

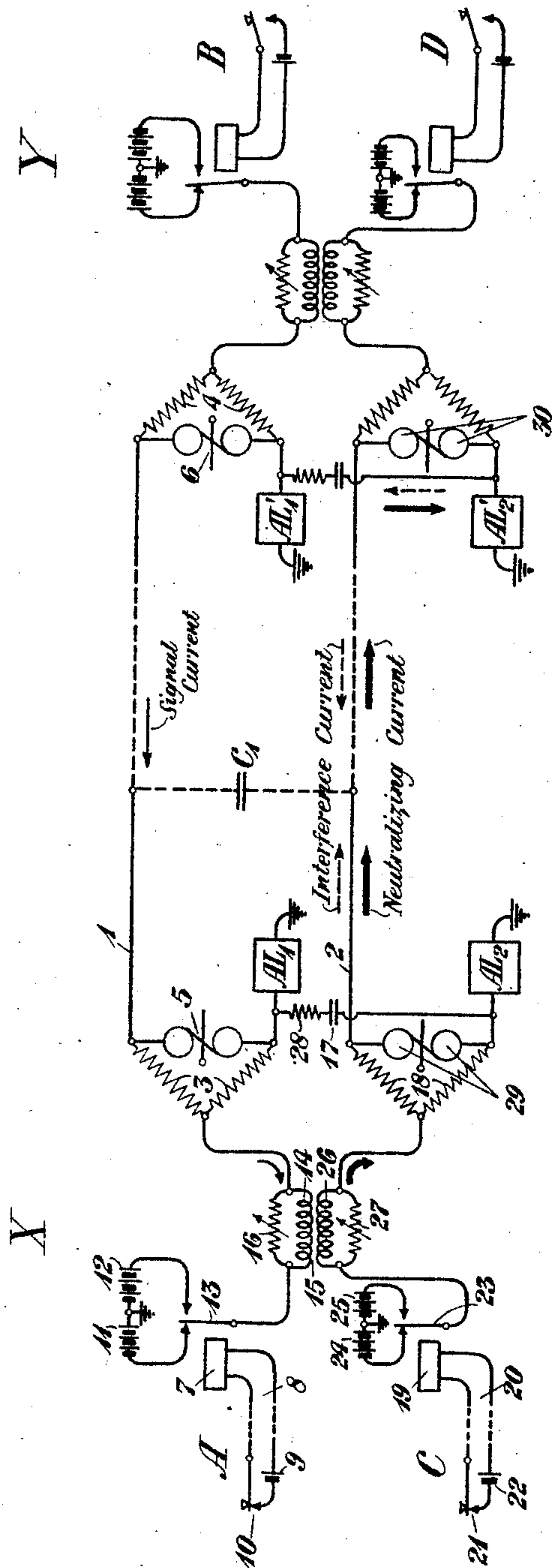
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MEANS FOR PREVENTING ELECTRICAL INTERFERENCE

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MEANS FOR PREVENTING ELECTRICAL INTERFERENCE.

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To all whom it may concern:

Be it known that I, SAMUEL I. CORY, residing at Elmhurst, in the county of Queens and State of New York, have invented certain Improvements in Means for Preventing Electrical Interference, of which the following is a specification.

This invention relates to means for preventing electrical interference between signaling circuits, and especially to an arrangement for preventing that form of interference between grounded telegraph circuits which is termed receiving-end cross-fire.

In the operation of grounded telegraph circuits it is well known that when signaling impulses are transmitted over one telegraph circuit, an interfering current will be set up in other circuits paralleling the first circuit due to the mutual admittance between the circuit over which the impulses are being transmitted, hereinafter referred to as the disturbing circuit, and the circuit or circuits paralleling the said circuit, hereinafter referred to as the disturbed circuit or circuits. This interfering current will cause a disturbance in the terminal apparatus at both ends of the disturbed circuit or circuits. The disturbance which is set up in the terminal apparatus of a disturbed circuit located in the same station in which is also located the terminal apparatus from which the signaling impulses are being impressed upon the said disturbing circuit, may be termed sending-end cross-fire. The disturbance which is set up in the terminal apparatus of the disturbed circuit located in the same station in which is also located the receiving apparatus of the said disturbing circuit, may be termed receiving-end cross-fire. Sending-end cross-fire in disturbed circuits has been successfully neutralized by connecting a condenser (preferably in series with a resistance) between the artificial lines of the duplex sets of the disturbing and the disturbed circuits.

