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TELEGRAPH SYSTEM

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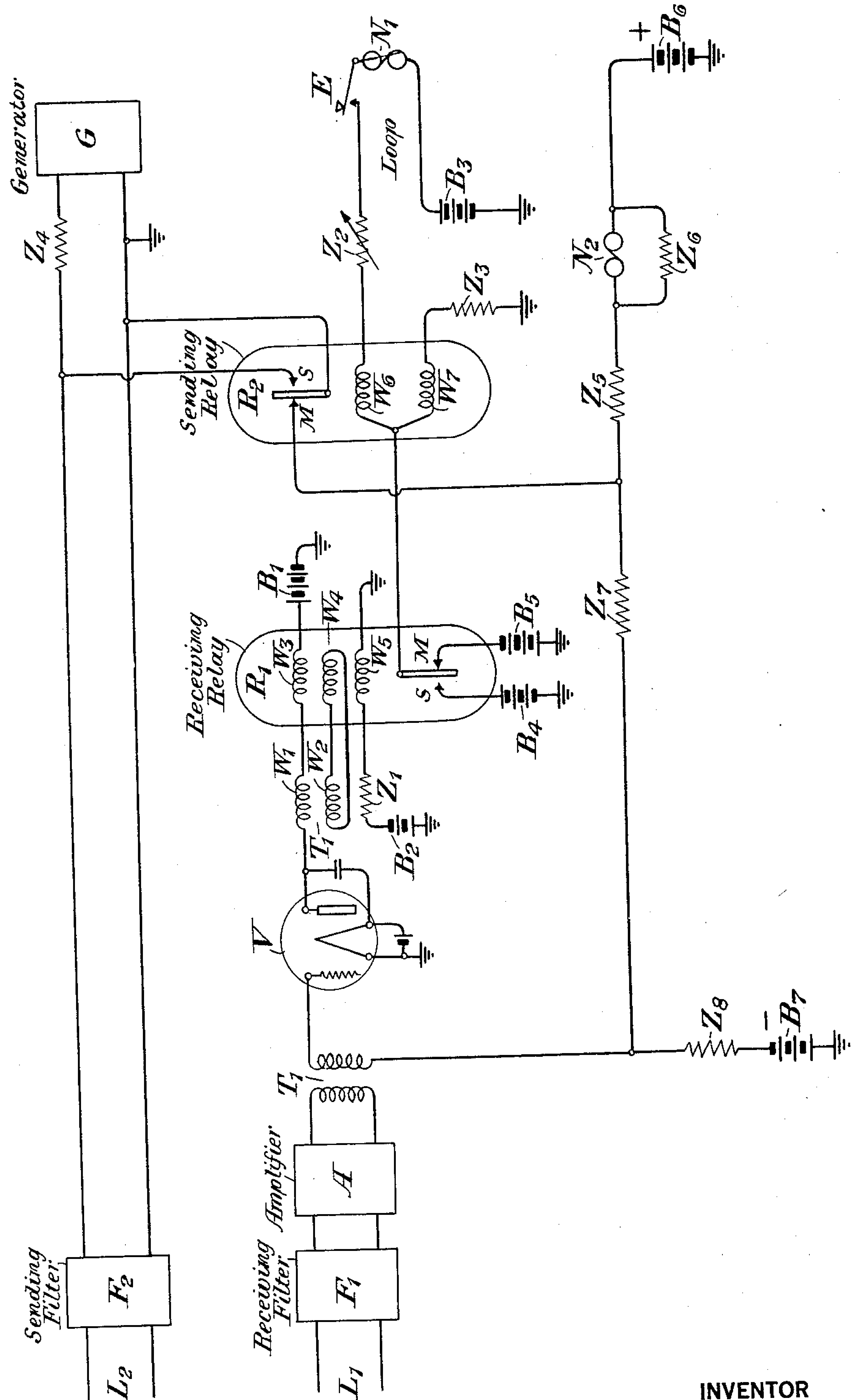

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TELEGRAPH SYSTEM

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This invention relates to telegraph systems and particularly to "breaking" arrangements for such systems.

In telegraph systems the circuits are usually arranged so that an operator may interrupt or "break" another operator sending signals from some distant point in the telegraph circuit in order to obtain control of the circuit. The usual method of "breaking" the circuit is for the operator to open his key for a short interval of time. It is essential that the circuits be arranged so that the first opening of the operator's key will cause a clean cut spacing signal to be transmitted to the sending operator, thereby interrupting his sending of signals. When this occurs the sending operator's loop will be in the spacing condition even when his key is closed.

