

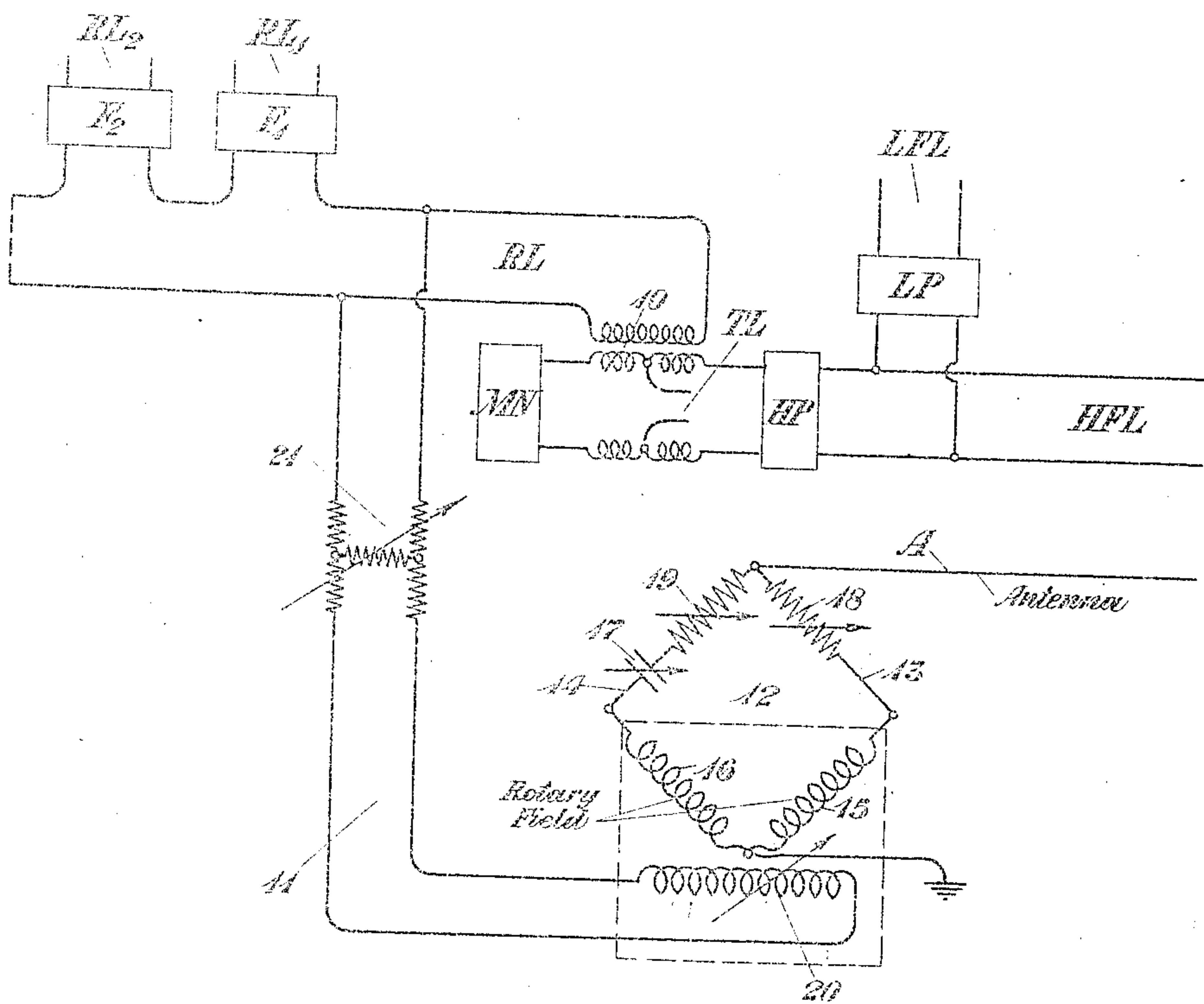
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L. M. ILGENFRITZ

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APPARATUS FOR NEUTRALIZING RADIOINTERFERENCE ON WIRE LINES

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INVENTOR.
L. M. Ilgenfritz
BY *gryde*
ATTORNEY

UNITED STATES PATENT OFFICE.

LESTER M. ILGENFRITZ, OF ORANGE, NEW JERSEY, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

APPARATUS FOR NEUTRALIZING RADIOINTERFERENCE ON WIRE LINES.

Application filed November 20, 1922. Serial No. 602,193.

To all whom it may concern:

Be it known that I, LESTER M. ILGENFRITZ, residing at Orange, in the county of Essex and State of New Jersey, have invented certain Improvements in Apparatus for Neutralizing Radiointerference on Wire Lines, of which the following is a specification.

