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S. P. SHACKLETON

SIGNALING CIRCUITS FOR REPEATERS

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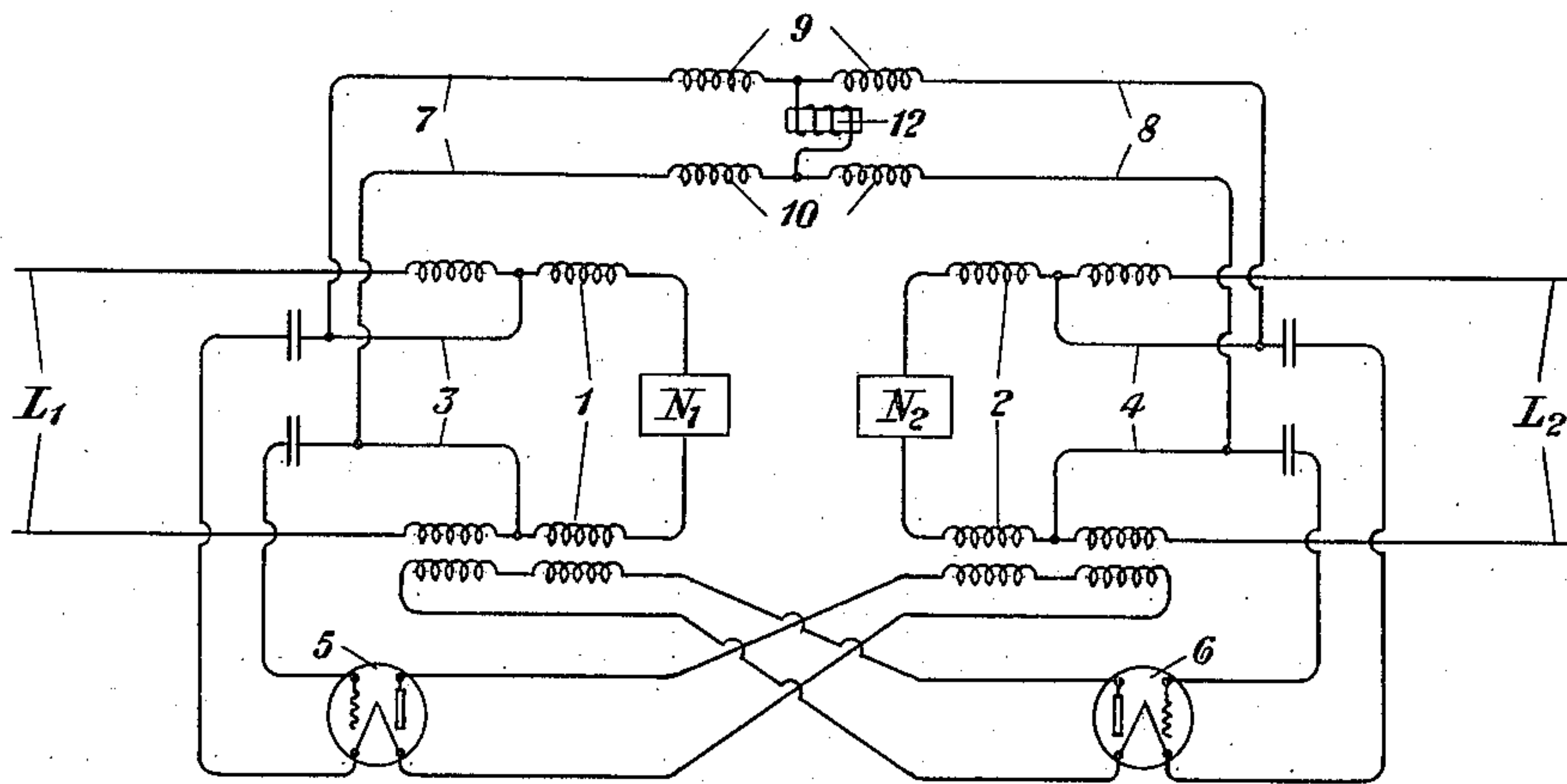


