

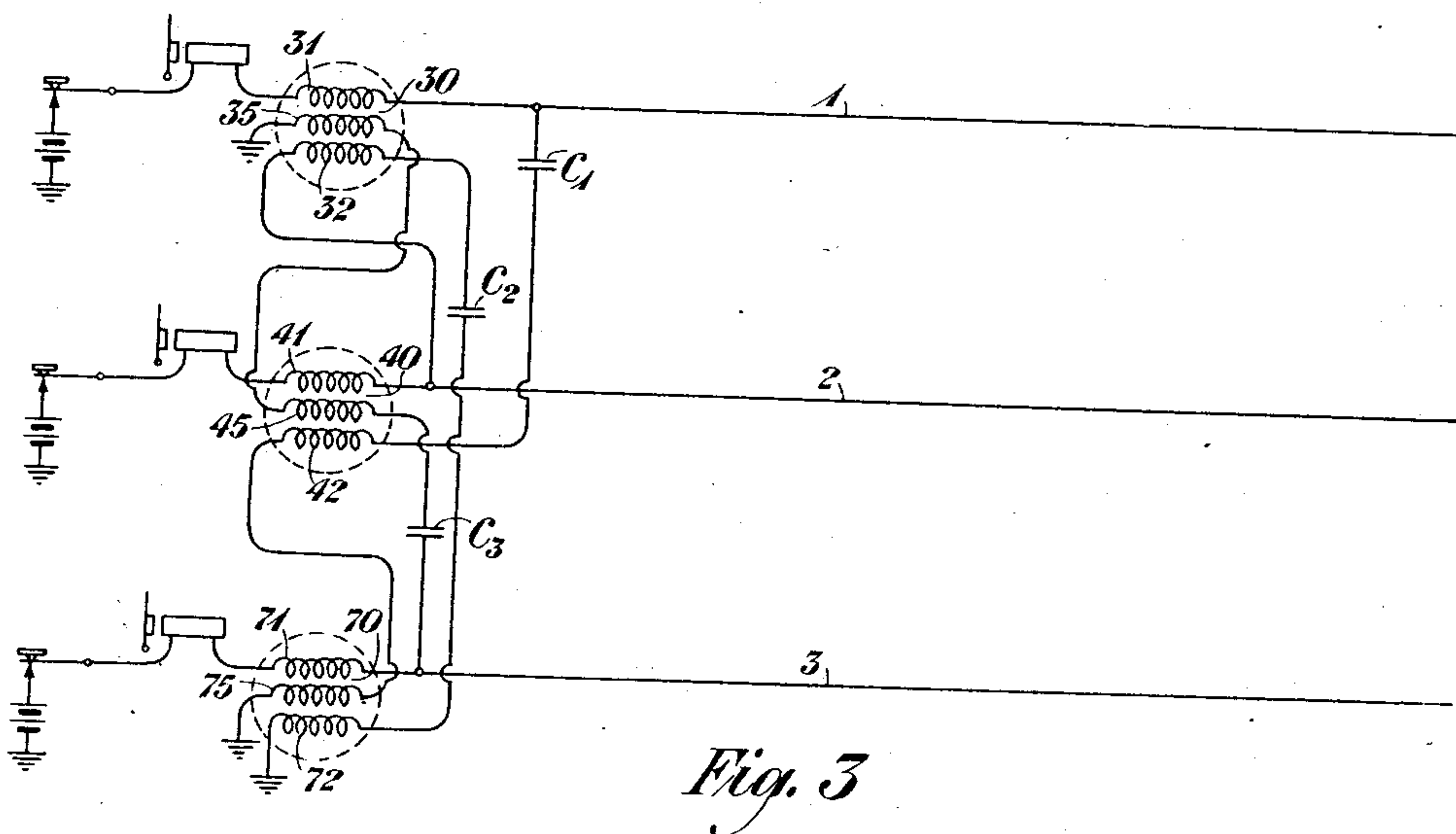
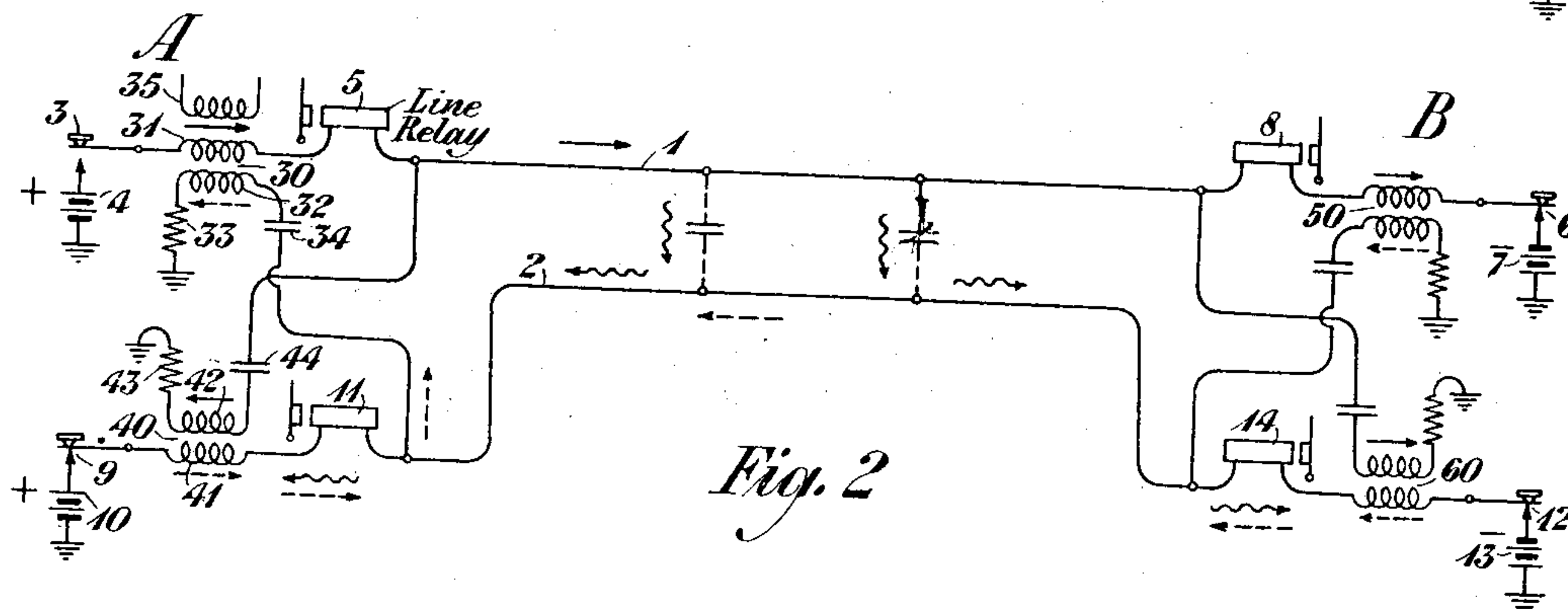
