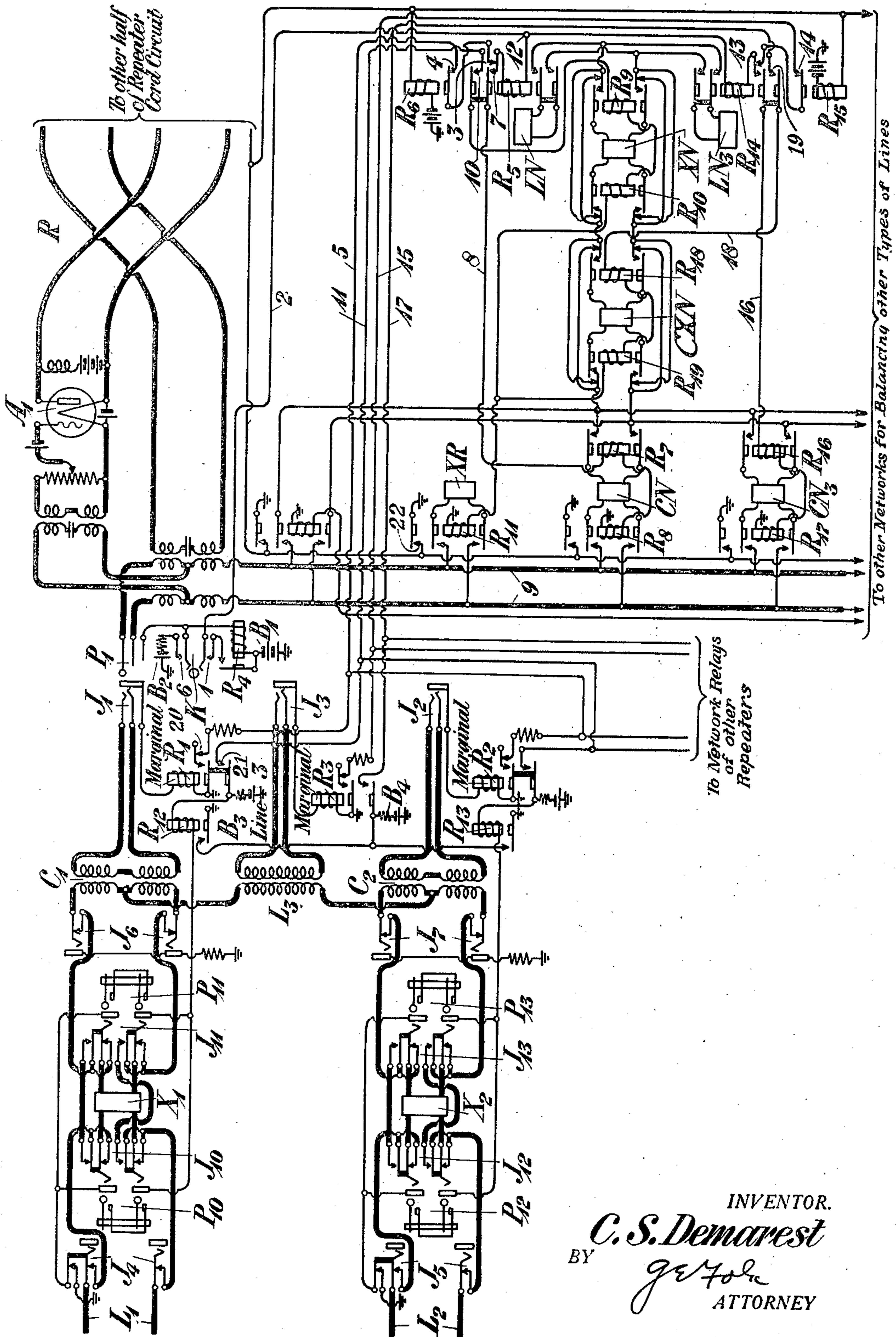


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 REPEATER NETWORK SELECTING APPARATUS.
 APPLICATION FILED JULY 9, 1919.

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REPEATER-NETWORK-SELECTING APPARATUS.

