

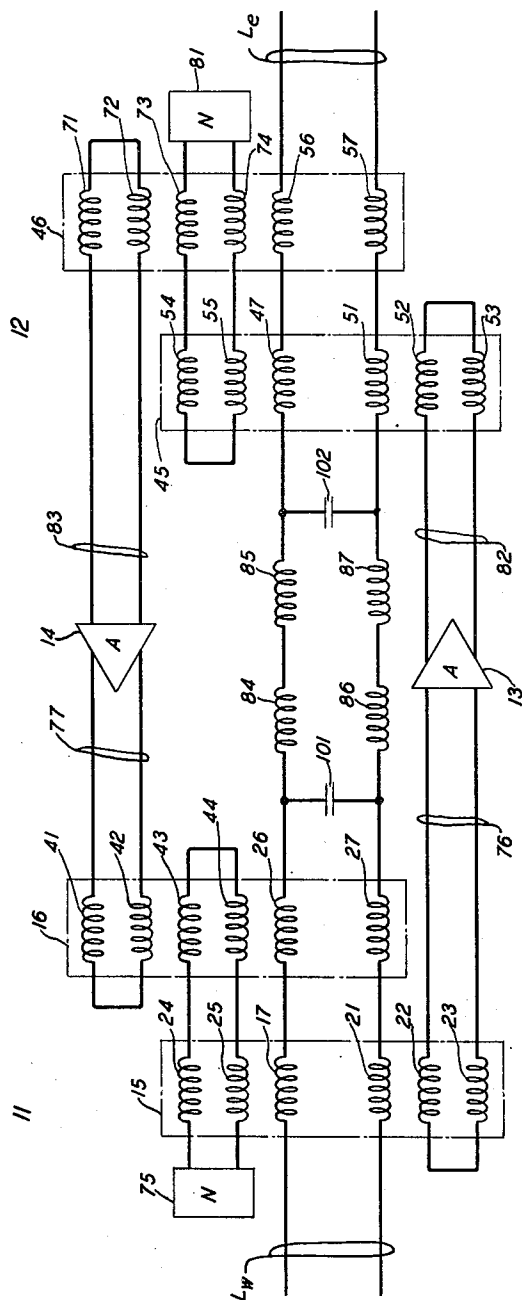
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SPEECH TRANSMISSION SYSTEM

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SPEECH TRANSMISSION SYSTEM

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4 Claims. (Cl. 179—170)

This invention relates to a speech transmission system of the type which includes a telephone repeater in the transmission line.

An object of the invention is to increase the efficiency of speech transmission systems of the type which includes a telephone repeater.

A more specific object of the invention is to facilitate and render more economical the transmission over such a speech transmission system of direct current and alternating currents of frequencies below voice frequency.

It is common practice, of course, in the operation of a speech transmission system of the type which includes a telephone repeater in the line to transmit, in addition to the voice frequency telephone currents, other currents. For example, direct current may be transmitted for dialing purposes, for energization of supervisory signals at the central office or for energization of the subscriber's telephone transmitter. Low frequency alternating current (usually of the order of 20~) may also be transmitted for signaling purposes. In the past transmission of these auxiliary currents has presented perplexing and expensive problems. The telephone repeater, being designed to amplify currents of the order of voice frequency, is not adapted to pass the direct current or the low frequency alternating current without resultant distortion so that it has been necessary heretofore to provide means for by-passing these currents around the repeater. The by-pass arrangements of prior systems have, in general, been expensive, have offered complex balancing problems and have resulted in substantial transmission loss.

A feature of the present invention is a continuous "straight-through" path of direct current and low frequency alternating current from one of the line sections to the other line section.

A complete understanding of the novel arrangements contemplated by the present invention as well as appreciation of the desirable features thereof will be gained by consideration of the following detailed description in connection with the annexed drawing, the single figure of which illustrates a telephone repeater including a novel path for direct current and low frequency alternating current of the nature contemplated by the present invention.

Referring now to the drawing, two speech transmission line sections L_w and L_e are shown coupled by respective hybrid coil sets 11 and 12 to west-east amplifier 13 and east-west amplifier 14. Hybrid coil set 11 includes two separate cores 15 and 16, core 15 being provided with line windings 17 and 21, amplifier windings 22 and 23 and balancing network windings 24 and 25, while core 16 is provided with line windings 26 and 27, amplifier windings 41 and 42 and balancing network windings 43 and 44.

Hybrid coil set 12 includes two cores 45 and 46, core 45 being provided with line windings 47 and 51, amplifier windings 52 and 53 and balancing network windings 54 and 55, while core 46 is provided with line windings 56 and 57, amplifier windings 71 and 82 and balancing network windings 73 and 74.

Hybrid coil set 11 and associated balancing network or artificial line 75 act to couple input path 76 of west-east amplifier 13 and output path 77 of east-west amplifier 14 in conjugate relationship with each other and in energy transmitting relationship with line section L_w ; similarly, hybrid coil set 12 and associated balancing network or artificial line 81 act to couple output path 82 of amplifier 13 and input path 83 of amplifier 14 in conjugate relationship with each other and in energy transmitting relationship with line section L_e .

Voice frequency currents received over line section L_w from the west terminal divide, one-half passing into output path 77 of east-west amplifier 14 and being lost and the useful half passing into input path 76 of west-east amplifier 13. These currents, after amplification by amplifier 13, are impressed on line section L_e . As output path 82 and input path 83 are coupled in conjugate relationship, as pointed out above, no part of these amplified currents enters the input path of amplifier 14.