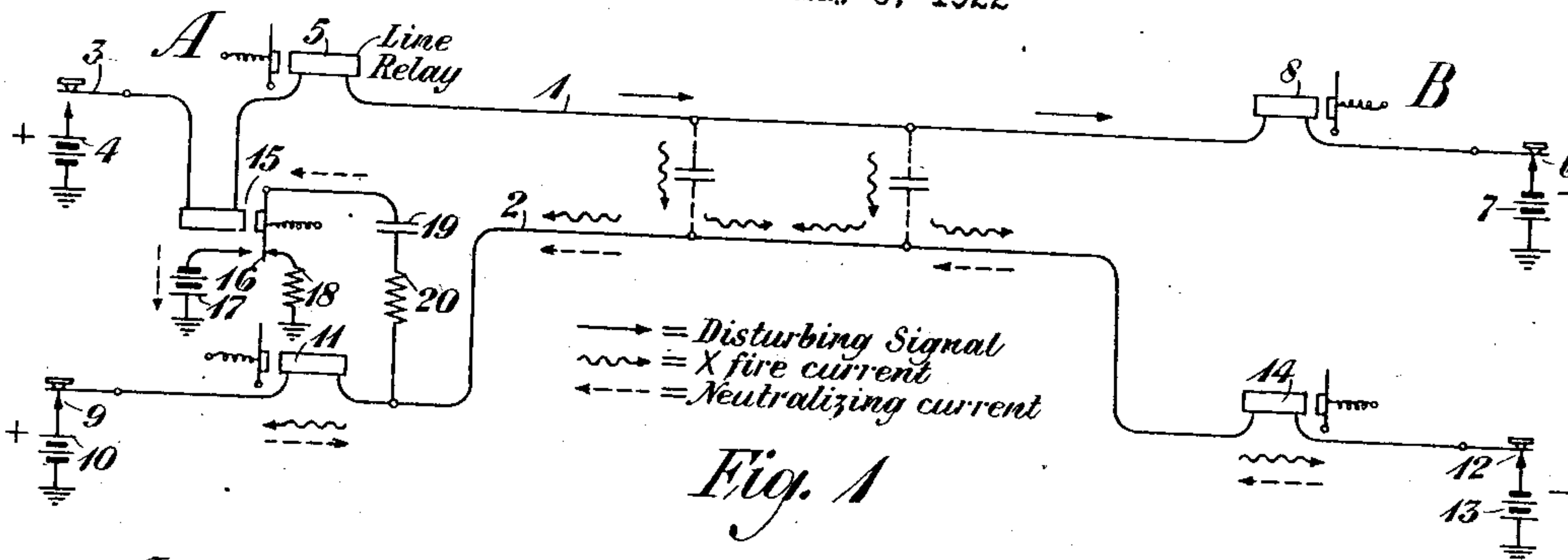
June 28, 1927.