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To all whom it may concern:

Be it known that I, CHARLES S. DEMAREST, residing at Brooklyn, in the county of Kings and State of New York, have invented certain Improvements in Repeater-Network-Selecting Apparatus, of which the following is a specification.

This invention relates to telephone repeaters and more particularly to means for selecting the proper electrical networks for balancing a transmission line and its associated apparatus when a telephone repeater is connected thereto.

In order that a telephone repeater may operate properly it is necessary that there shall be connected with the repeater circuit a group of electrical networks whose function is to balance the line and its associated apparatus. The individual networks that constitute the balancing group each have an impedance characteristic simulating a part of the transmission circuit, and the entire group, therefore, when combined will have the same characteristic as the entire transmission line circuit, including such auxiliary apparatus as may be connected thereto. Such auxiliary apparatus usually consists of composite sets, phantom coils, and composite ringers. A transmission line may have one or more types of auxiliary apparatus that is, it may be equipped with phantom coils only, or with phantom coils, composite sets and composite ringers, or other combinations. The repeaters that are adapted to be connected with such transmission lines have associated with them sufficient networks to balance the various types of lines with which the repeater may be associated, and also to balance the various types of apparatus that may be associated with the said lines. It is the purpose of this invention to provide means to control the selection of the proper network for balancing a line and the associated apparatus, and to prevent the connection of a network to the repeater circuit when its corresponding apparatus has been disconnected from the line.

Further objects of this invention will appear from the following description of the said invention when read in connection with the attached drawing which is a circuit diagram of one embodiment of the invention.

In the drawing L_1 and L_2 represent two physical transmission circuits which con-

stitute the side circuits of the phantom circuit L_3 . Each side circuit is equipped with a composite set represented by X_1 and X_2 , whereby these circuits may be used for simultaneous telephone and telegraph operation. Likewise, each side circuit is equipped with a phantom coil, C_1 and C_2 , by means of which the phantom circuit is superposed upon these side circuits. The two side circuits and the phantom circuit terminate at the switchboard in jacks J_1 , J_2 , and J_3 , respectively, which are adapted to receive the plug P_1 of the cord circuit repeater R . Associated with each of the jacks J_1 , J_2 , and J_3 is a marginal controlling relay, represented by R_1 , R_2 , or R_3 , which controls the selection of the proper type of balancing network.

Associated with the cord circuit repeater R are various networks which are intended to balance the lines and their associated apparatus. The network XR is intended to balance the composite ringing apparatus (not shown), the network CN to balance either of the phantom coils C_1 or C_2 of line L_1 or line L_2 , the network CN_3 to balance the effect of the phantom coils upon the phantom line L_3 , network CXN to balance the effect of the composite sets on the phantom line L_3 , the network XN to balance the composite sets associated with either line L_1 or L_2 , since these composite sets are of the same type, and the networks LN and LN_3 , which are intended to balance the transmission lines L_1 or L_2 and L_3 , respectively, exclusive of the apparatus that may be associated therewith. Associated with the networks LN and LN_3 are the master controlling relays R_5 and R_{14} respectively whose function is not only to connect the line balancing networks LN and LN_3 respectively to the repeater circuit but also to control the operation of the switching relays associated with the auxiliary balancing networks by means of which the said latter networks are connected to the repeater circuit. A controlling key K is associated with the repeater for the purpose of controlling the operation of the relays by means of which the selection of the networks is effected. In order to simplify the drawing the transmission lines in one direction and one half of the repeater cord circuit only is shown, since the other half of the said circuit and the other line circuits

are similar to those shown. Relays R_6 and R_{15} are in the nature of guard relays to prevent the accidental selection and connection of a balancing network to one repeater circuit which is already connected to a line, as the result of connecting another repeater to another line. Each repeater is designed to be used with each line circuit, adapted for repeater operation, and each repeater has individual thereto a plurality of networks which may balance any line circuit (and its associated apparatus) with which the repeater may be used. The relays associated with the line jacks (of which R_1 , R_2 and R_3 are typical) are common to all of the repeater circuits. The guard relays such as R_6 and R_{15} operate as soon as the final balancing network has been selected and connected to the repeater connected with any line circuit, and when operated, these guard relays prevent other networks from being accidentally connected with the same repeater circuit, when and as the result of connecting another repeater with another line circuit. This will be made clear in connection with the description of the mode of operating the repeater circuit.

