

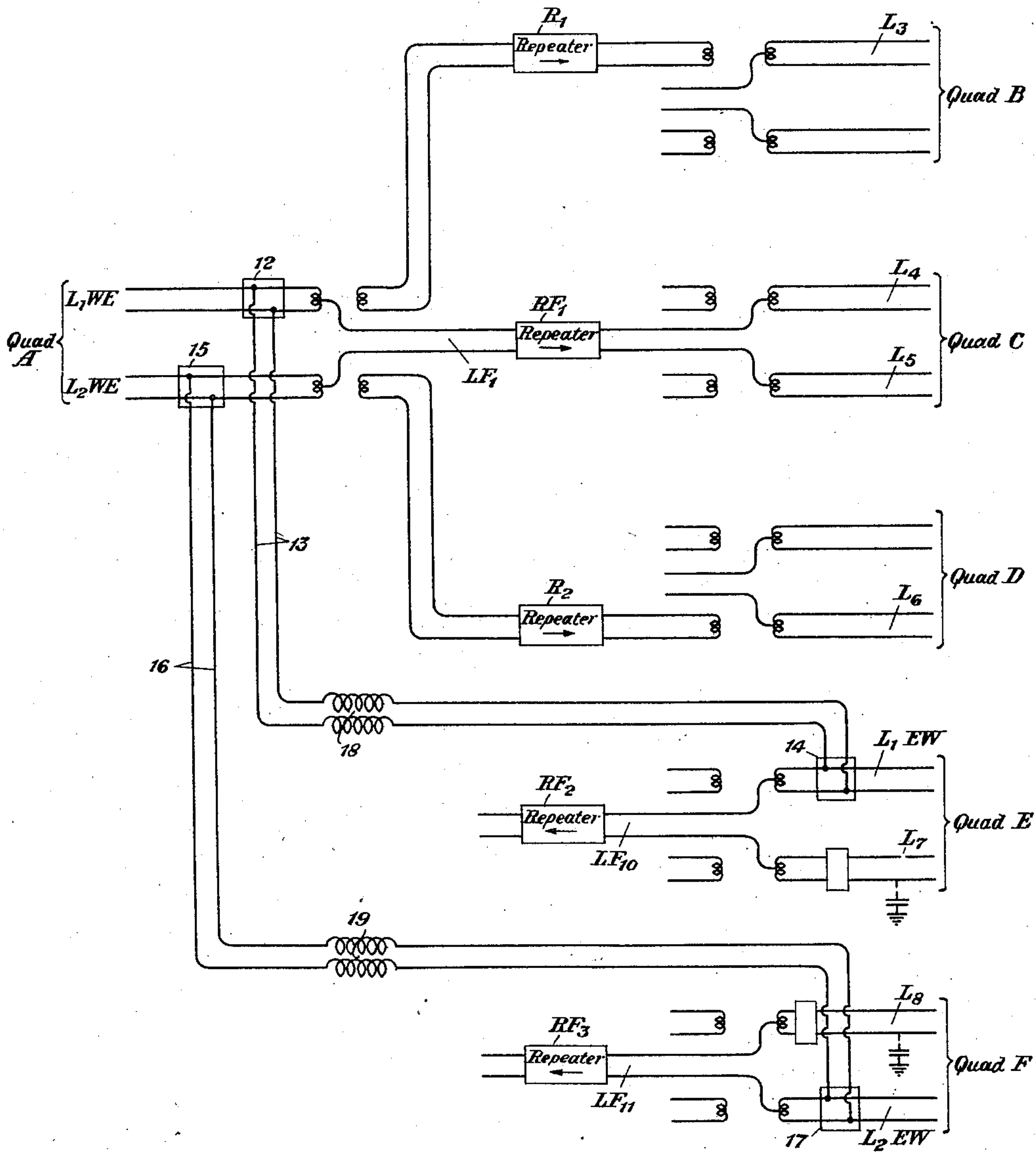
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TELEPHONE AND TELEGRAPH SYSTEM

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TELEPHONE AND TELEGRAPH SYSTEM

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This invention relates to telephone systems of the well known four-wire type and more particularly to arrangements for utilizing the conductors of such systems for telegraph as well as telephone purposes under certain conditions when the wires of the systems are so transposed that the phantom circuits will be separated from their side circuits at the transposition points.