R. B. SHANCK

1,633,611

MEANS FOR PREVENTING ELECTRICAL INTERFERENCE

Filed May 6, 1922



INVENTOR.
R. B. Shanck
BY *J. H. G. L.*
ATTORNEY

Patented June 28, 1927.

1,633,611

UNITED STATES PATENT OFFICE.

ROY B. SHANCK, OF WOODSIDE, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

MEANS FOR PREVENTING ELECTRICAL INTERFERENCE.

Application filed May 6, 1922. Serial No. 559,029.

This invention relates to means for preventing electrical interference and especially to an arrangement for preventing that form of interference between single-line grounded telegraph circuits, which is termed 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 first 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. The disturbance 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 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.

Various methods and means for neutralizing both types of cross-fire in duplex or half-duplex telegraph circuits have been described in the copending application of Shanck, Serial No. 473,118, filed May 27, 1921, and that of Cory, Serial No. 533,370, filed February 1, 1922.

It is the object of the present invention to prevent or to minimize telegraph cross-fire in single-line Morse circuits, which as will be shown, are structurally and operatively different from the duplex and half-duplex circuits heretofore referred to.

This invention will be better understood from the following description when read in connection with the attached drawing, of which Figure 1 shows a form of embodiment of the invention using a capacitive coupling; Fig. 2 shows a form using an inductive coupling, and Fig. 3 shows the application of the form of the invention shown in Fig. 2 to a network involving more than two line circuits.

In Fig. 1, 1 and 2 represent two line circuits, the former of which will be considered, for the purpose of describing this invention, as the disturbing circuit, and the latter the disturbed circuit, that is to say, the transmission of signaling impulses over line 1 will set up an interfering or cross-fire current in line 2 by virtue of the mutual admittance represented in the drawing by condensers connected by dotted conductors between the two lines. The line 1 has connected therewith at the station A a key 3, a source of direct current 4 and a main line relay 5. In similar manner there is connected with the line 1 at station B a key 6, a source of direct current 7, the polarity of which is opposite that of the source 4, and a main line relay 8. At station A there is also connected into the line 1 the winding of a relay 15, forming part of the cross-fire neutralization equipment which will presently be described in full.

The line circuit 2 has connected therewith at station A a key 9, a source of direct current 10 and a main line relay 11, and similarly at station B, a key 12, a source of direct current 13, the polarity of which is opposite that of the source 10, and a main line relay 14. The line circuit 2 is connected preferably at station A with the armature 16 of the neutralizing relay, the said connection including in series a condenser 19 and a resistance 20. The armature 16 is adapted to move between two contacts, the left-hand one of which is connected with a source of direct current 17 of opposite polarity to source 4 and the right-hand one is connected to ground through an impedance 18.

Having in mind the foregoing description of the circuit in which this invention is embodied it will be clearly understood from the following description of the mode of operation of the circuit.