Let us assume that it is desired to connect the repeater cord circuit R with the transmission line L_1 . This is done by inserting the plug P_1 in the jack J_1 , thereby establishing a circuit from battery B_1 , winding of relay R_4 , sleeve contacts of plug P_1 and jack J_1 , winding of relay R_1 to ground. Relay R_4 is operated thereby, but relay R_1 being a marginal relay does not receive sufficient current to cause it to be energized. By inserting the plug of the cord circuit in the jack J_1 the operator at the repeater station is enabled to talk over the transmission line L_1 to the operator at its opposite end. When the repeater operator has received the requisite information regarding the connection that it is desired to have established, she inserts the plug at the other end of the repeater cord circuit in the jack of the desired transmission line and then operates the control key K . This establishes a circuit from battery B_1 , contact 1 of key K , conductor 2, winding of relay R_5 , contact 3 of said relay, contact 4 of relay R_6 , conductor 5 to ground through the contact 20 of relay R_1 , which has already been energized by current from battery B_2 and contact 6 of key K . The contact of relay R_1 just referred to is of the wiping type and so designed as to close momentarily the circuit through relay R_5 , that is, just sufficiently long to energize R_5 . Relay R_5 by its operation opens contact 3 but closes contact 7 and is locked up over conductor 8 and the windings of relays R_7 and R_8 to ground. As a result of the operation of relays R_5 , R_7 , and R_8 the line balancing network LN and the phantom coil balancing network CN are

connected to conductors 9 and thereby to the repeater circuit. Furthermore, through the operation of the marginal relay R_1 a circuit is established from battery B_3 , contact 21 of relay R_1 , conductor 11, contact 10 of relay R_5 , windings of relays R_9 and R_{10} , winding of relay R_{11} to ground, which operates relays R_9 , R_{10} , and R_{11} and connects the composite network XN and the composite ringer network XR to the conductors 9 and thereby to the repeater circuit. As the result of these operations, it will be seen that there has been connected to the repeater circuit the network LN to balance the transmission line L_1 , the composite network XN to balance the composite set X_1 , the phantom network CN to balance the phantom coil C_1 , and the composite ringer network XR to balance a composite ringer connected with line L_1 , but not shown on the drawing.

Assume for instance that it is desired to disconnect the composite set X_1 from the line circuit L_1 . Plug P_{10} is inserted in jack J_{10} and plug P_{11} is inserted in jack J_{11} . This operation not only disconnects the composite set from the line circuit, but also establishes a circuit from battery B_3 , relay R_{12} , sleeve contacts of plugs P_{10} and P_{11} and jacks J_{10} and J_{11} respectively in parallel, the upper normal contact of jack J_4 to ground, thereby causing relay R_{12} to operate, which grounds the battery B_4 of the marginal relay R_3 , associated with the jack J_3 of the phantom circuit L_3 , the function of which will be made clear later. It is also apparent that battery B_3 associated with relay R_1 , is grounded through the winding of relay R_{12} , the resistance of which is sufficiently low to amount to a short-circuit of the windings of the relays R_9 , R_{10} , and R_{11} which, as previously stated and described, are energized by current from battery L_3 . The consequence, therefore, of the short-circuiting of battery B_3 , by the disconnection of the composite set, is to prevent the operation of the relays R_9 , R_{10} , and R_{11} that would normally connect the composite balancing network and the composite ringer balancing network with the repeater circuit. It will be seen, therefore, that the applicant's invention provides a simple method to prevent the connection of balancing networks to the repeater circuit when the auxiliary apparatus which the said networks are intended to balance are disconnected from the line circuit.

