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INTERFERENCE NEUTRALIZER FOR ALTERNATING CURRENT TELEGRAPH SYSTEMS

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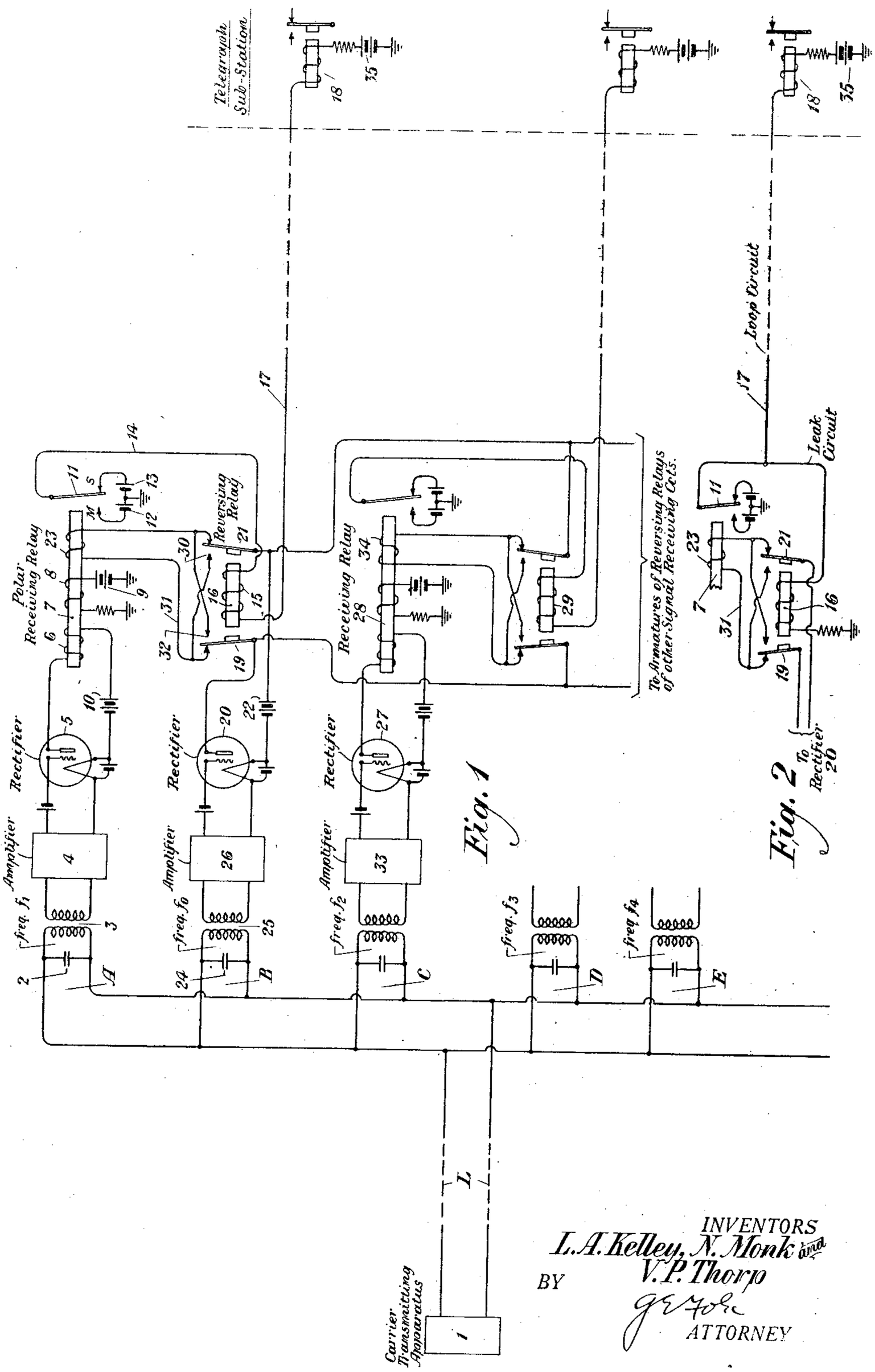