It is the object of this invention to provide a circuit arrangement for substantially neutralizing the receiving-end cross-fire in disturbed circuits without increasing the sending-end cross-fire such as has resulted from the use of arrangements heretofore designed for this purpose.

Other and further objects of this invention will be apparent from the following description, when read in connection with the

attached drawing showing one form of embodiment of the invention.

In the drawing, 1 and 2 represent two telegraph signaling circuits which have associated therewith the terminal circuits A and C respectively at station X, and B and D respectively at station Y. The opposite ends of the line 1 are connected with one of the windings of the bridge coils 3 and 4 respectively, and to the apexes of the said coils are connected the terminal circuits A and B respectively. Across the outer terminals of the bridge coils 3 and 4 are connected the polar relays 5 and 6 respectively. The balancing networks AL_1 and AL_1' are connected with one winding of the bridge coils 3 and 4 respectively to balance the line 1 connected with the said other winding of the said coils.

The terminal circuit at A comprises a pole changer 7, the operation of which is controlled by the apparatus connected with the loop circuit 8 represented by the key 10 and the battery 9. The armature 13 of the pole changer is adapted to move between two contacts, of which the left-hand one is connected with the negative battery 11, and the right-hand one with the positive battery 12. The armature 13 is connected with the apex of the bridge coils 3, the connection including serially the primary winding 14 of a transformer 15, which is shunted by a variable resistance 16 by means of which the magnitude of the current flowing through the said winding may be controlled.

The terminal circuit C connected with the line circuit 2 is similar to the terminal circuit A. It includes a pole changer 19 connected with a loop circuit 20, having a key 21 and a battery 22 associated therewith. The armature 23 of the pole changer is adapted to move between two contacts, of which the left-hand one is connected with the negative battery 24, and the right-hand one with the positive battery 25. This armature is connected with the apex of the coils 18, the connection including serially a secondary winding 26 of the transformer 15, which is shunted by a variable resistance 27. The artificial line side of the bridge coils 3 is connected with the corresponding side of the coils 18 by a condenser 17 preferably in series with a resistance 28, the connection serving to eliminate sending-end cross-fire.

The terminal circuits B and D at the station Y are similar to the circuits A and C and need no further description in order that they may be clearly understood.

5 Having in mind the foregoing description of the apparatus connected with the circuits in which this invention is embodied, the invention will be clearly understood from the following description of the mode
10 of operation of the invention.

Let it be assumed that signals are being transmitted from the terminal circuit A to the distant terminal circuit B over the line 1, so that, in respect to interference, the
15 said line becomes the disturbing circuit of the system, and line 2 and other lines similarly situated become the disturbed circuit or circuits. When the key 10 is closed, as in the figure, current from the battery 9
20 flowing through the loop 8 will energize the pole changer 7, so that the armature 13 touches its left-hand contact, so that a negative impulse from the battery 11 is transmitted over the connection between the
25 armature and the apex of the bridge coils 3. This negative impulse will cause current to flow over the line 1 from the distant end in the direction represented by the arrows shown by light solid lines, and will operate
30 the receiving relay 6 connected across the bridge coils 4. The transmission of this current over the line 1 will set up in line 2, and other lines similarly situated, an interfering current, flowing in the direction
35 represented by the dotted arrows, due to the mutual admittance between the line 1 and the other lines of the same system, which is represented symbolically by the condenser C_1 . The flow of current through the
40 winding 14 of the transformer 15 will induce a potential across the terminals of the winding 26 of the same transformer, the direction of which will cause a neutralizing current to flow in the line 2 in the direction
45 shown by the heavy solid arrows which will substantially neutralize the interfering current in the distant relay 30.