It is in general the object of this invention to provide improved arrangements for this apparatus by providing at a telegraph station arrangements whereby the armature of the receiving relay is maintained on its marking contact whenever the armature of the sending relay is on its spacing contact, thus rendering the incoming signals to the receiving relay ineffectual to the loop circuit and allowing a spacing signal to be transmitted to the sending operator, the spacing signal causing like battery polarities to be connected to both ends of the loop circuit and interrupting the sending.

The "breaking" feature of a telegraph system is generally accomplished by a break relay which forms equipment furnished in addition to the sending and receiving relays of the telegraph repeater. Another object of this invention is to eliminate this additional equipment, that is, the break relay, and to accomplish the purpose of such a relay by means of the sending relay, receiving relay and associated circuits.

While this invention will be pointed out with particularity in the appended claims, the invention itself, both as to its further objects and features, will be better understood from the detailed description hereinafter following, when read in connection with the accompanying drawing which shows one embodiment of the invention given merely for the purpose of illustration.

Referring to the drawing, there is shown one terminal of a carrier telegraph channel at which there is a line L_1 over which signals coming in from a distant station may be received and a line L_2 over which signals may be transmitted to a distant station. The received currents from line L_1 flow through a receiving filter F_1, an amplifier A, and to a vacuum tube V by means of transformer T. It will be apparent that pulses of alternating current corresponding to telegraph signals will appear in the input circuit of the tube V.

The output circuit of the tube V includes the battery B_1, the main line winding W_3 of the polar receiving relay R_1, the primary winding W_1 of a kick transformer T_1, the plate and filament electrodes of the tube V and ground. The tube V is employed to act as a rectifier, and by virtue of its rectifying properties the current flowing in its output circuit will be a direct current, interrupted in accordance with the telegraph signals. Each pulse of alternating current in the input circuit of the tube V will produce a corresponding direct current pulse in the output circuit of the tube V.

The receiving relay R_1 includes, in addition to the main winding W_3, a kick winding W_4, and a biasing winding W_5. The winding W_5 is connected in a series circuit which includes a battery B_2, a resistance Z_1, the winding W_5 itself, and ground. Current flows continuously through the latter circuit and the effect produced by winding W_5 tends to move the armature of the relay R_1 toward its spacing contact S, and if this armature is already on the spacing contact S the magnetic effect of winding W_5 will tend to hold it on this contact. The magnitude of the biasing effect of winding W_5 is generally about one-half the magnetic effect which may be produced by the winding W_3 and, moreover, the effects of windings W_3 and W_5 which are mutually opposite.

The kick winding W_4 of the receiving relay R_1 is connected to the secondary W_2 of transformer T_1, the only purpose being to aid or accelerate the movement of the armature between contacts M and S. As an incoming pulse of carrier causes a current to build up in the output circuit of tube V, a secondary pulse of current flows through windings W_2 and W_4 in a direction which aids the movement of the armature of the receiving relay R_1 from contact S to contact M. Similarly, when the incoming pulse of carrier is dying away, a secondary pulse is introduced in the opposite direction in the circuit of windings W_2 and W_4 and aids the movement of the armature of relay R_1 from contact M to contact S.

The armature of receiving relay R_1 is connected to the midpoint of a balanced loop circuit, one branch containing winding W_6 of the sending relay R_2, a variable resistance Z_2, and a loop circuit which includes a telegraph key E, a sounder N_1, and a battery B_3 as well as ground, the other branch containing winding W_7 of the sending relay R_2 and a fixed resistance Z_3 as well as ground. The resistance Z_3 is simply used for balancing purposes. The key E and the sounder N_1 may be considered the equipment at a local station and this circuit is generally known as a loop. The resistance Z_2 is generally adjusted so that the resistance of

the loop conductors as well as sounder N_1 will be equal to the fixed resistance Z_3. A longer loop will, of course, require less resistance at Z_2.

The contacts of the armature of relay R_1 are designated M and S, and these are generally known as marking and spacing contacts, respectively. These contacts are connected to oppositely poled batteries B_4 and B_5, both of which are grounded. When the armature of the relay R_1 is in its mid-position and free from its contacts M and S and key E is open, no current will flow through the windings W_6 or W_7 of the sending relay R_2. When the contact M of the relay R_1 becomes closed and key E at the loop is also closed, current will then flow through the winding W_6 of the relay R_2 and its magnitude will be about twice as great as that flowing through the winding W_7. Since the magnetic effects of windings W_6 and W_7 are arranged to be mutually opposite, and since the magnetic effect of winding W_6 is greater, it will tend to move the armature of the relay R_2 towards its marking contact M or to hold it on contact M if it is already there. When the armature of the relay R_1 closes its spacing contact S, the magnetic effect of the winding W_7 will be reversed, tending to maintain the armature of the relay R_2 closed against its marking contact M. While this condition exists the battery B_4, which is connected to the spacing contact S of the relay R_1, will oppose the battery B_3. If key E is closed, since the voltages of these batteries, i. e, batteries B_3 and B_4 are practically equal to each other, no current will flow through the winding W_6. If the key E is open, no current will flow through the winding W_6 of the relay R_2 as was the case when the key E was closed.