Fig. 1

Fig. 2

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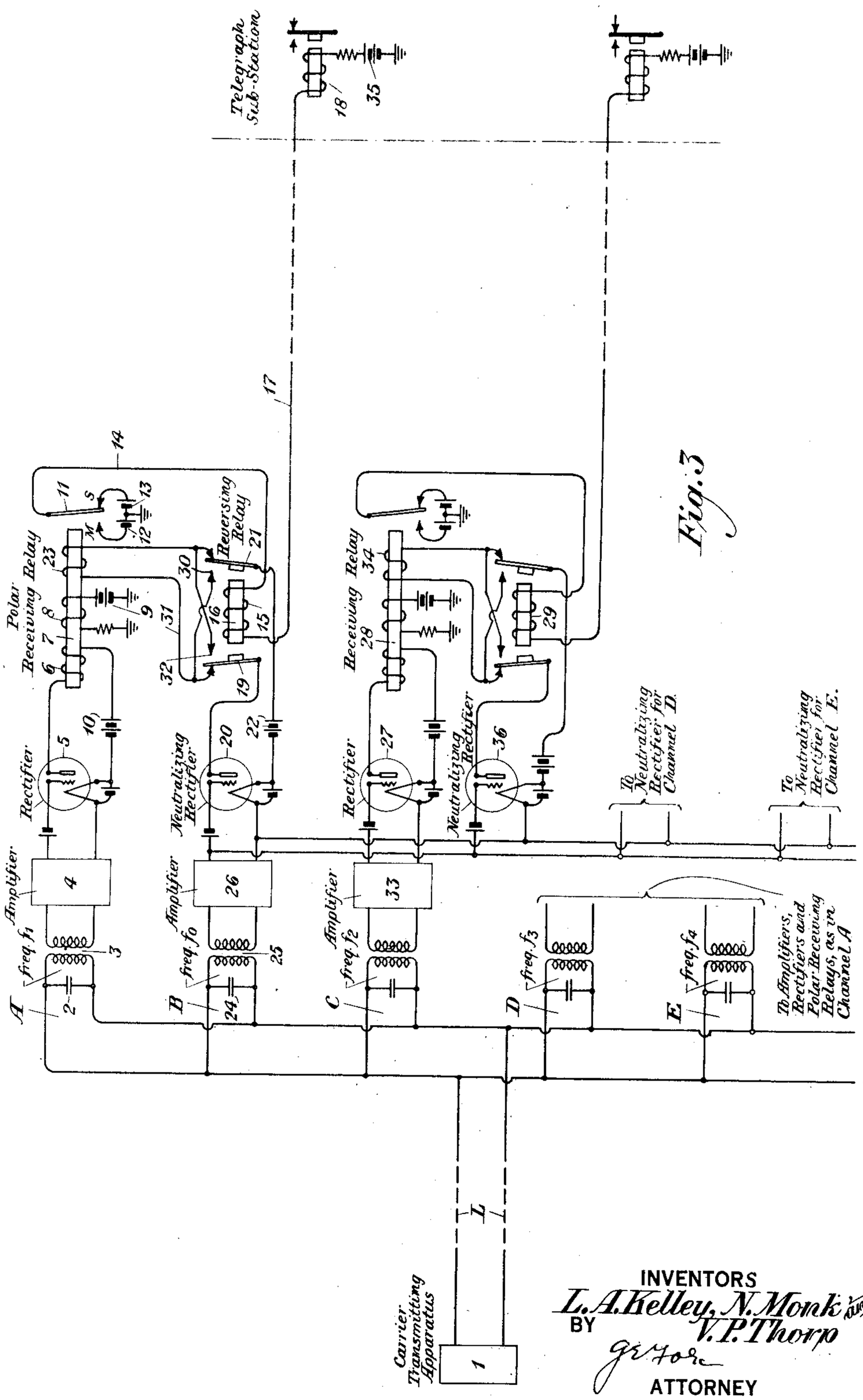

Fig. 3

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UNITED STATES PATENT OFFICE

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INTERFERENCE NEUTRALIZER FOR ALTERNATING-CURRENT TELEGRAPH SYSTEMS

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This invention relates to alternating current telegraph systems, and particularly to means for neutralizing the effect of extraneous interference upon the receiving apparatus of such systems.

In the carrier telegraph systems of the types that are well-known in the art, the carrier currents received from the line circuit are rectified, and the rectified current is used to operate a polar relay. This relay normally has a biasing winding through which a current flows steadily of such a value that it neutralizes approximately one-half of the effect of the normal operating current when both currents are flowing. This causes the armature to be moved from one contact to the other with equal force in either direction, as the operating current is alternately on and off. Interfering currents set up in the line circuit by sources extraneous to the system itself often cause false operation of the relay, and also produce distortion of the carrier current signals being transmitted over the line by such interference with the operation of the receiving relay.

