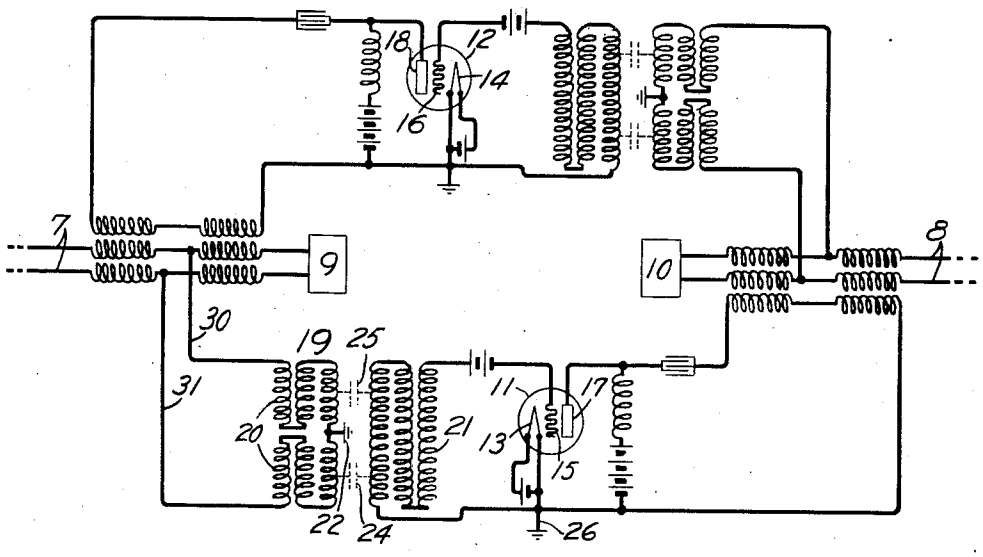
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W. L. CASPER

TRANSMISSION SYSTEM

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TRANSMISSION SYSTEM.

Application filed April 8, 1922. Serial No. 550,596.

To all whom it may concern:

Be it known that I, WILLIAM L. CASPER, a citizen of the United States, residing at Brooklyn, in the county of Kings, State of New York, have invented certain new and useful Improvements in Transmission Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to transmission systems and particularly to repeating systems employing electric discharge devices.

An object of this invention is to eliminate capacity effects between transformer windings included in a transmission circuit, wherein high quality transmission is desired.

Another object is to prevent capacity effects in a translating device from distorting signal waves impressed therethrough upon amplifying means such as electric discharge repeaters.

In accordance with the specific form of this invention hereinafter described in detail, the input transformer of an electric discharge repeater has its primary and secondary windings wound in such a manner and so associated with the input terminals of the repeater, that capacity effects existing between the windings are eliminated. If the primary winding of the transformer is wound next to the core, with the secondary winding, superposed on the primary winding, the outer layer of the primary winding is maintained at substantially ground potential, and the inner layer of the secondary winding is connected to that input terminal of the repeater, which is usually grounded during operation, and which terminal is usually the heated electrode or cathode. With this arrangement, the capacity effects between the transformer windings are substantially prevented from distorting the signals transmitted through the circuit in which the transformer is present.

The accompanying drawing illustrates this invention in connection with a two-way repeater system employing repeaters of the three-electrode type.

Referring in detail to the drawing, transmission lines 7 and 8 are shown terminating at a repeater station in balancing artificial lines 9 and 10 respectively. A vacuum tube repeater 11 is employed for impressing upon line section 8, amplified signals received from line section 7, while vacuum tube amplifier 12 is employed for amplifying and repeating signals in the reverse direction. The amplifiers may be of any desired type and three electrode vacuum tube repeaters are illustrated, comprising respectively, cathodes 13, 14, control electrodes 15, 16, and anodes 17, 18.

In accordance with this invention, the input electrodes 13 and 15 of amplifier 11 are coupled with line section 7 by an input transformer 19, arranged in such a manner that amplifier 11 is enabled to produce a faithful amplified copy of the signals received from line section 7 without having the signal waves distorted on account of capacity effects between the transformer windings. The input transformer 19 comprises a multi-layer primary winding 20 and a multi-layer secondary winding 21. The primary winding is shown to be in two sections which may, for example, be wound on different parts of the core, in such a manner as to be aiding for series currents, while the secondary winding is shown to be of only one section. In case the primary winding of the transformer is wound next to the core, and the secondary winding is superposed on the primary winding, a connection 22 is provided to ground for the outer layers of the two sections of the primary winding, while the secondary winding is so connected to repeater 11 that the inner layer of the secondary winding is connected to that electrode of the vacuum tube repeater, which in the operation of the device is maintained at substantially grounded potential. Since it is preferable to ground the cathode, the inner layer of the secondary winding is shown to be connected to cathode 13, while the outer layer of the secondary winding is connected to control electrode 15 which is the other input terminal for the repeater. The dotted capacities 24 and 25 represent the natural capacities which exist between the adjacent layers of the primary and secondary windings of the transformer. Due to ground connection 22 for that layer of the primary winding adjacent to secondary winding and the ground connection 26 for the cathode, it is evident that these natural capacities 24 and 25 have both terminals at substantially ground potential, so that these capacities are eliminated. The presence of these capacity effects would cause the transformer coupling to comprise an im-

