff, and consists in effecting the control of the amplifier gain by means of a regulator requiring only two vacuum tubes.

Other objects of this invention will be apparent from the following description, when read in connection with the attached drawing, of which Figure 1 shows schematically a simple form of embodiment of the invention, and Fig. 1^a is a graph illustrating the principle underlying the invention.

In Fig. 1 the transmitting apparatus 1 is connected with the line L_1 in order to transmit thereover carrier telegraph signals. This transmitting apparatus may be of any well-known type for producing carrier signals in which a marking impulse consists of a train of high frequency oscillations and a spacing impulse consists in the suppression of such oscillations, or vice versa. Bridged across the line L_1 at the receiving station, at a point between the sending and receiving stations, is a potentiometer 5 which is connected with the grids of the tubes 3 and 30. The voltage applied to the said grids by the potentiometer may be varied by movement of its contact point, which is controlled by the arm 12 of a gain control device 6. This device, which is shown schematically in the drawing, is a modification of a Leeds and Northrup recorder described in the patent to Leeds, 1,125,699, dated January 19, 1915, the modification consisting in the replacement of the pen which is normally employed for the production of a record, with a contact point engaging the wire of the potentiometer. This type of electrical recorder is also described in Bulletin No. 871, of the Leeds and Northrup Company, published in 1921. In an arrangement of that type the flow of current through the coil 11 in a given direction will cause the arm 12 to move in a definite direction, and the magnitude of its motion will be dependent upon the strength of the current in the coil. Likewise a reversal of the current through the coil 11 will cause the arm 12 to move in the opposite direction. The plate circuit of the tube 3, which effects rectification and amplification of the marking impulses, extends from the grounded battery 20 through the winding 25 of relay 21 and through the shunt 23, thence through the winding of relay 4 to the plate of the tube. Relay 4 serves to transmit the rectified impulses over the line L_2 to the direct current telegraph apparatus 2 connected therewith. The plate circuit of the tube 30 extends from the grounded battery 20 through the winding 22 to the plate of that tube. The armature of relay 21 is connected through the retardation coil 29 with one side of the operating winding 11 of the gain control device 6, and the other side of this winding is connected with the contacts of relay 21, the latter connection including oppositely poled batteries 26

and 27. The arrangement is such that when the armature of relay 21 is upon one contact, current will flow through the winding 11 in such direction as to cause the arm 12 to move in a predetermined direction, and when the armature of relay 21 moves to its other contact, current through the winding 11 will be reversed and the arm 12 will move in the opposite direction.

10 The principle underlying this invention, by virtue of which it is possible to effect regulation of the gain control device by means of two vacuum tubes, will be clearly seen by referring to Fig. 1^a, which represents the
15 well-known relationship between the grid voltage and the plate current of a vacuum tube. From this figure it will be seen that tube 3 has a different characteristic from tube 30. In this invention the grid biasing
20 voltages of the tubes have been so chosen as to cause the characteristics to cross at some fixed voltage. It is, of course, obvious that at the point where the characteristics cross, the same plate currents flow in the output
25 circuits of the tubes, each of which includes a winding of the polar relay. The winding 25 is shunted by the resistance 23 so that the flux produced by the current through that winding will be equal and opposite to that
30 produced by the current in the winding 22 when the normal signal is applied to the grids of tubes 3 and 30. The result of this is that for the normal signaling voltage the armature of the relay 21 will be unaffected
35 and the gain control device 6 will remain unoperated. If the signal voltage decreases below normal, the plate current through the winding 22 of tube 30 will be greater than that through the winding 25 of tube 3, as
40 will be readily seen in Fig. 1^a. Consequently, the armature of relay 21 will be moved to one of its contacts, which will cause current to flow through the winding 11 and the arm 12 will be moved in such a
45 direction as to increase the voltage applied to the grids of the tubes 3 and 30. As soon as the voltage applied to the grids is equal to γ of Fig. 1^a, the armature 21 will be restored to its normal midposition by virtue
50 of the equal opposing fluxes produced by the windings 22 and 25. On the other hand, if the signaling voltage is greater than the normal value, γ , the current through the winding 25 will be greater than that through
55 the winding 22. This will cause the armature 21 to move to its other contact, which will cause current to flow through the winding 11 so as to move the arm 12 in such direction as to reduce the voltage applied to
60 the grids of the tubes 3 and 30 to that represented by γ of Fig. 1^a. When this condition exists the armature of relay 21 will again return to its normal midposition.