This invention resides in a system for neutralizing interference in an alternating current telegraph system by a method that requires only that the neutralizing impulse occur at the time of the disturbance, the said system being characterized by means whereby the effect of such neutralizing impulse on the receiving relay may be made substantially equal to or greater than the effect of the disturbance.

Another object of this invention resides in the method and means for effecting such neutralization by utilizing the effect produced by the extraneous source of interference upon different carrier frequencies transmitted over the same circuit.

This invention will be clearly understood 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, Fig. 2 shows the use of a leak circuit to control the reversing relay; and Fig. 3 is a modification of Fig. 1 showing the use of separate neutralizing rectifiers.

In the drawing, the line L represents a transmission circuit or medium over or through which a plurality of carrier frequencies such as f_1, f_2, f_3 and f_4 may be transmitted from the carrier transmitting apparatus 1 to the carrier receiving apparatus connected with the other end of the said line. The receiving station comprises a plurality of branch circuits, of which all except one are intended for the reception of the transmitted frequencies sent out from the sending station. Thus, for example, the receiving circuit A is rendered selective by the condenser 2 and the primary winding of the transformer 3 for a channel which may consist of a band based upon the carrier frequency f_1. While a tuned circuit has been shown for the purpose of selecting a particular frequency band, such showing is purely illustrative, since other well known selective devices, such as filters, may be used. The secondary of the transformer 3 is connected with the carrier amplifier 4, the output of which is connected with the rectifier 5. The plate circuit of this rectifier, which includes a source of plate voltage 10, is connected with the winding 6 of the polar receiving relay 7. The grid potential of this rectifier is maintained sufficiently negative to prevent the flow of plate current when no signal current is coming into it. Another winding 8 of this relay is connected with the source 9 of biasing current. This winding is so poled and the magnitude of the current from the source 9 is such as to tend to keep the armature 11 upon its spacing contact. The contacts of relay 7 are connected with sources of potential 12 and 13, which have opposite poles connected to ground. The armature 11 is connected by conductor 14 with the winding 15 of the reversing relay 16, which winding is also connected by conductor 17 to the relay 18 of the telegraph sub-station. The winding of relay 16, which in Fig. 1 is in series with the loop may be connected in a leak circuit of the loop, as shown in Fig. 2. The armature 19 of the reversing relay is connected with the plate of the rectifier 20, and the armature 21 is connected with the source of plate potential 22. The contacts of relay 16 are connected with wind-

ing 23 of the polar relay 7. It will be seen that when the armatures of relay 16 are attracted, current from the source 22 flows through winding 23 in a direction differing from that when the armatures 19 and 21 are released. Since the purpose of the reversing relay 16, and the manner in which it cooperates with other apparatus will be apparent from the description of the mode of operation of the system, it is believed that further description of it is unnecessary at this point.

The rectifier 20 forms part of one of the branch circuits, designated B, which may be referred to as the neutralizing circuit of the system. This is effectively connected with the line L by some form of frequency selecting device, herein represented by a tuned circuit made up of the condenser 24 and the primary winding of transformer 25. The frequency thus selected is designated f_0 for the purpose of description and represents the frequency of a current produced in the line by a source of interference, such for example, as static, lightning, power line induction, etc. As pointed out hereinbefore the frequency selective device may be of a plurality of well known types. The interfering current f_0 will be impressed upon the amplifier 26, and, as amplified will be applied to the grid of the rectifier 20. The space current, which flows through the winding 23 of relay 7, prevents interference from affecting the receipt of signals.

The receiving circuit C, which selects the frequency f_2, is similar to the receiving circuit A. It includes amplifier 33, and the detector 27, which is connected with one of the windings of the receiving relay 28. This relay is similar to relay 7 and has its neutralizing winding 34 connected with contacts of the reversing relay 29. The plate battery 22 connected with the output circuit of the detector 20, is also connected with the armatures of the reversing relay 29 and with the armatures of the reversing relays of the other receiving circuits.