The neutralizing current and the interfering current will be transmitted over the
50 line 2, and, if of approximately the same wave shape and in proper phase, they will substantially balance each other, thereby minimizing the effect of cross-fire upon the apparatus at the receiving end of the circuit. The magnitude of the neutralizing
55 current may be controlled by the proper adjustment of the self and mutual inductance of transformer 15 or the variable shunt resistances 16 and 27. Since this neutralizing
60 current is applied to the apex of the coils 18, it will have no detrimental effect upon the relay 29 at the transmitting end of line 2. By means of the condenser 17 in series with resistance 28, the effect of
65 the interfering current upon relay 29 is

substantially neutralized. Current flowing in the artificial line branch of the bridge coils 3, as the result of the impression of the signaling impulse upon the apex of
70 the said coils 3 will cause a neutralizing current to flow in the artificial line branch of bridge coils 18, by way of the condenser 17 and resistance 28.

It will, of course, be understood that when an impulse of opposite polarity is applied
75 to the line 1 by the battery 12, the interference currents in line 2, represented by the dotted arrows, will be in the opposite directions, as will also be the neutralizing current represented by the heavy solid ar-
80 rows.

In a similar manner, when the key 21 of the loop circuit 20 of the terminal circuit C is closed, a negative impulse from the
85 battery 24 will flow over the connection between the armature 23 and the apex of the bridge coils 18. This current will flow through the winding 26, which will induce a difference of potential across the winding
90 14, which is connected with the line 1. The transmission of the current over the line 2 will not only operate the receiving apparatus 30 connected with the distant end of the said line, but, by virtue of the said mu-
95 tual admittance between the line 2 and the line 1 and other lines similarly situated, will set up an interfering current in the said line 1 and the other lines. This interfering current set up in line 1 will be substan-
100 tially neutralized in relay 6 by the neutralizing current resulting from the difference of potential induced across the terminals of the winding 14 by the current flowing
105 through the winding 26, which induced potential is adapted to produce a current of correct size, shape and phase to neutralize the interfering current existing in the relay 6 due to the transmission of the signaling
110 impulse over the line 2. As stated heretofore, the impression of the neutralizing current upon the coils 3 produces no detrimental effect upon the receiving relay 5, in
115 view of the differential connection of the coils. By means of the condenser 17 and resistance 28, the effect of the interfering current upon relay 5 is substantially neu-
120 tralized by the current flowing in the artificial line branch of the bridge coils 18, as the result of impressing the signaling current upon the apex of the said coils.

Although the transformer 15 is represented as having only two windings, which
125 are connected with the two line circuits shown in the drawing, it is to be understood that a transformer may be designed embodying the principles set forth in this in-
130 vention, having a winding individual to each of the circuits of a system, the said windings being magnetically connected in such manner that the transmission of a sig-

nalizing impulse over any line circuit connected with the said transformer winding will induce neutralizing impulses in the other windings of the said transformer in such direction as to neutralize the interfering currents set up in the other line circuits of the said system connected with the said other transformer windings in which the neutralizing impulses are generated.

It will be seen from the foregoing description that my invention discloses simple and effective means for protecting parallel telegraph circuits against receiving-end interference. Although this invention has been described as embodied in a particular form and arrangement of parts, it is to be understood that it is capable of embodiment in other forms and arrangements without departing from the spirit and scope of the appended claims.

What is claimed is:

1. In a system for reducing receiving-end cross-fire in telegraph circuits, the method which consists in transmitting over any circuit of a system a signaling impulse adapted, by the admittance of the system, to create an interfering impulse in the other circuits of the system, and simultaneously inducing in the other circuits of the system, by means of the transmission of the said signaling impulse over the said first mentioned circuit, neutralizing impulses to substantially neutralize the effect of the interfering impulse upon the distant receiving apparatus of the said other circuits.

2. In a system for reducing receiving-end cross-fire in telegraph circuits, the method which consists in transmitting over a circuit of a system a signaling impulse adapted, by the admittance of the system, to create an interfering impulse in the other circuits of the system, and impressing upon the said other circuits a neutralizing impulse without affecting the receiving apparatus at the point of application, but adapted to neutralize the effect of the interfering impulse upon the receiving apparatus more remote from the point of application of the said neutralizing impulse, the said neutralizing impulse being created inductively by the signaling impulse in said first circuit.

3. In a system for reducing receiving-end cross-fire in telegraph circuits, the method which consists in transmitting over a circuit of a system a signaling impulse adapted, by the admittance of the system, to create an interfering impulse in the other circuits of the system, and impressing upon the said other circuits a neutralizing impulse without affecting the receiving apparatus of the said other circuits at the point of application but serving to neutralize the effect of the interfering impulse upon the distant apparatus of the said other circuits.