It will be seen that by means of the arrangement shown and described above, the

current applied to the relay 4 which controls the transmission of the rectified impulses over the line L_2 , may be kept substantially constant regardless of variations in the transmission equivalent of the line L_1 over which the high frequency telegraph impulses are transmitted. And it will further be seen that by using tubes having grid voltage-plate current characteristics that cross at a predetermined grid voltage, it is possible
75 to effect complete regulation of the gain control device by an arrangement employing only two vacuum tubes.

This invention has been disclosed as applied to a carrier telegraph system, but it is, of course, obvious that it is equally applicable to a radio system since the transmitting device 1 may be connected with a sending antenna, and the potentiometer 5 may be bridged across a receiving antenna. Accordingly, wherever the term "high frequency telegraph impulses" has been employed, it should be understood to cover either a carrier or a radio system.

While the invention has been disclosed as embodied in a particular form, it is capable of embodiment in other forms without departing from the spirit and scope of the appended claims.

What is claimed is:

1. In a telegraph system in which a mark is transmitted by a train of waves of fixed normal amplitude and a space by the suppression of such waves, or vice versa, the combination with a source of alternating current of two vacuum tube rectifiers having their input circuits connected in parallel with the said source, the said tubes having dissimilar grid voltage-plate current characteristics such that the plate currents of both tubes will be equal when the normal alternating voltage is applied to the grids of both tubes and will be unequal for all other values of grid voltage, means to apply a voltage to the plates of the said tubes, an electro-responsive device having a winding individual to each plate circuit, the windings being oppositely poled, and means controlled by the said electro-responsive means to vary the input voltage of the said tubes inversely with changes in the plate currents.

2. In a telegraph system in which a mark is transmitted by a train of waves of fixed normal amplitude and a space by the suppression of such waves, or vice versa, the combination with a source of alternating current of two vacuum tube rectifiers having their input circuits connected in parallel with the said source, the said tubes having dissimilar grid voltage-plate current characteristics, means to negatively bias the grids of both tubes, the degree of bias of one tube being different from that of the other, the difference being such that the plate currents of both tubes will be equal when the

normal alternating voltage is applied to the grids thereof and will be unequal for all other values of grid voltage, means to apply a plate potential to the said tubes, an electro-responsive device having a winding individual to each plate circuit, the windings being oppositely poled, and means controlled by the said electro-responsive means to vary the input of the said device inversely with changes in the plate currents.

3. In a telegraph system in which a mark is transmitted by a train of waves of fixed normal amplitude and a space by the suppression of such waves, or vice versa, the combination with a source of alternating current of two vacuum tube rectifiers having their input circuits connected in parallel with the said source, the said tubes having dissimilar grid voltage-plate current characteristics, means to negatively bias the grids of both tubes, the degree of bias of one tube being different from that of the other, the difference being such that the plate currents of both tubes will be equal when the normal alternating voltage is applied to the grids thereof and will be unequal for all other values of grid voltage, means to apply a plate potential to the said tubes, an electro-responsive device having a winding individual to each plate circuit, the windings being oppositely poled, a regulating device

controlled by the said electro-responsive device, and a potentiometer controlled by the said regulating device to vary the input voltage of the said tubes inversely with changes of the plate currents.

4. In a carrier telegraph system, the combination with a source of alternating current of a transmitting medium over or through which the said current may be transmitted and a receiving circuit upon which said current may be impressed, said circuit comprising a plurality of thermionic rectifiers having dissimilar grid voltage-plate current characteristics, means to bias negatively the grids of said tubes to such degree that for the normal received alternating voltage the plate currents of both rectifiers will be of the same magnitude, an electromagnetic switching device having a winding individual to and connected with the plate circuit of each rectifier, the said device being unoperated for normal alternating voltage, and a voltage controlling device connected with and controlled by the said switching device, the said voltage controlling device being arranged to restore the input voltage of said rectifiers to normal.

In testimony whereof, I have signed my name to this specification this 17th day of August, 1926.

ROBERT H. CLAPP.