pedance, a portion of which varies with the frequency, thereby producing considerable distortion in the signals received from line 7 and impressed on the input of the amplifier, a distortion effect which would be greatly amplified by amplifier 11. With the connection shown, however, these capacity effects are shunted out, and the repeater is enabled to impress upon the outgoing line a faithful amplified copy of the received currents.

The primary winding of the input transformer is preferably wound in an even number of sections, so that the ground connection for the outer layer may be made at the exact mid-point of the primary winding. This grounding at the mid-point of the primary winding is preferable, since a ground connection for any other point of the primary winding would tend to cause line section 7 to be unbalanced with respect to ground. It is also preferably that the secondary winding be wound in a single section so that all the turns of that layer of the secondary winding adjacent the primary winding, may be grounded by a path which does not include any turns of other layers to the secondary winding. While the ground connections 22 and 26 are shown to be made without the intermediary of any impedance devices, such an arrangement is not essential as long as each of the paths 22 and 26 is of low impedance to the frequency of the alternating current signals to be transmitted. The grounding of the mid-point of the primary winding may be made in any suitable manner such as through the intermediary of a grounded shield between the primary and secondary windings.

It frequently will not be necessary to provide an actual path to ground for the mid-point of the primary winding 20, since if the two wires of line 7 are at equi-potential with respect to ground, the mid-point of winding 20 will be at ground potential independent of an actual connection to ground, such as shown at 22. In case the two wires of line 7 are unbalanced with respect to ground, one of the sections of the primary winding 20 should be of a greater number of turns or layers than the other section, thereby compensating for the unbalance of line 7 and enabling those layers of the primary winding adjacent the secondary to be substantially at the desired ground potential.

If the mid-point of the primary winding 20 is not actually grounded, the transformer construction of this invention has an additional advantage in suppressing longitudinal currents in the repeater circuit. For example undesired longitudinal currents in leads 30 and 31 will flow through the two halves of winding 20 in opposite directions and through capacities 24 and 25 to the ground connection 26 for the cathode. Due to the fact that these currents flow in opposite directions in the primary winding, the potentials induced in the secondary winding of the transformer will neutralize each other and will, therefore, produce no change in the potential of control electrode 15.

While this invention has been disclosed above, embodied in special connections for an input transformer for vacuum tube repeaters, it is obvious that this invention is not limited in its use to input transformers, but may be employed in connection with transformers located in other parts of a transmission circuit through which high quality transmission is desired.

The invention claimed is:

1. A transformer having a multi-layer winding, a second multi-layer winding superimposed on the first mentioned winding, a direct low impedance connection to ground for the outer layer of said first mentioned winding, and a direct connection of low impedance to ground for the inner layer of said second winding.

2. A transformer having a multi-layer winding, a second multi-layer winding superimposed on the first mentioned winding, means for maintaining the mid-point of the outer layer of said first mentioned winding substantially at ground potential, and means for maintaining the inner layer of said second winding substantially at ground potential.

3. In combination, a transformer having a primary winding and a secondary winding, an incoming line associated with said primary winding, an outgoing line associated with said secondary winding, and grounded connections for said primary winding and said secondary winding for shunting out the natural capacity present between adjacent layers of said primary winding and said secondary winding.

4. A transformer comprising a multi-layer winding wound in a plurality of sections, a second winding wound in a single section, means for maintaining the mid-point of the first mentioned winding at substantially ground potential, and means for maintaining substantially at ground potential one terminal of that layer of said second winding adjacent said first mentioned winding.

5. A transformer for signaling circuits comprising a multilayer primary winding, a multilayer secondary winding, means for maintaining at substantially ground potential that layer of said primary winding adjacent the secondary winding, and means for maintaining at substantially ground potential that layer of said secondary winding adjacent the primary winding.

6. A transformer for coupling a balanced two wire line to a second line having one side grounded, said transformer comprising

a multilayer primary winding connected to the first mentioned line, a multilayer secondary winding connected to said second line, and means for maintaining at substantially ground potential the mid-point of said primary winding, said secondary winding having that layer adjacent said primary winding connected to the grounded side of said second line and having a remote layer connected to the ungrounded side of said second line.

In witness whereof, I hereunto subscribe my name this 4th day of April A. D., 1922.

WILLIAM L. CASPER.