The four-wire type of telephone system comprises two one-way line sections each for transmission in opposite directions. One-way repeaters would ordinarily be included in these one-way line sections at various points. Furthermore, two one-way line sections each transmitting in the same direction and being parts of different four-wire systems, might be arranged in quads and utilized for the production of phantom telephone circuits. In certain types of systems, the one-way line sections in one quad might be connected through amplifiers at repeater points to one-way line sections in the same quad. The phantom circuits might also be connected at repeater points to the conductors in the same quad. In other words, under such conditions, the phantom circuits would not be separated from their side circuits. In systems of this type, it would be possible to transfer a metallic telegraph circuit at an intermediate repeater point from one pair of a particular four-wire circuit to the other pair of conductors of said four-wire circuit. As the phantom circuits are not separated from the side circuits, any telephone energy which might be transmitted over such a telegraph connection from the phantom line associated therewith would be transmitted back to the station of its own origin in the phantom line which was the other side of the same circuit, and might cause echo but would not cause any cross-talk.

However, it is often found desirable to transpose the conductors of the various quads in a system at certain points so that the conductors in one quad will be separated from each other and will be extended as parts of other quads. Such a transposition arrangement might readily result in the phantom circuits being separated from their side circuits

in one quad and result in their being completed over the conductors of another quad. If under such conditions, a metallic telegraph circuit was connected at an intermediate repeater point from one pair of a four-wire circuit to the other pair of said circuit, any telephone energy which might be transmitted over such a telegraph connection from the phantom line associated with one end thereof, would not be transmitted back to the station of its own origin so as to cause harmless echo, but would be transmitted over a new phantom line to a new station and would cause undesirable phantom cross-talk. The phantom circuit would be made noisy, also, if the telegraph circuits or the pairs comprising it were transferred to two different cables.

The primary purpose of the arrangements of the invention is to provide arrangements whereby undesirable phantom cross-talk and noise may be prevented from occurring due to the telegraph connections in the above type of systems. Accordingly, there will be provided in the telegraph connection, a "phantom by-pass coil". This coil is connected in the telegraph circuit with its windings series opposed for the side circuit and, therefore, in parallel aiding for the phantom. Its impedance to the telegraph current, therefore, is non-inductive resistance, which may be made small enough so that it will not degrade transmission seriously. To the phantom, however, the coil is inductive, and, therefore, prevents cross-talk from one phantom circuit to the other. In other words, the "phantom by-pass coil" will effectively open the telegraph circuit for currents transmitted over the sides thereof in parallel and prevent their transmission but will readily transmit the currents transmitted over the sides thereof in series. Other objects and features of the invention will appear more fully from the detailed description thereof hereinafter given.

The invention may be more fully understood from the following description together with the accompanying drawing in the figure of which is shown a circuit diagram embodying a preferred form of the invention.

In the drawing are shown two line sections L_1WE and L_2WE in the quad A and adapted

for transmission from W to E. Line section L_1WE is one side of a four-wire circuit. The other side of this four-wire circuit is the line section L_1EW in quad E. Line section L_2WE may be one side of a four-wire circuit. The other side may be line L_2EW in quad F. Line section L_1WE may be extended at the repeater station through the repeater R_1 to the line section L_3 in quad B. Line section L_2WE may be extended at the repeater station through the repeater R_2 to line section L_6 in quad D. In other words, the two line sections in quad A may be separated and connected to conductors in other quads. This transposing of the conductors is desirable to minimize cross-talk between the various circuits in that it limits the distance for which two circuits are exposed to each other in the same quad. The line sections in quad A are phantom to produce the phantom circuit LF_1 . Obviously when the lines are transposed the phantom circuit will be separated from its side circuits. The phantom circuit LF_1 is shown connected to repeater RF_1 and then by a phantom connection to circuits L_4 and L_5 in quad C. In a similar manner, the other line sections of the various quads might be so transposed that the phantom circuits would be separated from the side circuits and the circuits in each quad might be separated from each other.