It will be seen that as long as the key E is open there will be no magnetic effect whatever in the winding W_6 of the sending relay R_2. Under this condition the magnetic effect of the winding W_7 of the relay R_2 would be dependent upon the position of the armature of the relay R_1. If the armature of the relay R_1 is on its marking contact M, the armature of the relay R_2 will go to its spacing contact. However, if the armature of the relay R_1 is on its spacing contact the armature of the relay R_2 will go to its marking contact. Thus, when the winding W_6 of the relay R_2 becomes effectively deenergized, the armature of the relay R_2 will close its spacing contact S when the armature of the relay R_1 closes its marking contact, and conversely the armature of the relay R_2 will close its marking contact M when the armature of the relay R_1 closes its spacing contact S.

Under these conditions if a "break" feature, which will be described hereinafter, were not incorporated in the system, signals received over the circuit L_1 would be retransmitted over the circuit L_2 in reversed form, and this would occur for a period of time which depends upon the length and characteristic of the line circuit.

The armature of the relay R_2 and its spacing contact S lead to an alternating current generator G which is connected in series with a resistance Z_4. The generator G and its resistance Z_4 are also connected to a sending filter F_2, which extends to the output circuit L_2, and the circuit L_2 leads to a distant station. Just as the circuit L_1 receives alternating current signaling pulses from a distant station so the circuit L_2 sends alternating current signaling pulses to a distant station, which may be, and preferably is, the same station connected or coupled to the circuit L_1. Thus, it will be seen that the circuits L_1 and L_2 form a four-wire arrangement suitable for the transmission of pulses of alternating current in opposite directions between a pair of stations.

It is to be noted that when the spacing contact S of the relay R_2 is closed by its armature, the generator G will be short-circuited through the resistance Z_1, and practically no current will flow from the generator G through the filter F_2 over the circuit L_2. When the contact S of the relay R_2 is open, alternating current will be transmitted from the generator G through filter F_2 and over the circuit L_2. Thus, signals composed of pulses of alternating current may be transmitted over the circuit L_2 in accordance with the operation of the armature of the relay R_2.

The armature of the relay R_2 is grounded. The contact M of the relay R_2 is connected to a circuit containing resistance Z_5, a telegraph sounder N_2 shunted by resistance Z_6, a positive battery B_6, and ground. The contact M is also connected to a circuit containing resistance Z_7, which is also in turn connected to the grid circuit of the tube V and to resistance Z_8 and negative battery B_7. Normally the grid circuit of the tube V is held at a negative potential of about 40 volts to allow the tube to operate as a rectifier. This potential is applied to the grid of the tube V through the winding of transformer T_1, the resistance Z_8, and negative battery B_7. When the armature of the sending relay R_2 is on its marking contact M, a ground is connected to the circuit between resistances Z_5 and Z_7. This will cause a small current to flow in the circuit from the battery B_7 through resistances Z_8 and Z_7, and to ground at contact M and the armature of relay R_2. The resistances Z_7 and Z_8 of the order of megohms are so proportioned that this small current will cause a voltage drop in resistance Z_8 which when added algebraically to the voltage of battery B_7 will provide the correct negative grid bias for the tube V to operate as a rectifier, that is, approximately 40 volts. It is thus apparent that under this condition the tube V can operate in a normal way as a rectifier, and each pulse of alternating current in the input circuit will produce a corresponding pulse of direct current in the output circuit. The ground between resistances Z_5 and Z_7 will also cause a current to flow from battery B_6 through the sounder N_2 and shunt Z_6, through Z_5 and to ground through the contact M and armature of relay R_2. The current through the sounder N_2 will be sufficient to operate this sounder.

