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METHOD AND APPARATUS FOR NEUTRALIZING RADIOINTERFERENCE ON WIRE LINES

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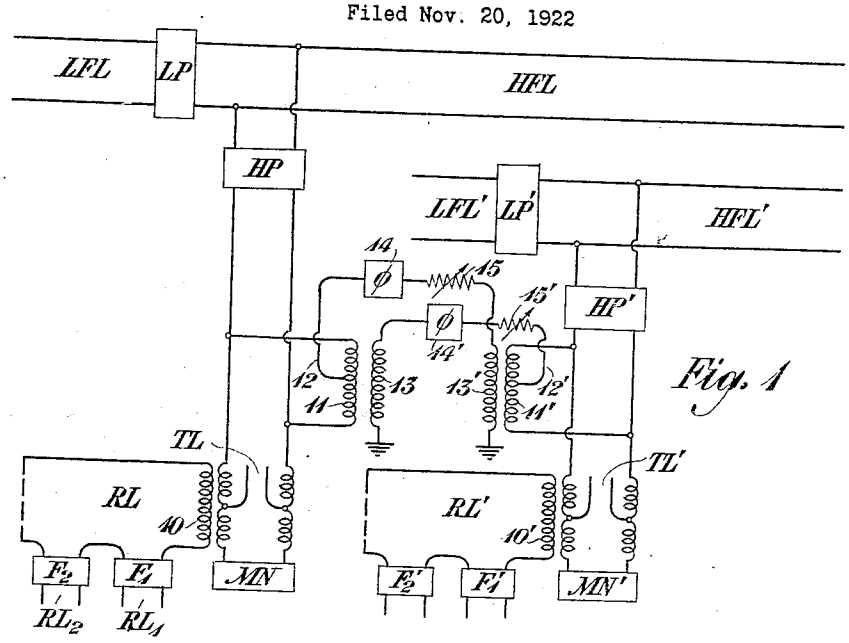


Fig. 1

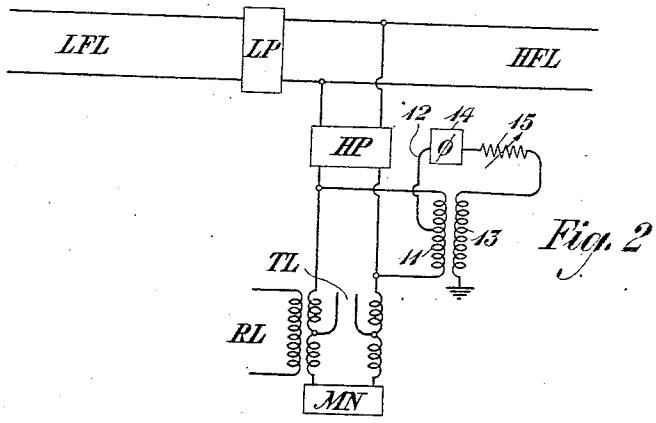


Fig. 2

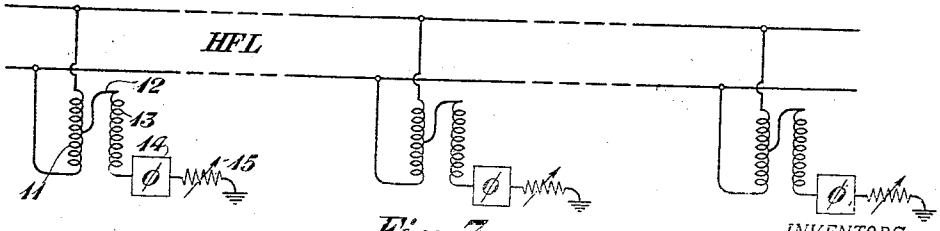


Fig. 3

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UNITED STATES PATENT OFFICE.

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METHOD AND APPARATUS FOR NEUTRALIZING RADIOINTERFERENCE ON WIRE LINES.

Application filed November 20, 1922. Serial No. 602,218.