In carrier telegraph systems a marking impulse consists of a train of oscillations of the carrier frequency and a spacing impulse represents the absence or suppression of such oscillations during the spacing interval. Let it be assumed that a spacing impulse is being sent over the channel A. Since no carrier current is received during the spacing interval, no space current will flow through the plate circuit of the rectifier 5, and the armature of the receiving relay 7 will be held against its spacing contact by virtue of the magnetic action of the biasing winding 8. Furthermore, let it be assumed that some form of interference, such as lightning sets up a potential in the circuit upon which the channels are superimposed. When that potential causes a breakdown of the lightning arresters, it produces a surge containing a plurality of frequencies, some of which may lie in the range represented by f_0 to f_4. That part of the interference of frequency f_0 will pass into the neutralizing circuit B, while that part of the interference of frequency f_1 will pass into the receiving circuit A, the selection being made, of course, by the selective networks of the receiving circuits. The interference on circuit A will be amplified by 4 and rectified by 5, thus producing a flow of current in the winding 6 connected with the plate circuit of rectifier 5. The tendency of the current in winding 6 would be to pull the armature 11 away from its spacing contact. The interference that passes into circuit B serves to neutralize the interference in circuit A, in the following manner. The interfering voltage in B, as amplified by 26 and rectified by 20, causes current to flow from the source 22 over a circuit including the back contact of armature 21 of relay 16, winding 23 of relay 7, back contact of armature 19 of relay 16 and the plate and filament of tube 20. Since for the condition assumed, namely that for receiving a spacing impulse, the armature 11 of relay 7 is on its spacing contact, the battery 13 (connected with the right-hand contact of armature 11) opposes the battery 35 at the sub-station 18, and no current will flow through the winding of relay 16. Consequently the armatures of relay 16 will remain on the back contacts. The connection between the plate circuit of tube 20 and the winding 23 of relay 7 for the condition just described is such that the direction of flow of the neutralizing current through winding 23 is such that the magnetic effect thereof opposes that due to the rectified interference in winding 6. By adjusting the degree of amplification of the amplifier 26, the rectified neutralizing current flowing through winding 23 may be given the necessary value to prevent the rectified interference currents, that flow through winding 6 of relay 7, from moving the armature 11 away from its spacing contact and producing a false signal.

When a marking impulse is received the system operates in the following manner to prevent interference from moving the armature of the receiving relay from its marking contact. The current impulse of frequency f_1, representing a marking signal, will be selected by circuit A, and when amplified by 4 and rectified by 5 will flow through winding 6. This overcomes the effect of the biasing current in winding 8 and moves the armature 11 to its marking contact. Since the marking battery 12 is so poled as to be in a series aiding connection with battery 35 when armature 11 closes its left-hand contact, current will flow over the loop, and relay 16 will be operated, closing its contacts 30 and 32. This reverses the direction of current flow through winding 23 of relay 7, the mag-

netic effect of which is to aid the current in winding 6 in holding the armature 11 against its marking contact, and it matters not whether the interference is positive or negative in its character. Sometimes the interference may be of such magnitude as to overload the apparatus and reduce the strength of the signal. This manifests itself in a reduction of the plate current of the rectifier 5 of the signal receiving circuit during the marking impulse. The effect of such reduction in the plate current of the rectifier 5 is offset by the effect of the rectified neutralizing current in the winding 23. It will be remembered that during the receipt of a marking impulse, the connection between the plate circuit of the neutralizing rectifier 20 and the winding 23 is such, that the magnetic effect of the neutralizing current in that winding aids the effect of the current in winding 6 in keeping the armature 11 on its marking contact. By adjusting the amplifier 26 so that it will produce a gain slightly greater than that of the amplifier 4 in the signal receiving circuit it has been found that the system will function properly to prevent interference from affecting both the marking signals and the spacing signals.

It will therefore be seen that by means of the arrangement shown, the neutralizing current will be substantially simultaneous with and substantially equal to or greater than the interfering current produced in the signal channels. Furthermore, the effect of that neutralizing current is such as to always keep the armatures of each receiving relay upon the contact to which it was moved by the last received signal impulse.

As shown in Fig. 3, separate neutralizing rectifiers may be used for each receiving relay instead of a common neutralizing rectifier such as 20 shown in Fig. 1. When separate neutralizing rectifiers are employed, they are connected with the output of the amplifier 26, all of the rectifiers being in parallel. Rectifier 20 is then connected solely with the armatures of relay 16, and another of the said separate rectifiers, viz. 36, is connected with the armatures of relay 29. Similarly, as shown in Fig. 3, each of the other channels would have its individual neutralizing rectifier associated therewith.