The method of controlling the selection of the proper networks for balancing the phantom circuit is as follows:—If the plug P_1 of the cord circuit is inserted in the jack J_3 and the repeater control key K has been operated the marginal relay R_3 will likewise be operated, and a circuit will be established from battery B_1 , contact 1 of key K , conductor 2, thence through the winding and

the contact 13 of relay R_{14} , contact 14 of relay R_{15} , thence over conductor 15 to ground over the contact of marginal relay R_3 . Relay R_{14} is energized thereby and is locked up over a circuit through conductor 16 and the windings of relays R_{16} and R_{17} to ground. As a result of the operation of relays R_{14} , R_{16} , and R_{17} , the phantom line network LN_3 and the network CN_3 , intended to balance the effect upon the phantom line of the phantom coils C_1 and C_2 associated with the side circuits are connected with the repeater circuit over conductors 9. The network CXN , which is intended to balance the effect upon the phantom circuit of the composite sets X_1 and X_2 associated with the side circuits and the composite ringer network XR , would normally be connected with the repeater circuit by the operation of relays R_{18} , R_{19} , and R_{11} , over a circuit from battery B_4 , conductor 17, contact 19 of relay R_{14} , conductor 18, relays R_{18} , R_{19} , and R_{11} to ground. After the composite sets have been disconnected from the side circuits of the phantom, it is, of course, unnecessary and undesirable to have the phantom composite network connected with the repeater circuit when the repeater cord circuit is connected with the phantom circuit. Consequently, when the composite sets X_1 and X_2 have been disconnected from the lines L_1 and L_2 respectively, relays R_{12} and R_{13} will be operated thereby, which will ground battery B_4 associated with the marginal relay R_3 of jack J_3 . In like manner if the composite ringers have been disconnected from the side circuits, battery B_4 will be grounded through the contacts of relays R_{12} and R_{13} , and relays R_{18} , R_{19} , and R_{11} will be short-circuited. In consequence thereof the networks CXN and XR are not connected with the repeater circuit.

In order to prevent a false connection of balancing networks to a repeater circuit after the proper selection has been made, guard relays, such as R_6 and R_{15} heretofore referred to, have been provided. When, for example, plug P_1 was inserted in jack J_1 and key K_1 had been operated, networks LN , CN , XN , and XR were selected and connected to the repeater circuit. Assuming that no guard relays were used, if another repeater had been connected with line L_2 by the insertion of its plug in jack J_3 and its control key had been operated, relay R_3 , associated with the jack J_3 would be operated which would momentarily ground conductor 15 as well as a similar conductor leading to the other repeater. The grounding of 15 would cause relay R_{14} to operate which would connect networks LN_3 , CN_3 , and CXN , to repeater R connected with line L_1 . Such accidental and false selection and connection of these networks is prevented by a guard relay such as R_{15} which operates as soon as contact 22 of relay R_{11} is

closed (or a similar contact of other switching relays) which occurs after the selection has been made of the final network intended to balance the line and apparatus with which repeater R may be connected. Each master control relay, such as R_5 and R_{14} , has its individual guard relay, as R_6 and R_{15} , respectively, and as soon as the final network has been selected all of the guard relays will be operated so that no master control relays of the connected repeater circuit will be operated as a result of connecting another repeater circuit to another line circuit.

If a composite set, as for example X_1 , which is ordinarily associated with line L_1 , has become defective so as to necessitate its removal from the line, and it is necessary or desirable to maintain telegraph service over this line, it may be done in the following manner: the defective set X_1 may be disconnected in the manner heretofore described by the insertion of plugs P_{10} and P_{11} in the jacks J_{10} and J_{11} , respectively. A portable composite set (not shown) similar to X_1 , the conductors of which extending in each direction terminate in a cord and a plug is usually provided as a temporary substitute for the regular composite sets. One of the plugs of this portable set may be inserted in jack J_4 and the other plug in jack J_6 , thus connecting the portable composite set between the line L_1 and the phantom coil C_1 . When the composite set X_1 was disconnected from the line, the battery B_3 was grounded over the upper normal contact of jack J_4 , which consequently would prevent the selection of a composite balancing network when the repeater cord circuit was connected with this line. However, when the plug of the temporary composite set is inserted in the jack J_4 , the ground is removed from battery B_3 by the opening of the upper normal contact of this jack, so that the composite balancing networks will be connected with the repeater circuit in order to balance the temporary composite set.