To all whom it may concern:

Be it known that we, HERMAN A. AFFEL and LESTER M. ILGENFRITZ, citizens of the United States, residing at Brooklyn and Orange, in the counties of Kings and Essex and States of New York and New Jersey, respectively, have invented certain Improvements in Methods and 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. These interfering frequencies are due to potentials induced in the two sides of the transmission circuit in parallel. Ordinarily it would not be expected that such potentials would affect the receiving apparatus which is in bridged relation with respect to the line. However, in practice, the two sides of the line are not exactly alike, so that some unbalance results and a current is permitted to flow through the bridged receiving device owing to a difference in the two interfering potentials on the two sides of the line.

In accordance with the present invention, it is proposed to balance out the interference by obtaining a current derived from the interfering potentials impressed upon the two sides of the circuit in parallel and impressing the derived current serially upon the circuit in opposite phase relation, but with the same amplitude as the serial disturbance flowing through the bridge.

The arrangements whereby these results are accomplished may be understood from the following description of the invention when read in connection with the accompanying drawing, Figs. 1, 2 and 3 of which illustrate three different embodiments of the invention.

Referring to Fig. 1, HFL and HFL′ designate two carrier transmission lines, both of which have similar characteristics and are subject to similar interference from a radio transmitting station. The line HFL terminates at the carrier station in a branch leading through a low-pass filter LP to a low-frequency line LFL and another branch leading through a high-pass filter HP to the carrier apparatus. The carrier apparatus comprises a transmitting circuit TL and a receiving circuit RL arranged in conjugate relation to each other by means of a balanced transformer 10, the balance being effected through the medium of the balancing network MN. The receiving circuit RL is associated with a plurality of receiving channels, such as RL_1, RL_2, etc., having filters, such as F_1 and F_2 therein for the purpose of selecting into each receiving channel its proper band of frequencies. The terminal arrangements of the line HFL′ are similar to those just described and are indicated by the same reference characters primed.

From this arrangement it will be apparent that interfering carrier frequencies from a distant radio station may be impressed upon both the high frequency lines HFL and HFL′ and will be transmitted to the individual receiving channels of each line which have assigned to them a range of frequencies corresponding to the interfering frequencies.

These interfering frequencies are impressed in parallel upon the two sides of either high frequency circuit, as, for example, the high frequency HFL, but, due to unbalance of the two sides of the circuit, a series component results which will be transmitted through the transformer 10 to the corresponding receiving channel to pro-

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duce the interference above referred to. In order to balance out this component, an inductance comprising a winding 11 is bridged across the carrier terminal circuit of the high frequency line HFL, this winding having a very high impedance so as to produce but little shunting effect with respect to the series carrier frequencies transmitted over the line HFL when used for ordinary carrier transmission purposes. A tap 12 is taken from the midpoint of the inductance 11, and, as the two halves of the inductance oppose each other with respect to the tap 12, it will be apparent that the disturbing potentials flowing in parallel from the two sides of the circuit HFL will pass into the tap 12 without being materially impeded by the inductance 11. The tap 12 includes a winding 13' inductively related to an inductance 11' bridged across the carrier circuit associated with the line HFL' in a manner similar to that of the inductance 11 already described.

The phase angle and amplitude of the currents flowing in the tap 12 may be controlled by the phase shifting device 14 and the adjustable resistance 15 respectively, so that the currents flowing in the tap 12 may be adjusted as regards phase and amplitude so as to impress upon the carrier terminal of the circuit HFL' through the inductance 11' a potential equal in amplitude but opposite in phase, to the disturbing component from the distant radio station. Similarly, by means of a tap 12', from the midpoint of the inductance 11' and leading to ground through a coil 13 inductively related to the inductance 11, the disturbing components, flowing over the sides of the line HFL' in parallel may be impressed upon the carrier circuit of the line HFL serially to neutralize the serial disturbing component impressed upon the latter line. A phase shifter 14' and an adjustable resistance 15' will, of course, be used to obtain the desired phase and amplitude for the balancing potentials.

Instead of using potentials obtained from one line for balancing out disturbing potentials upon another line, the balancing potentials may be obtained from the disturbed line itself in the manner indicated in Fig. 2. In this case the ground tap 12 is taken from the midpoint of the inductance 11 as before, but it is connected to the coil 13 inductively associated with the inductance 11 of the same line, instead of a coil associated with an inductance of another line. The disturbing components flowing in parallel over the sides of the line HFL will pass into the ground tap 12 without producing any effect upon the inductance 11 which is balanced with respect to the parallel components. These components in passing through the ground tap will be adjusted as to phase and amplitude by the devices 14 and 15 and will then be impressed through the primary 13 upon the inductance 11 in such a manner as to cause a series component in the carrier branch of the line HFL. This series component will, of course, be adjusted to balance out the disturbing series component due to unbalance between the two sides of the line HFL.