Fig. 1

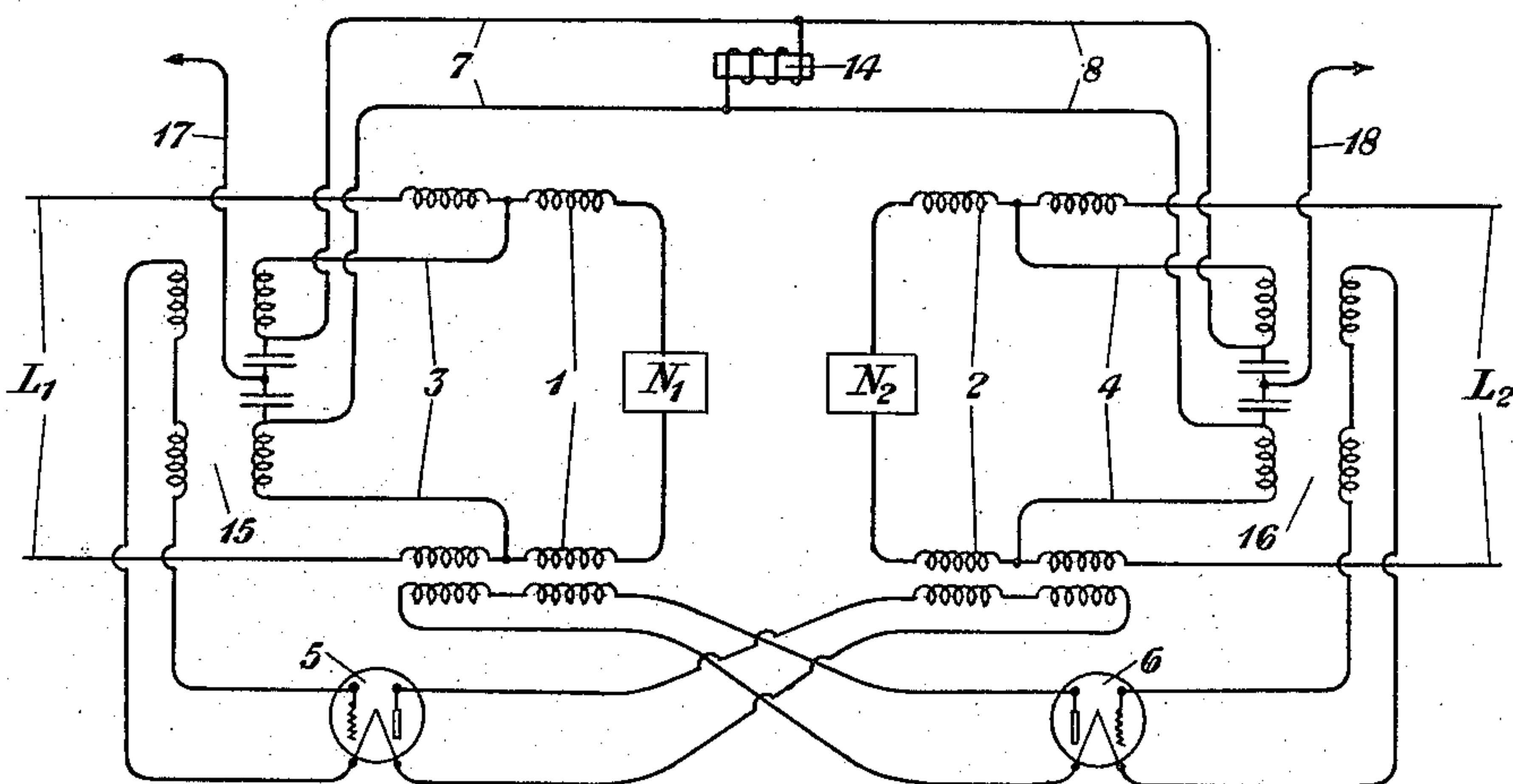


Fig. 2

INVENTOR.
S. P. Shackleton
BY
gr 708
ATTORNEYS.

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UNITED STATES PATENT OFFICE.

SAMUEL P. SHACKLETON, OF WYOMING, NEW JERSEY, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

SIGNALING CIRCUITS FOR REPEATERS.

Application filed October 26, 1926. Serial No. 144,310.