This invention relates to transmission circuits, and more particularly to a new and improved system for overcoming interference on signaling conductors due to radio transmission.

In carrier transmission systems in which carrier channels are superposed on ordinary signaling conductors, interference is sometimes produced in one or more of the carrier channels due to radio signals transmitted at the carrier frequency assigned to the channel. In order to overcome this difficulty, it has heretofore been proposed to balance out the interfering frequency by impressing upon the channel a balancing frequency of equal amplitude and opposite phase, the balancing frequency being obtained from the disturbing source through the medium of an auxiliary circuit which is subject to the disturbing influence.

In applying this remedy, some difficulty has been experienced in obtaining the proper balance due to the fact that adjustments of the balancing potential must be made both with respect to phase and amplitude, and instrumentalities heretofore used for obtaining such adjustments have been of such a character that an adjustment of either the phase or the amplitude results in a change in the other, so that it has required considerable manipulation in order to obtain a balance. It is one of the objects of the present invention to provide a system in which the phase and amplitude of the balancing potential may be controlled each independently of the other, so that when the phase angle has once been adjusted, changes in amplitude may thereafter be made without changing the phase angle, or vice versa. This object and other objects of the invention may be attained by means of the arrangement set forth in the following description and illustrated in the accompanying drawing, Figure 1 of which discloses one form of circuit arrangement for practicing the invention.

Referring to the drawing, HFL designates a high frequency carrier transmission

line terminating at a carrier station in a branch leading through a low-pass filter LP to a low-frequency line LFL and in another branch leading through a high-pass filter HP to the terminal carrier equipment. The carrier equipment comprises a transmitting circuit TL and a receiving circuit RL associated with the carrier branch through the usual high frequency balanced transformer 10. The transmitting circuit TL is connected to midpoints of the balanced transformer, and the receiving channel RL is shown as being connected to the third winding of the transformer, and a balance is obtained by means of the usual balancing network MN. The various carrier receiving channels, such as RL₁, RL₂, etc., are associated with the receiving circuit RL through suitable filters, such as F₁, F₂, etc., adapted to select the range of frequencies assigned to each receiving channel.

If the main line HFL is subject to interference from a radio station employing a carrier frequency lying within the range of one of the receiving channels, as, for example, the channel RL₂, it is apparent that the interfering radio frequency will be transmitted over the line HFL to the receiving channel RL₂ in the same manner as the modulated carrier frequency transmitted to said channel in the normal operation of the carrier system. In order to balance out the interfering frequency, a radio antenna A may be provided for absorbing from the distant radio station the same radio signals which are impressed upon the line HFL, and this frequency may be impressed upon the channel RL₂ through the circuit 11 in opposite phase relation, but with the same amplitude as the interfering potential.

In order to adjust the phase angle of the balancing potential, a rotary field phase adjustment device is provided. This arrangement comprises two branch circuits 13 and 14, including suitable field windings 15 and 16 for producing the rotary field. In circuit with one of the windings, as, for example, the winding 16, is a capacity 17, and in each of the branches resistances 18 and 19 are provided. Since the capacity 17 is included in one of the branches, and not in the other one, the component of the fre-

quency received from the antenna flowing through the winding 16 will be 90° out of phase with the component flowing through the winding 15. The resistances 18 and 19 may be set, so that both components have the same amplitude. Consequently, the two components energizing the two field windings 15 and 16 will produce a rotary field which rotates at the frequency of the electromotive force impressed upon the antenna A. A third winding 20 is placed within the field of influence of the windings 15 and 16, and, by merely shifting the angle of the coil 20 with respect to the field of the coils 15 and 16, any desired phase angle may be obtained for the induced electromotive forces in the circuit 11. These electromotive forces will, of course, have the same frequency as the electromotive forces impressed upon the antenna A, the phase angle being dependent only upon the angle at which the point 20 cuts the rotary field.

The amplitude may be adjusted by means of a separate amplitude controlling device 21 without producing any change in the phase angle of the balancing current, especially if the amplitude controlling device is of such a nature as to be adjustable without producing any change in the impedance of the circuit 11 as viewed from the coil 20. In order to accomplish this result, the amplitude changing device is made up of series and shunt resistances as indicated, the series and shunt resistances being adjustable together, so that as the series resistance is increased the shunt resistance is decreased and vice versa. Under these conditions the impedance of the circuit 11 viewed from the coil 20 will be substantially equal to the sum of the shunt resistance and the two resistances included in the two wires of the circuit 11 below the shunt resistance. Constant impedance transmission controlling devices of the type of the device 21 are well known in the art, and the theory of such devices need not be further elucidated.