While the invention has been described, as embodied in a carrier system, it is equally applicable to a radio system. For example, the radio receiving apparatus may be connected with an antenna broadly tuned to cover the range of frequencies of all channels, or separate antennæ may be provided for each receiving circuit.

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

What is claimed is:

1. In a system for neutralizing interference in an alternating current telegraph system, the combination with a source of carrier currents of different frequencies of a transmitting medium over or through which the carrier currents are transmitted, the said medium being exposed to atmospheric disturbances capable of producing interfering currents whose frequencies may be within as well as without the range of frequencies of the said carrier currents, and a plurality of receiving circuits connected with the said medium each having means to select the current of one of said frequencies resulting either from signals or disturbances, means to rectify the selected currents, another receiving circuit connected with the said medium having means to pick up disturbances of a frequency or frequencies lying outside the range of carrier frequencies and to rectify the said disturbances, and a translating device connected with a rectifier of the first-mentioned receiving circuits and with the rectifier of the said other receiving circuit in such manner that the rectified currents resulting from disturbances will always flow in such direction in the said device as to oppose a change in its condition.

2. In a system for neutralizing interference in an alternating current telegraph system, the combination with a line, of means to transmit over said line a train of carrier frequency oscillations representing a carrier frequency marking impulse, and to suppress such oscillations to effect the sending of a spacing impulse, the said impulses being exposed to interference from a source extraneous to said line, means to select and rectify the carrier frequency oscillations, means to select and rectify disturbances whose frequency lies outside the range of the signal frequency, a receiving relay connected with both rectifying means, and a reversing relay controlled by the current in a loop circuit connected with the armature of the receiving relay to control the direction of flow of rectified disturbing current through one of the windings of the said receiving relay to neutralize the effect of rectified disturbing current in the other winding thereof.

3. In a system for neutralizing interference in an alternating current telegraph system, the combination with a transmission circuit of means to impress thereon carrier currents of a plurality of frequencies for transmission thereover, a plurality of receiving circuits connected with the said transmission circuit, each having frequency selecting means and means to rectify the selected current, one of said receiving circuits including a polar relay having a plurality of windings, one of said windings being connected with the output of one rectifier, a second winding connected with a source of current to bias the effect of the normal current

flowing through the first winding, and a third winding connected with the output of the other rectifier, the latter connection including the armatures and contacts of a reversing relay, the winding of which is connected between the armature of the said polar relay and the telegraph sub-station connected therewith.

4. The method of substantially eliminating the effect of interference upon the reception of alternating current telegraph signals, which consists in selecting from the said interference a frequency lying outside the range of the frequency of the channel of the said signal, applying the said selected interference effectively to a translating device normally responsive to the marking and spacing impulses of the said transmitted channel, and automatically controlling the direction of application of the selected interference to the said translating device by and in accordance with the signal impulse being received at the instant of reception of the interference.

5. The method of substantially eliminating the effect of interference upon the reception of alternating current telegraph signals, which consists in selecting from the said interference a frequency lying outside the range of frequencies of the signaling channels, applying the said selected interference effectively to a translating device upon which are impressed the impulses of the frequency of a signaling channel, and automatically controlling the application of the said selected interference to the said device so that its effect will always be such as to aid the signal impulse being received at the instant of reception of the interference.

6. In an alternating current telegraph system, in which rectified carrier signal impulses control the operation of the receiving relay connected with a loop circuit, the method of neutralizing interference, which consists in applying to a winding of the said relay a neutralizing impulse produced by the rectification of an interfering frequency lying outside the range of the signal frequencies, and automatically controlling the direction of flow of the said neutralizing impulse so that its effect upon the armature of the receiving relay will always oppose the effect produced thereon by the rectified interfering current of the same frequency as the signal frequency flowing through the operating winding of the said relay.

7. The method of substantially eliminating the effect of interference upon alternating current telegraph signals transmitted over a signaling system, which consists in selecting a part of the interfering current lying within a certain frequency range, similarly selecting another part of the interfering current lying within the range of frequencies employed in a signaling channel operating over the said system, effectively applying both of the said selected parts of the interfering current to a translating device, and automatically controlling the relative direction of the said selected parts of the interference, as applied to the said translating device, by and in accordance with the signal character being received at any instant.

In testimony whereof, we have signed our names to this specification this 30th day of January, 1929.

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