

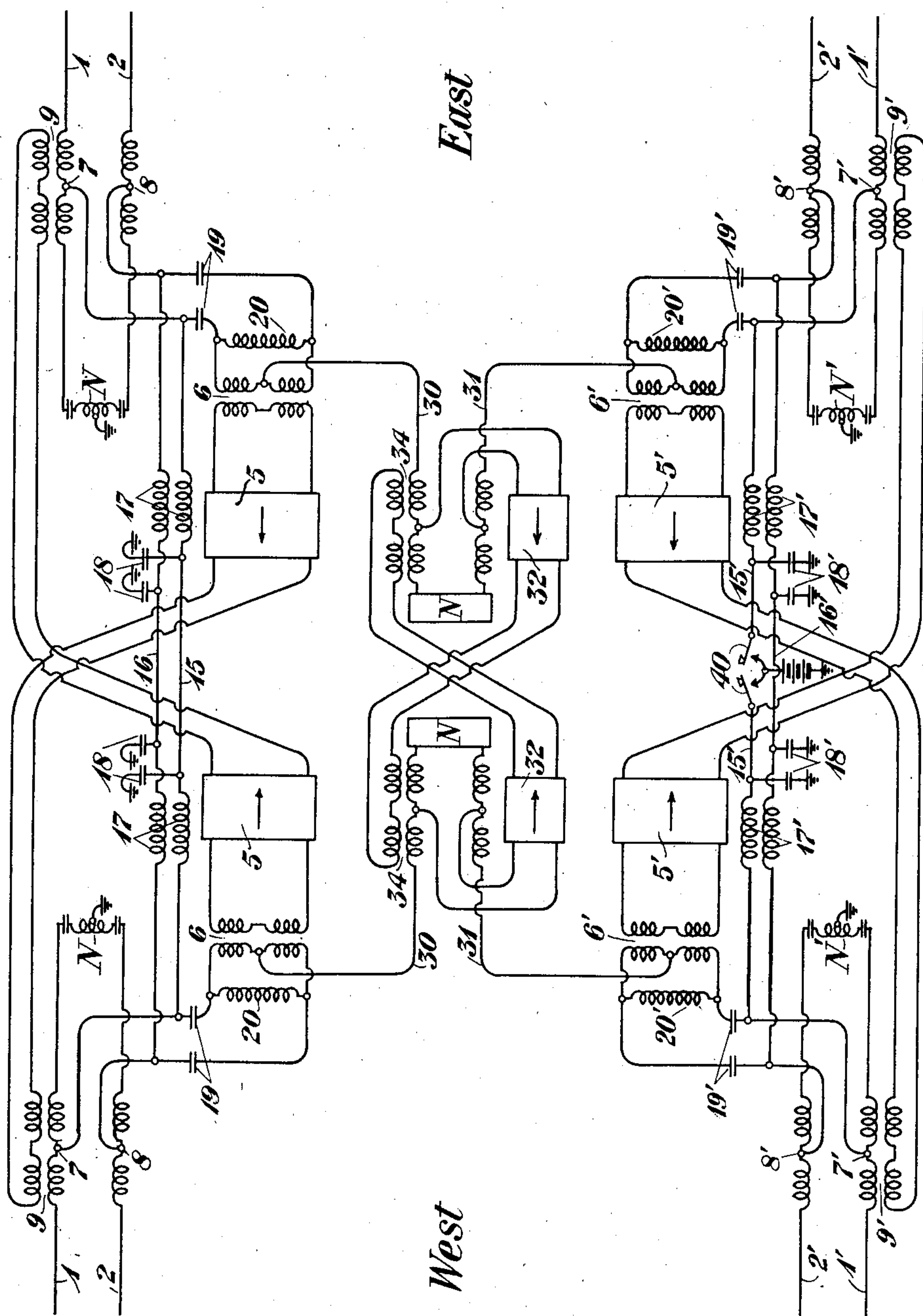
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TELEPHONE REPEATER

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UNITED STATES PATENT OFFICE.

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TELEPHONE REPEATER.

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My invention relates to repeater circuits.

One object of the invention is to eliminate the repeating coils heretofore commonly placed into the side conductors of a phantom group for the purpose of associating a repeater with the phantom circuit, these coils being objectionable for the reason that they necessitate the addition of impedance devices to the network to correct for the change which is caused by the coils in the impedance of the line. In this invention the apparatus of the phantom repeater is connected to the line conductors at the points or symmetry between the lines and the side circuit networks, i. e., at the points where the impedance of the network circuit is substantially equal to the impedance of the line circuit, which points coincide with the midpoints of the transformers commonly used in the side circuit repeaters. Apparatus associated with these points causes no change in the relative values of the impedances of the network and line circuits, and therefore no unbalance.