It will be apparent from this arrangement that the phase and amplitude adjustments may be made separately in a very simple manner. For example, the phase adjustment may be made first by listening in the receiving circuit RL_2 and adjusting the angle of the coil 20 until the interference is reduced to a minimum. When the minimum setting has been found, it will be apparent at once that this corresponds to the condition in which the phase of the potential from the circuit 11 is opposite to that of the interfering potential transmitted to the circuit RL_2 over the high frequency line HFL. Having made this adjustment, the device 21 will then be adjusted until the interfering disturbance can no longer be heard in the channel RL_2 . The latter adjustment will not disturb the phase angle obtained by the

previous adjustment, and consequently a very accurate balance may be obtained in an extremely simple manner.

It will be obvious that the general principles herein disclosed may be embodied in many other organizations widely different from those illustrated without departing from the spirit of the invention as defined in the following claims.

What is claimed is:

1. In a wire signaling system subject to interference due to radio signaling, an auxiliary circuit upon which a similar disturbing electromotive force may be impressed for balancing purposes, a device associated with said auxiliary circuit for adjusting the phase of the current resulting from said balancing electromotive force and a device associated with said auxiliary circuit for adjusting the amplitude of said current, said phase adjusting device and amplitude adjusting device controlling their respective functions independently of each other.

2. In a wire signaling system subject to interference due to radio signaling, an auxiliary circuit upon which a similar disturbing electromotive force may be impressed for balancing purposes, a device associated with said auxiliary circuit for adjusting the phase of the current resulting from said balancing electromotive force and a device associated with said auxiliary circuit for adjusting the amplitude of said current, said amplitude controlling device being capable of adjustment for controlling the amplitude without producing any change in the phase determined by said phase adjusting means.

3. In a wire signaling system subject to interference due to radio signaling, an auxiliary circuit upon which a similar disturbing electromotive force may be impressed for balancing purposes, a device associated with said auxiliary circuit for adjusting the phase of the current resulting from said balancing electromotive force and a device associated with said auxiliary circuit for adjusting the amplitude of said current, said phase controlling device comprising means for producing a rotary field, and a coil inductively related to said field and adjustable as to its angle with respect to said field.

4. In a wire signaling system subject to interference due to radio signaling, an auxiliary circuit upon which a similar disturbing electromotive force may be impressed for balancing purposes, a device associated with said auxiliary circuit for adjusting the phase of the current resulting from said balancing electromotive force and a device associated with said auxiliary circuit for adjusting the amplitude of said current, said phase controlling means comprising a pair of branch circuits each having a coil therein, means to cause a 90° phase dif-

ference in the currents in said branch circuits thereby producing a rotary field in the neighborhood of said coils and a third coil arranged to cut said field at any desired angle.

5. In a wire signaling system subject to interference due to radio signaling, an auxiliary circuit upon which a similar disturbing electromotive force may be impressed for balancing purposes, a device associated with said auxiliary circuit for adjusting the phase of the current resulting from said balancing electromotive force and a device associated with said auxiliary circuit for adjusting the amplitude of said current, said amplitude controlling device being capable of adjustment for controlling the amplitude without producing any change in the phase determined by said phase adjusting means, and said amplitude controlling device comprising adjustable series and shunt impedance elements so related to each other that the impedance as viewed from said phase adjusting device will be substantially constant.

6. In a wire signaling system subject to interference due to radio signaling, an auxiliary circuit upon which a similar disturbing electromotive force may be impressed for balancing purposes, a device associated with said auxiliary circuit for adjusting the phase of the current resulting from said balancing electromotive force and a device associated with said auxiliary circuit

for adjusting the amplitude of said current, said phase controlling means comprising a pair of branch circuits each having a coil therein, means to cause a 90° phase difference in the currents in said branch circuits thereby producing a rotary field in the neighborhood of said coils and a third coil arranged to cut said field at any desired angle, and said amplitude controlling device comprising adjustable series and shunt impedance elements so related to each other that the impedance as viewed from said phase adjusting device will be substantially constant.

7. In a wire signaling system subject to interference due to radio signaling, an auxiliary circuit upon which a similar disturbing electromotive force may be impressed for balancing purposes, a device associated with said auxiliary circuit for adjusting the phase of the current resulting from said balancing electromotive force and a device associated with said auxiliary circuit for adjusting the amplitude of said current, and said amplitude controlling device comprising adjustable series and shunt impedance elements so related to each other that the impedance as viewed from said phase adjusting device will be substantially constant.

In testimony whereof, I have signed my name to this specification this 17th day of November, 1922.

LESTER M. ILGENFRITZ.