This invention provides simple and effective means for controlling the selection of suitable networks for balancing a telephone line and its associated apparatus when a telephone repeater is connected with the said line. It may be applied to physical circuits alone, or to a phantom group comprising both physical and phantom circuits. Although this invention has been shown as embodied in a specific organization, it is apparent that it may be embodied in other and different forms from that shown, without departing from the spirit of the appended claims.

What is claimed is:

1. In a telephone transmission system, a combination of a telephone transmission line, auxiliary apparatus associated with the

said transmission line, a telephone repeater adapted for connection with the said transmission line, a repeater control key, a network adapted to balance said line, auxiliary
5 networks adapted to balance said auxiliary apparatus, auxiliary network switching relays, a master control relay designed to connect the line network and to control the operation of the switching relays associated with
10 the auxiliary balancing networks whereby the said networks may be connected to the repeater, and a relay directly operable by the connection of the repeater with the transmission line and the actuation of the re-
15 peater control key for controlling the energization of the said master control relay.

2. In a telephone transmission system, the combination of a telephone transmission line, auxiliary apparatus associated with the
20 said transmission line, a telephone repeater adapted for connection with the said transmission line, a repeater control key, a network adapted to balance said line, auxiliary networks adapted to balance said auxiliary
25 apparatus, auxiliary network switching relays, a master control relay designed to connect the line network and to control the operation of the switching relays associated with the said auxiliary balancing networks
30 whereby the said networks may be connected to the repeater, a relay directly operable by the connection of the repeater circuit with the transmission line and the actuation of the repeater control key for con-
35 trolling the energization of the said master control relay and means whereby the said auxiliary network switching relays may be short-circuited, thereby preventing the connection of the said networks with the re-
40 peater circuit when their corresponding line apparatus is disconnected from the line circuit.

3. In a telephone transmission system, the combination of a group of transmission lines
45 comprising a phantom circuit and two side circuits, auxiliary apparatus associated with each of said side circuits, a telephone repeater adapted for connection with each of said transmission lines, a group of networks
50 adapted to balance said lines, a second group of networks adapted to balance said auxiliary apparatus and means for preventing the selection of an auxiliary network for the

phantom line whenever the corresponding auxiliary apparatus has been disconnected 55
from a side circuit.

4. In a telephone transmission system, the combination of a group of telephone transmission lines comprising a phantom circuit and two side circuits, auxiliary apparatus 60
associated with each of said side circuits, a repeater adapted for connection with each of said transmission lines, a repeater control key, a group of networks adapted to balance said lines, a second group of networks adapted 65
to balance said auxiliary apparatus, a control relay associated with said phantom circuit and directly operable by the connection of the repeater circuit with the transmission line and the actuation of the re- 70
peater control key, and switching relays directly energized by said control relay whereby the networks that are adapted to balance the effect upon the phantom circuit of the auxiliary apparatus associated with the side 75
circuits may be connected with the repeater circuit.

5. In a telephone transmission system, the combination of a group of telephone transmission lines comprising a phantom circuit 80
and two side circuits, composite sets associated with each of said side circuits, a repeater adapted for connection with each of said transmission lines, a repeater control key, a group of networks adapted to balance 85
said lines, a second group of networks adapted to balance said composite sets, a control relay associated with said phantom circuit and directly operable by the connection of the repeater circuit with the trans- 90
mission line and the actuation of the repeater control key, switching relays directly energized by said control relay for connecting with the repeater circuit the auxiliary networks for balancing the effect upon the 95
phantom circuit of the auxiliary apparatus associated with said side circuits, and means whereby the said auxiliary network switching relays may be short-circuited, thereby preventing the connection of the said net- 100
works with the repeater circuit.

In testimony whereof, I have signed my name to this specification this 8th day of July, 1919.

CHARLES S. DEMAREST.