In a manner similar to that just described, voice frequency currents received over line section L_e from the east terminal divide one-half being lost in output path 82 and the useful half being amplified by east-west amplifier 14 and impressed on line section L_w .

As pointed out above, direct current and low frequency alternating current need be transmitted over the line for dialing, supervision, battery supply and the like. As illustrated, a direct continuous path is provided for these currents, one side of the path including as series elements line windings 17 and 26 of hybrid coil set 11, inductances 84 and 85 and line windings 47 and 56 of hybrid coil set 12 and the other side of the path including as series elements line windings 21 and 27 of hybrid coil set 11, inductances 86 and 87 and line windings 51 and 57 of hybrid coil set 12. Inductances 84, 85, 86 and 87 and capacitances 101 and 102 provide filtering action effective to exclude the voice frequency currents from this path.

The provision of the straight-through continuous path contemplated by the present invention results in low loss transmission of the direct currents and low frequency alternating currents directly through the repeater section in either direction while inclusion of the filtering means in the path prevents passage of any part of the alternating currents therethrough. The ex-

pensive elements and the perplexing problem of preventing unbalance of the speech transmission circuits attendant upon provision of the by-pass paths of prior arrangements are entirely eliminated and a substantial transmission gain, as compared to the performance of prior arrangements, is achieved.

While a specific embodiment of the invention has been selected for detailed description, the invention is not limited in its application to the embodiment described. This embodiment should be taken as illustrative of the invention and not as restrictive thereof.

What is claimed is:

1. In combination with a two-way line divided into sections, a two-way repeater comprising two one-way amplifying paths for repeating in respectively opposite direction between opposite sections of line, a separate differential transformer included between each line section and said two paths, each such transformer comprising a pair of magnetic cores, line windings connected to the respective line sections and mounted in each case on both cores of the respective transformer, a balancing artificial line for each line section, windings mounted on both cores of the respective transformer and connected to the respective artificial line, other windings mounted on certain of said cores in the case of each transformer and connected respectively in circuit with the input side of one of said one-way paths and the output side of the other of said one-way paths, and a path for through transmission of currents of low frequencies including direct current extending from one line section to the other through said line windings of both transformers in series, said path consisting, between the respective points of connection to said line windings, of two lines and means for excluding therefrom voice frequency currents.

2. In combination with a two-way line divided into sections, a two-way repeater comprising two one-way amplifying paths for repeating in respectively opposite direction between opposite sections of line, a separate differential transformer included between each line section and said two paths, each such transformer comprising a pair of magnetic cores, line windings connected to the respective line sections and mounted in each case on both cores of the respective transformer, a balancing artificial line for each line section, windings mounted on both cores of the respective transformer and connected to the respective artificial line, other windings for each of said transformers connected respectively in circuit with the input side of one of said one-way paths and the output side of the other of said one-way paths, said other windings in the case of each transformer being mounted on a different one of said cores, and a path for through transmission of currents of low frequencies including direct current extending from one line section to the other through said line windings of both transformers in series, said path consisting, between the respective points of connection to said line windings, of two lines and means for excluding therefrom voice frequency currents.

3. In a speech transmission system, a west amplifier for voice frequency currents, an east amplifier for voice frequency currents, a two-wire west line section, a two-wire east line section, a first hybrid coil set and a first balancing network

for coupling said west line to the input of said west amplifier in speech energy transferring relationship, for coupling the output of said east amplifier and said west line section in speech energy transferring relationship and for coupling the output of said east amplifier to the input of said west amplifier in conjugate relationship, said first hybrid coil set comprising a first core and a second core, a first line winding and a second line winding on said first core, a first line winding and a second line winding on said second core, said first line windings being connected in series with each other and with one side of said west line section, said second line windings being connected in series with each other and with the other side of said west line section, a second hybrid coil set and a second balancing network for coupling said east line section to the input of said east amplifier in speech energy transferring relationship, for coupling the output of said west amplifier to said east line section in speech energy transferring relationship and for coupling the output of said west amplifier to the input of said east amplifier in conjugate relationship, said second hybrid coil set comprising a first core and a second core, a first line winding and a second line winding on said first core of said second hybrid coil set, a first line winding and a second line winding on said second core of said second hybrid coil set, said last-mentioned first line windings being connected in series with each other and with one side of said east line section, said last-mentioned second line windings being connected in series with each other and with the other side of said east line section, and a direct current transmitting path connected directly in series with said line windings of said two hybrid coil sets, said direct current path consisting, between the respective points of connection to said line windings, of two lines and means for excluding therefrom voice frequency currents.

4. In combination with a two-way line divided into sections, a two-way repeater comprising two one-way amplifying paths for repeating in respectively opposite direction between opposite sections of line, a separate differential transformer included between each line section and said two paths, each such transformer comprising a pair of magnetic cores, line windings connected to the respective line sections and mounted in each case on both cores of the respective transformer, a balancing artificial line for each line section, windings mounted on both cores of the respective transformer and connected to the respective artificial line, other windings for each of said transformers connected respectively in circuit with the input side of one of said one-way paths and the output side of the other of said one-way paths, said other windings in the case of each transformer being mounted on a different one of said cores, the input side of each one-way path being conjugate to the output side of the opposite one-way path and a path for through transmission of currents of low frequencies including direct current extending from one line section to the other through said line windings of both transformers in series, said path consisting only of two lines, inductance elements in series with each line and capacitance elements in shunt to the two lines.

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