When the armature of the sending relay R_2 is not on its marking contact M, the ground on the circuit between Z_5 and Z_6 will be removed. This will allow positive battery B_6 to exert its influence in reducing the negative potential applied to the grid of tube V to practically zero. This will cause an output current in the plate circuit of the tube V regardless of whether or not there is incoming carrier current in the line circuit L_1. This output current will be effective in moving the armature of relay R_1 towards its marking contact M if the armature is not already on this contact. It is thus apparent that under this condition the tube V is not in a condition to receive signals from the distant station but will keep the armature of relay R_1

against its marking contact M as long as the armature of the sending relay R_2 is not on its M contact. The resulting current which will flow from battery B_6 through the sounder N_2, resistance Z_5, resistance Z_7, resistance Z_8 and battery B_7 to ground is very small in magnitude, generally of the order of a fraction of a milliampere, and the sounder N_2 will be released. The sounder N_2 will be closed when the armature of relay R_2 is on its contact M and will release when the armature of relay R_2 is not on its contact M and will thus enable outgoing signals to be read.

The operator at the loop may desire to send signals over the circuit L_2 to the distant station. This he may do by opening his key E in order to gain control of the circuit and "break" the transmission of signals from the distant station over the circuit L_1. If the armature of the relay R_1 is on its spacing contact S, the armature of the relay R_2 will remain on its marking contact M and generator G will continue to send current through filter F_2 over the circuit L_2. Still there will be no "break" in the circuit. When, under the control of incoming signals, the armature of the relay R_1 goes to its marking contact M, the armature of the relay R_2 will reach its spacing contact S, and generator G will be short-circuited through the resistance Z_4. No current will then be transmitted by the generator G over the circuit L_2. If no break feature were provided and a spacing signal were to be received before the breaking signal had reached the operator at the distant station, the armature of the relay R_1 would be operated to its spacing contact S, thereby causing the armature of sending relay R_2 to move to its marking contact. This would interrupt the breaking signal.

A special feature of this invention lies in the prevention of the armature of the relay R_1 from leaving its marking contact M after it has reached this contact and after the key E has been opened by the operator at the loop for the purpose of "breaking" the circuit. Since armature of the sending relay R_2 will thereby be operated to its spacing contact S, the ground will be removed from the circuit between resistances Z_5 and Z_7. This will reduce the negative potential on the grid of the tube V and cause a steady plate current to flow from battery B_1 through the winding W_3 of the relay R_1, winding W_1 of transformer T and the plate and filament electrodes of the tube V and ground, and the current through winding W_3 will be sufficient to cause the armature of relay R_1 to close to its marking contact M. If, as here shown, the marking contact of relay R_1 is maintained closed, the spacing contact of the relay R_2 will also remain closed and no current will flow from the generator over the circuit L_2. It is essential to maintain the spacing contact of the relay R_2 closed for a sufficient interval of time so that the spacing or breaking signal to the distant station located at the distant end of the circuit L_2 will be completed and registered.

While this invention has been shown and described in certain particular arrangements merely for the purpose 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 telegraph system having a line over which signals are transmitted and a line over which signals are received, the combination of a receiving relay, a sending relay, a detector tube which is normally highly biased and is interposed between the receiving line and the receiving relay and acts as a rectifier when so biased, a loop including a key connected to the receiving relay through the sending relay, and means responsive to the breaking of the circuit by the opening of the key at the loop to bring the armature of the sending relay and the armature of the receiving relay into predetermined positions and to maintain these armatures in said predetermined positions as long as the key remains open, said means including means to substantially reduce the bias of the detector tube so that it can not act as a rectifier.

2. In a telegraph system having a line over which signals are transmitted and a line over which signals are received, the combination of a receiving relay, a sending relay, a detector tube which is normally highly biased and is interposed between the receiving line and the receiving relay and acts as a rectifier when so biased, a loop including a key connected to the receiving relay through the sending relay, means responsive to the breaking of the circuit by the opening of the key at the loop to bring the armature of the sending relay and the armature of the receiving relay into predetermined positions and to maintain these armatures in said predetermined positions as long as the key remains open, said means including means to substantially reduce the bias of the detector tube so that it can not act as a rectifier, and a sounder which is controlled by the armature of the sending relay.

3. In a telegraph system having a line over which signals are transmitted and a line over which signals are received, the combination of means including a vacuum tube having plate, filament and grid electrodes, the grid and filament electrodes of said vacuum tube being impressed with pulses of alternating current corresponding to telegraph signals received over the receiving line, the grid electrode of the vacuum tube being normally highly biased negatively with respect to the filament electrode, a receiving relay having a winding connected to the plate and filament electrodes of the vacuum tube, a loop including a key, a sending relay connected between the receiving relay and the loop, a sounder controlled by the armature of the sending relay, the armature of the sending relay also controlling the transmission of alternating current over the sending line, and means controlled by the sending relay and responsive to the opening of the key included in the loop to substantially reduce the negative bias on the grid electrode of the vacuum tube with respect to the filament electrode and bring the armature of the receiving relay to a predetermined position and maintain it in that position while the key of the loop remains open.

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