In order that the various lines may be utilized for telegraph purposes, means are provided for transmitting the telegraph currents between the various lines at repeater points. These means comprise metallic telegraph connections from one side of a four-wire circuit to the other side of such four-wire circuit. For example, the telegraph circuit 13 will be provided and will be connected by the composite set 12 to line L_1WE and will be connected by the composite set 14 to line L_1EW . These connections may be established at points of approximately the same transmission level such as at the inputs of the repeaters connected to each of said lines. In a similar manner, the telegraph conductor 16 will be provided and will be connected by composite set 15 to line L_2WE and will be connected by composite set 17 to line L_2EW . Other telegraph legs might be provided between the sides of other four-wire circuits in the system. These, however, have been omitted for the sake of simplicity in the drawing.

In a system of the above type in which the transposition of the lines caused the phantom circuits to be separated from their side circuits such telegraph connections might cause phantom cross-talk and noise or in other words, might cause disturbances to exist on the various phantom lines. For example, a portion of the telephone energy, which was transmitted over phantom line LF_1 , or in other words over the sides of lines L_1WE and L_2WE in parallel, might be transmitted over

telegraph circuit 13. This energy might then be applied to phantom circuit LF_{10} , the circuit being completed by the capacity connection to ground of line L_7 . It is pointed out that the phantom line LF_{10} is a totally different line from phantom line LF_1 and accordingly, this telephone energy would not cause harmless echo but would cause cross-talk and noise. In a similar manner, the telephone energy from phantom line LF_1 might be transmitted over telegraph circuit 16 and cause cross-talk on phantom line LF_{11} . In accordance with the arrangements of this invention, "phantom by-pass coils" will be provided in each telegraph leg. The coils 18 and 19 have been shown included in the telegraph legs 13 and 16, respectively. As has been pointed out, the windings of these coils will be so arranged as to be series opposed for the side circuit and therefore in parallel aiding for the phantom. In other words, currents transmitted over the sides of circuit L_1WE in series, and hence transmitted over the conductors of circuit 13 in series would be readily transmitted through coil 18. However, when lines L_1WE and L_2WE are used as sides of a phantom line the currents will be transmitted in parallel over the conductors of each of said circuits. Such currents would be transmitted in parallel over the sides of circuit 13 and their transmission would be effectively opposed by the coil 18. Hence, the currents intended for the phantom line LF_1 will not cause any cross-talk or noise on the phantom lines LF_{10} and LF_{11} .

While the invention has been disclosed as embodied in certain specific arrangements which are deemed desirable, it is understood that it is capable of embodiment in many other and widely varied forms without departing from the spirit of the inventions as defined by the appended claims.

What is claimed is:

1. A transmission system comprising a plurality of four-wire telephone circuits having their one-way circuits arranged in quads and arranged for the production of phantom circuits, the individual circuits being so transposed at a point that the phantom circuits will be separated from their side circuits, telegraph circuits connected between the one-way circuits of certain of said four-wire circuits, and means in said telegraph circuits for preventing the transmission thereof of currents from said phantom circuits.

2. A transmission system comprising a plurality of four-wire telephone circuits having their one-way circuits arranged in quads and arranged for the production of phantom circuits, the individual circuits being so transposed at a point that the phantom circuits will be separated from their side circuits, telegraph circuits connected between the one-way circuits of certain of said four-wire cir-

cuits at points of about the same transmission level, and coils in said telegraph circuits having their windings series opposed and parallel aiding.

5 3. A transmission system comprising a plurality of four-wire telephone circuits having their one-way circuits arranged in quads and arranged for the production of phantom circuits, the individual circuits being so
10 transposed at a point that the phantom circuits will be separated from their side circuits, telegraph circuits connected between the one-way circuits of certain of said four-wire circuits at points of about the same
15 transmission level, and means in said telegraph circuits for preventing the transmission thereover of currents applied to the sides of said circuits in parallel.

4. A transmission system comprising a
20 plurality of four-wire telephone circuits having their one-way circuits arranged in quads and arranged for the production of phantom circuits, the individual circuits being so transposed at a point that the phantom cir-
25 cuits will be separated from their side circuits, telegraph circuits connected between the one-way circuits of certain of said four-wire circuits at points of about the same transmission level, and means in said tele-
30 graph circuits for preventing the transmission thereover of currents applied to the sides of said circuits in parallel but readily allowing the transmission thereover of currents applied to the sides of said circuits
35 serially.

In testimony whereof, I have signed my name to this specification this 25th day of September, 1929.

LELAND C. ROBERTS.

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