Another object of the invention is to associate with the said points of symmetry other apparatus heretofore so connected to the line wires as to cause an unbalance between the network and the line, for example the apparatus employed for shunting or relaying signaling currents (low frequency alternating or direct) around the repeater installation.

Various other features and objects of the invention will appear from the following description thereof, reference being had to the accompanying drawing showing in diagrammatic view one form and arrangement of apparatus embodying the invention.

In this drawing, reference characters 1 and 2 designate the line conductors of one side of a phantom group and numerals 1' and 2', the conductors of the other side of the group. Conductors 1 and 2 are divided into east and west sections terminated by balancing networks N, which sections are associated for currents of voice frequencies by means of a two-element two-way repeater of a type well known in the art, this repeater comprising transformers 9, the midpoints 7 and 8 of which are associated by means of transformers 6 with the input sides of amplifying devices 5, the output circuits of which are associated with the primary windings of the aforementioned transformers 9. The opera-

tion of the repeater is well understood and is briefly as follows: A portion of the voice currents in the west section of conductors 1 and 2 enters transformer 6 and is impressed thereby on the amplifying device 5, which augments the value of the current and impresses the amplified current on transformer 9, which causes the current to enter the east section of the line. The operation of the repeater from east to west is similar.

The conductors 1' and 2' are provided with a similar repeater, the parts of which are designated in the drawing by like characters of reference, a prime mark (') being used to distinguish this apparatus from that of conductors 1 and 2.

The phantom repeater, comprised of transformers 34 and amplifying devices 32, is similar to the side circuit repeaters hereinbefore described. It is associated with the line conductors by means of connections 30 and 31 to the midpoints of the primary windings of the transformers 6 and 6', respectively. It operates by causing phantom current in conductors 1 and 2 to flow through transformer 6 in opposite directions and enter conductors 30, from which conductor the current traverse the windings of transformer 34 and network N, and returns through conductor 31 and the winding of transformer 6' to conductors 1' and 2'. The input circuit of the amplifying device 32 shunts a portion of this current and causes amplified current to flow through transformer 34 into the east section of the phantom circuit. The operation of the repeater from east to west is similar and need not be separately explained.

The apparatus of the phantom repeater is thus connected through transformers 6 and 6', to the transformer midpoints 7, 8 and 7', 8', at which points there exists symmetry between the line circuits and the network circuits, the impedance of the circuit extending west of these points being substantially equal to that of the circuit extending east thereof. The phantom repeater apparatus thus causes no unbalance between the networks and their respective sections of the line, and additional impedances are not required in the networks for maintaining the balance.

For the purpose of conducting the signaling currents from one section of the line to

the other, I provide connections 15 and 16 between points 7, 8, 7' and 8' of the east and west sections respectively, of the line. The connections are provided with inductance coils 17 to prevent the flow therethrough of the high frequency alternating voice currents, and with condensers 18 connected to ground to shunt out such alternating currents as traverse coils 17, series condensers 19 and shunt inductance coils 20 being employed to prevent the flow of the direct and low frequency signaling currents into the repeater apparatus. The networks N are preferably grounded at their midpoints so that the telegraphic current in one line conductor is unable to cause a disturbance of the Morse circuit over the other conductor.

The conductors 15 and 16 may be severed at the repeater station and telegraphic or other signaling apparatus associated therewith as illustrated for the conductor 15' connected to line wire 1'. In this arrangement there are provided telegraph keys 40 for sending telegraphic messages over the conductors 1' of the left and right sections of the line respectively. This arrangement is merely illustrative, it being readily understood that any other suitable apparatus may be associated with any of the line wires in the manner herein shown.

Although only one form and arrangement

of apparatus embodying this invention is shown and described herein, it is readily understood that various changes and modifications may be made therein within the scope of the following claims, without departing from the spirit and scope of this invention.

What is claimed is:

1. In combination, a transmission line having phantom and side circuits, each in two sections, balancing networks for said side circuit sections, a phantom repeater associated with the line at the points of symmetry between the line sections and the networks, and a direct current path connecting the sections between the same points.

2. In combination, a transmission line having phantom and side circuits, each side circuit having two conductors, balancing networks for said side circuits, a phantom repeater associated with the line at the points of symmetry between the line and the networks, and low frequency through bilaterally conductive signaling paths connecting these points of symmetry for respective pairs of conductors.

In testimony whereof, I have signed my name to this specification this 17th day of October 1919.

OLIVER B. JACOBS.