Assume that the line 2 is not being operated, which means that the keys 9 and 12 are closed. Also assume that signals are being sent from station A to station B, in which event the key 6 at B will be kept closed and the key 3 at A will be opened and closed, depending upon the type of signal to be transmitted. When key 3 is closed an impulse of current will flow from station A to station B in the direction represented by the solid arrows. The transmission of such

an impulse over the line 1 will set up in the disturbed circuit 2 a cross-fire current represented by the wavy arrows. This current will flow in opposite directions in the said circuit 2, depending upon the magnitude of the impedance to ground in the two directions. When the signal impulse was transmitted over the line 1 by the closing of the key 3, the relay 15 was operated, which connected the negative battery 17 to the line circuit 2 through the condenser 19 and resistance 20. There would accordingly occur in the line circuit 2 a transitory flow of current in the directions represented by the dotted arrows, the duration of which would depend upon the capacity of the condenser 19 and the value of resistance 20. By the proper adjustment of the constants of the neutralizing circuit the magnitudes of the cross-fire current, and the neutralizing current, may be made substantially equal, thereby effecting proper neutralization of the disturbing currents.

When the key 3 is open for the transmission of a "space" signal to the distant station, current will cease to flow in the line 1 and consequently the relay 15 is de-energized, thereby connecting the line circuit 2 to ground, the connection including resistance 20, condenser 19 and the impedance 18. Since the battery 4 is disconnected from line 1, the said line assumes a negative potential with respect to the earth, due to the connection therewith of the source 7. This occasions a cross-fire current in the line 2 which will be opposite to that shown by the wavy arrows in Fig. 1. Therefore, in order to neutralize this cross-fire current the direction of the neutralizing current must be opposite. Thus, when the armature 16 moves to the right and touches the contact that connects the impedance 18 in series therewith, some of the energy of the condenser 19 will be given up, causing a current to flow in the direction opposite to that represented by the dotted arrows in the figure.

Fig. 2 shows the application of the principle of this invention to a single line Morse circuit by means of an inductive coupling. The same reference numerals used in Fig. 1 have been used in this figure to represent similar parts. Connected in the circuit of the line 1 is the primary winding 31 of a transformer 30, the secondary winding of which, 32, is connected between ground and the line circuit 2, the connection including a resistance 33 and a condenser 34. Similarly, there has been connected in series with the line circuit 2 a primary winding 41 of a transformer 40, the secondary of which, 42, has been connected between ground and the line circuit 1, the connection including a resistance 43 and condenser 44. Similar transformers 50 and 60 have been connected

in a similar manner with the circuits 1 and 2 at the distant station B.

When the keys of the line circuit 2 are closed, as shown in the figure, and key 3 of line circuit 1 is closed in order to transmit a marking impulse to the distant station B, current flows through the primary winding 31 of the transformer 30, which induces in the secondary 32 a potential such as to cause current to flow in the said secondary winding in opposite direction to the current in the line circuit 1. This current in the secondary winding is represented by the dotted arrow. It will accordingly be seen that the interfering cross-fire current set up in the line 2 (represented by the wavy arrow), will be opposed in direction by the neutralizing current represented by the dotted arrows. The magnitude of the neutralizing current may be controlled by the proper adjustment of the constants of the neutralizing circuit so as to substantially equal the interfering current and therefore to prevent any effect of the latter upon the relays at either end of the exposed circuit 2.

When the key 13 is opened for the transmission of a space signal the direction of the interfering current in the line 2 will be opposite that shown in the figure. The change of current in line 1 induces a current which will flow in the exposed circuit 2 in a direction opposite to that represented by the dotted arrows of the figure, so that the interfering current will be neutralized. The transformers 50 and 60, represented at the distant station B, function in the same manner as the transformers 30 and 40, shown at station A, and it is believed that further description of them is not necessary.

Fig. 3 shows the application of this invention, in the form shown in Fig. 2, to three line circuits. In this figure are shown three transformers, 30, 40 and 70, the primaries of which, 31, 41 and 71, are connected in series with the line circuits 1, 2 and 3. The secondary 35 and the secondary 45 are connected in series between ground and the line circuit 3, the said connection including a condenser C_3 . Similarly, the secondary 32 and the secondary 72 are connected in series between the ground and the line circuit 2, the said connection including the condenser C_2 , and in like manner the secondary 42 and the secondary 75 are connected in series between the ground and the line circuit 1, the said connection including the condenser C_1 . By this inductive interconnection of the various lines that make up the network it will be seen that a neutralizing impulse is set up in every other line circuit of the network when a signaling impulse is transmitted over one of the lines of the said network.