Instead of arranging compensating devices at the terminal station, such devices may be located at different points along the line, as indicated in Fig. 3, for the purpose of balancing the disturbing potentials before transmission to the terminal station. Each of the compensating devices in Fig. 3 may be similar to those shown in Fig. 2, comprising a bridged inductance 11 with a tap 12 taken from its midpoint and leading through a primary 13 inductively related to the inductance 11 and also through a phase shifter 14 and through amplitude changing device 15. The operation will be apparent without further description.

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 the operation of a wire signaling system, the method of overcoming interference due to components flowing in series over the two sides of the line circuit as a result of electromotive forces impressed upon the line by a radio signaling station, which consists in causing the desired signaling currents to flow serially only over the line conductors, obtaining components flowing over the sides of a line circuit in parallel due to electromotive forces impressed thereon from the interfering radio signaling station and applying such electromotive forces to oppose the interfering series component.

2. In the operation of a wire signaling system, the method of overcoming interference due to components flowing in series over the two sides of the line circuit as a result of electromotive forces impressed upon the line by a radio signaling station, which consists in causing the desired signaling currents to flow serially only over the line conductors, obtaining components flowing over the sides of a line circuit in parallel due to electromotive forces impressed thereon from the interfering radio signaling station, derived from said components electromotive forces of proper amplitude and phase relation and applying them in opposition to the series interfering electromotive forces.

3. In the operation of a wire signaling system, the method of overcoming interference due to components flowing in series

over the two sides of the line circuit as a result of electromotive forces impressed upon the line by a radio signaling station, which consists in causing the desired signaling currents to flow serially only over the line conductors, obtaining from the same line circuit components flowing over the sides of the line circuit in parallel due to electromotive forces impressed thereon from the interfering radio signaling station and applying said electromotive forces to oppose the interfering series component.

4. In the operation of a wire signaling system, the method of overcoming interference due to components flowing in series over the two sides of the line circuit as a result of electromotive forces impressed upon the line by a radio signaling station, which consists in causing the desired signaling currents to flow serially only over the line conductors, obtaining from the same line circuit components flowing over the sides of the line circuit in parallel due to electromotive forces impressed thereon from the interfering radio signaling station, deriving from said components electromotive forces of proper amplitude and phase relation and applying them in opposition to the series interfering electromotive forces.

5. In a wire signaling system, a line circuit subject to interference due to components flowing serially from the two sides of the line as a result of potentials impressed thereon from a radio signaling station, means to permit the desired signaling currents to flow over the line conductors serially only, means to obtain currents due to parallel components resulting from interfering potentials from the said radio signaling station and means to produce upon said line circuit by the said parallel components series components of equal amplitude and opposite in sign to the interfering component.

6. In a wire signaling system, a line circuit subject to interference due to components flowing serially from the two sides of the line as a result of potentials impressed thereon from a radio signaling station, means to permit the desired signaling currents to flow over the line conductors serially only, means to obtain currents due to parallel components resulting from interfering potentials impressed upon the same line circiut by said radio signaling station and means to produce upon said line circuit by the said parallel components series components of equal amplitude and opposite in sign to the interfering component.

7. In a wire signaling system, a line circuit subject to interference due to series components flowing over the two sides of the line as a result of potentials induced from a radio signaling station, an inductance bridged across the line, a ground tap connected to the midpoint of said inductance for obtaining currents due to the interfering components flowing over the two sides of the line circuit in parallel, a primary coil in said ground tap inductively associated with said inductance for impressing the parallel components flowing in the ground tap serially upon the circuit and means for adjusting the phase and amplitude of the balancng potentials thus applied to the circuit to neutralize said series components.

In testimony whereof, we have signed our names to this specification this 17th day of November, 1922.

HERMAN A. AFFEL.
LESTER M. ILGENFRITZ.