This invention relates to transmission lines which include repeater apparatus, and more particularly to improvements in arrangements for by-passing direct current signals around repeater apparatus in such lines.

In the arrangements of this invention the direct current signaling circuit is connected from the midpoints of the windings of the output transformer usually associated with the repeater apparatus. Under such conditions no additional equipment need be added to the customary balancing networks as there will be no necessity for balancing any of the signaling equipment. Accordingly, the arrangements of the invention afford advantageous features from an economical standpoint. Furthermore, the arrangements of the invention will cause balance conditions to be improved, resulting in a better telephone circuit than would be possible with circuits which tended to unbalance the repeater apparatus and which required additional balancing equipment. A further advantage consists in the fact that the signaling circuit of this invention may be provided with very little additional resistance in the circuit. This may be of particular advantage in instances where the limit of the signaling range is approached. Further features and objects of the invention will appear more fully from the detailed description hereinafter given.

The invention may be more fully understood from the following description, together with the accompanying drawing, in the Figures 1 and 2 of which the invention is illustrated. Fig. 1 is a circuit diagram showing the invention as applied to a transmission line including a two-way two-element repeater; Fig. 2 is a circuit diagram showing the invention as applied to a transmission line including a two-way two-element repeater which is also arranged to operate as part of a phantom telephone circuit. Like reference characters have been utilized to denote like parts in both of the figures.

In Fig. 1 are shown two sections L_1 and L_2 of a transmission line which are interconnected by a two-way, two-element repeater. This repeater arrangement is well known in the art and comprises the networks N_1 and N_2 for balancing the line sections L_1 and L_2 , respectively. The repeater arrangement also comprises the three-winding output transformers 1 and 2 and the amplifying elements

5 and 6, which, in this instance, are shown as vacuum tubes. The input circuits 3 and 4 of the vacuum tubes are connected to the midpoints of windings of the output transformers 1 and 2, respectively. The input circuits 3 and 4 include condensers to prevent the incoming direct current signals from being transmitted to the tube elements. Bridged across the input circuits 3 and 4, or in other words, connected to the midpoints of the output transformer windings, are the circuits 7 and 8, which comprise the signaling circuit of the invention for by-passing direct current signals around the repeater apparatus. The circuits 7 and 8 may include the retardation coils 9 and 10, which will readily transmit the direct current signals but will offer a high impedance to the alternating telephone current signals. If it is desired to intercept the direct current signals at the repeater, the relay 12 may be provided as shown. Such a relay might be required either in connection with the signaling circuit itself or to insert the telephone repeater in the connection when required. It is reiterated herein that a signaling circuit thus connected to the midpoints of the output transformer windings will have no effect on the balance of the repeater apparatus and accordingly, it will not be necessary to provide additional balancing equipment in the networks N_1 and N_2 to balance the signaling equipment.

In Fig. 2 is shown a repeater station substantially similar to that shown in Fig. 1, except that the line sections L_1 and L_2 are also used as portions of a phantom telephone circuit 17—18. The input circuits 3 and 4 of the vacuum tubes 5 and 6, respectively, will include a winding of the transformers 15 and 16. The portions 17 and 18 of the phantom circuit will be connected to the midpoints of the windings of these transformers. The signaling circuits 7 and 8 will be connected to the windings of these transformers as illustrated. Between the windings of the transformers 15 and 16 are provided condensers which will be fairly large so that they may operate as a short circuit for the incoming telephone currents and prevent these telephone currents from being transmitted over the signaling circuit. These condensers will furthermore prevent the direct current signals from being transmitted to the repeater apparatus. A relay 14 may be connected in

the signaling circuit as shown if it is desired to intercept the direct current signals at the repeater.

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

What is claimed is:

A transmission line comprising two line sections interconnected by two-way two-element repeater apparatus, said repeater ap-

paratus including balancing networks, repeater output transformers, and repeater elements having their input circuits in inductive relation with phantom coils connected to the midpoints of the windings of said output transformers, a phantom circuit associated with the midpoints of said coils, and a direct current signaling circuit connected to the midpoints of each of said repeater output transformers.

In testimony whereof, I have signed my name to this specification this 22nd day of October, 1926.

SAMUEL P. SHACKLETON.