4. In a system for reducing receiving-end

cross-fire in telegraph circuits, the method which consists in impressing upon any circuit of a system signaling currents tending to produce in the other circuits, by virtue of the admittance of the system, interfering currents having at the distant ends of said other circuits the same direction as the said signaling impulse, and simultaneously inducing in the said other circuits, by means of the transmitted signaling impulse of the said first circuit, current in opposite direction to the interfering currents at the distant ends of the said other circuits, whereby the effects of the latter upon the receiving apparatus at the distant ends of the said other circuits may be substantially eliminated.

5. In a system for reducing receiving-end cross-fire in telegraph circuits, the combination with a line circuit having duplex terminal circuits associated therewith, of a second line circuit also having duplex terminal circuits associated therewith, each of said terminal circuits having a transmitting branch connected with the apex of the said duplex set and an inductive coupling between the said transmitting branches of the terminal circuits at the same ends of all of the said circuits so arranged that the transmission of signaling current through the winding of the said coupling connected with the terminal circuit of one line will induce a current in the direction opposite to the signaling current of the first line in the winding connected with the corresponding terminal circuit of the said other line circuit.

6. In a system for reducing receiving-end cross-fire in telegraph circuits, the combination with a line circuit having duplex terminal circuits associated therewith, of a second line circuit also having duplex terminal circuits associated therewith, each of said terminal circuits having a transmitting branch connected with the apex thereof, means for coupling together the transmitting branches of the said terminal circuits at the same end of all of said circuits, the said coupling being so arranged that the transmission of signaling current through one of said transmitting branches will produce a neutralizing current in the transmitting branches coupled therewith, the direction of which will be opposite to that of the signaling current, the said neutralizing current being applied to the other circuits in a manner adapted to neutralize the interfering currents in the receiving apparatus at the distant ends thereof without affecting the receiving relay connected with the said other terminal circuits at the same end of the line circuits where the neutralizing impulse is applied.

7. In a system for reducing receiving-end cross-fire in telegraph circuits, the combina-

tion with a plurality of line circuits of a plurality of duplex terminal circuits individual to and connected with the opposite ends thereof, each terminal circuit having a transmitting branch connected with the apex of the said terminal circuit for applying signaling impulses for transmission over the said line circuit, and an inductive coupling device comprising a plurality of windings individual to and connected with the said transmitting branches, the said windings being so arranged that the flow of signaling current through one of the said windings will create a flow in opposite direction in the other of said windings.

8. In a system for reducing receiving-end cross-fire in telegraph circuits, the combination with a plurality of line circuits, of duplex terminal circuits individual to and connected with each end of said line circuits, the said terminal circuits comprising a line branch, an artificial line branch, and a transmitting branch connected with the junction of the said other branches, and a transformer having a plurality of windings individual to and connected with the transmitting branches of the terminal circuits in order to inductively connect the said line circuits and to minimize receiving-end cross-fire.

9. In a system for reducing receiving-end cross-fire in telegraph circuits, the combination with a plurality of line circuits of duplex terminal circuits connected with the ends of the said line circuits, the said ter-

minal circuits comprising a line branch, an artificial line branch, and a transmitting branch connected with the junction of the said other branches, and a transformer having a plurality of windings individual to and connected with the transmitting branches of the correspondingly located terminal circuits, the windings being so disposed that the transmission of a signaling impulse through one of the said windings will create an impulse in opposite direction in the others.

10. In a system for reducing receiving-end cross-fire in telegraph circuits, the combination with a plurality of line circuits of duplex terminal circuits individual to and connected with the said line circuits, each of said terminal circuits comprising a line branch, an artificial line branch and a transmitting branch connected with the junction of the said other branches, a transformer having a plurality of windings individual to and connected with the transmitting branches of the said duplex terminal circuits adapted to inductively connect all of the transmitting branches correspondingly located, and means to control the magnitude, wave shape, and phase relations of currents flowing through the said line circuits.

In testimony whereof, I have signed my name to this specification this 30th day of January 1922.

SAMUEL I. CORY.