In the case of a large gauge cable circuits,

receiving-end cross-fire is ordinarily larger than the sending-end cross-fire, making neutralization somewhat difficult by the methods heretofore described. It is believed however, that by allowing the sending-end cross-fire to be over-neutralized when the exposed circuit is closed, sufficient neutralization of the receiving-end cross-fire can be secured. When the key of the exposed circuit is open, the impulse for neutralizing receiving-end cross-fire is considerably greater, but probably will not be great enough to cause serious over-neutralization.

It will be seen that by the means of this invention, several forms of which are shown and described herein, cross-fire interference between a plurality of single-line Morse circuits may be substantially neutralized or prevented. From the foregoing description it will be noted that the problem of neutralizing cross-fire between single-line Morse circuit is different from that of neutralizing cross-fire between duplex or half-duplex circuits, inasmuch as in the first mentioned circuit, the impedance of the disturbed line circuit varies for different positions of its sending key at the home station, whereas in the duplex or half-duplex circuit, the position of the key on the disturbed circuit has no bearing upon the impedance of the exposed circuit. Furthermore, owing to the fact that single-line Morse circuits have no neutral point such as if provided by the balanced ratio arms in duplex or half-duplex circuits, it is impracticable in the former type of circuit to neutralize independently the sending-end and receiving-end cross-fire, which can be done in the case of the duplex or half-duplex circuit, as fully described in the said copending applications heretofore referred to.

Although this invention has been disclosed as embodied in particular forms it is not limited to these forms but is capable of embodiment in a variety of forms within the scope of the appended claims.

What is claimed is:

1. In a single-line Morse telegraph system, the method for substantially neutralizing cross-fire which consists in impressing a signaling impulse upon one of the circuits of the said system, causing the said impulse to create a neutralizing impulse in each of the other circuits of the said system in such directions as to prevent both the receiving-end and the sending-end cross-fire impulses.

2. In a single-line Morse telegraph system, the method for substantially neutralizing cross-fire, which consists in impressing a signaling impulse upon one of the circuits of the said system, causing the said impulse to create a difference of potential to ground in the other circuits of the said system, whereby all of the cross-fire currents pro-

duced by the mutual admittance between the circuits of the said system may be neutralized.

3. In a single-line Morse telegraph system, the method for minimizing cross-fire, which consists in impressing a signal impulse upon one of the circuits of the said system, thereby producing interfering impulses in another circuit of the said system, and controlling the production of neutralizing impulses in the said other circuit, the direction of propagation of the said neutralizing impulses being such as to oppose and neutralize the interfering impulses throughout the said other circuit.

4. In a single-line Morse telegraph system, the combination with two single-line Morse circuits, of a transformer, one winding of which is connected in series with one of said Morse circuits, and the other winding of which is connected in series with a condenser between the other of said Morse circuits and ground.

5. In a single-line Morse telegraph system, the combination with two single-line Morse circuits, of a transformer, one winding of which is connected in series with one of said Morse circuits, and the other winding of which is connected in series with a condenser and a resistance between the other of said Morse circuits and ground.

6. In a single-line Morse telegraph system, the combination with two single-line Morse circuits, of a plurality of transformers, each of which has one of its windings in series with one of the said Morse circuits, and the other winding connected in series with a condenser between said other Morse circuit and ground.

7. In a single-line Morse telegraph system, the combination with two single-line Morse circuits, of a plurality of transformers, each of which has one of its windings in series with one of the said Morse circuits, and the other winding connected in series with a condenser and a resistance between said other Morse circuits and ground.

8. In a single-line Morse telegraph system, the combination with a plurality of single-line Morse circuits, of a plurality of multiwinding transformers, each of which has one winding connected in series with one of said Morse circuits, and each of the other windings connected in series with a condenser between one of the other Morse circuits and ground.

9. In a single-line Morse telegraph system, the combination with a plurality of single-line Morse circuits, of a plurality of multiwinding transformers, individual to each having one winding connected in series with one of said Morse circuits, and each line having connected to it a path to ground containing a condenser, a resistance and another winding of each of the said

transformers associated with the other lines.

10. In a single-line Morse telegraph system, the combination with a plurality of single-line Morse circuits, of a plurality of multiwinding transformers individual to and each having one winding connected in series with one of said Morse circuits, and the other windings of the respective trans-

formers arranged in groups, each group being connected in series with a condenser between a line circuit and ground. 10

In testimony whereof, I have signed my name to this specification this 5th day of May, 1922.

ROY B. SHANCK.