

1,355,147.

Patented Oct. 12, 1920.

2 SHEETS—SHEET 1.

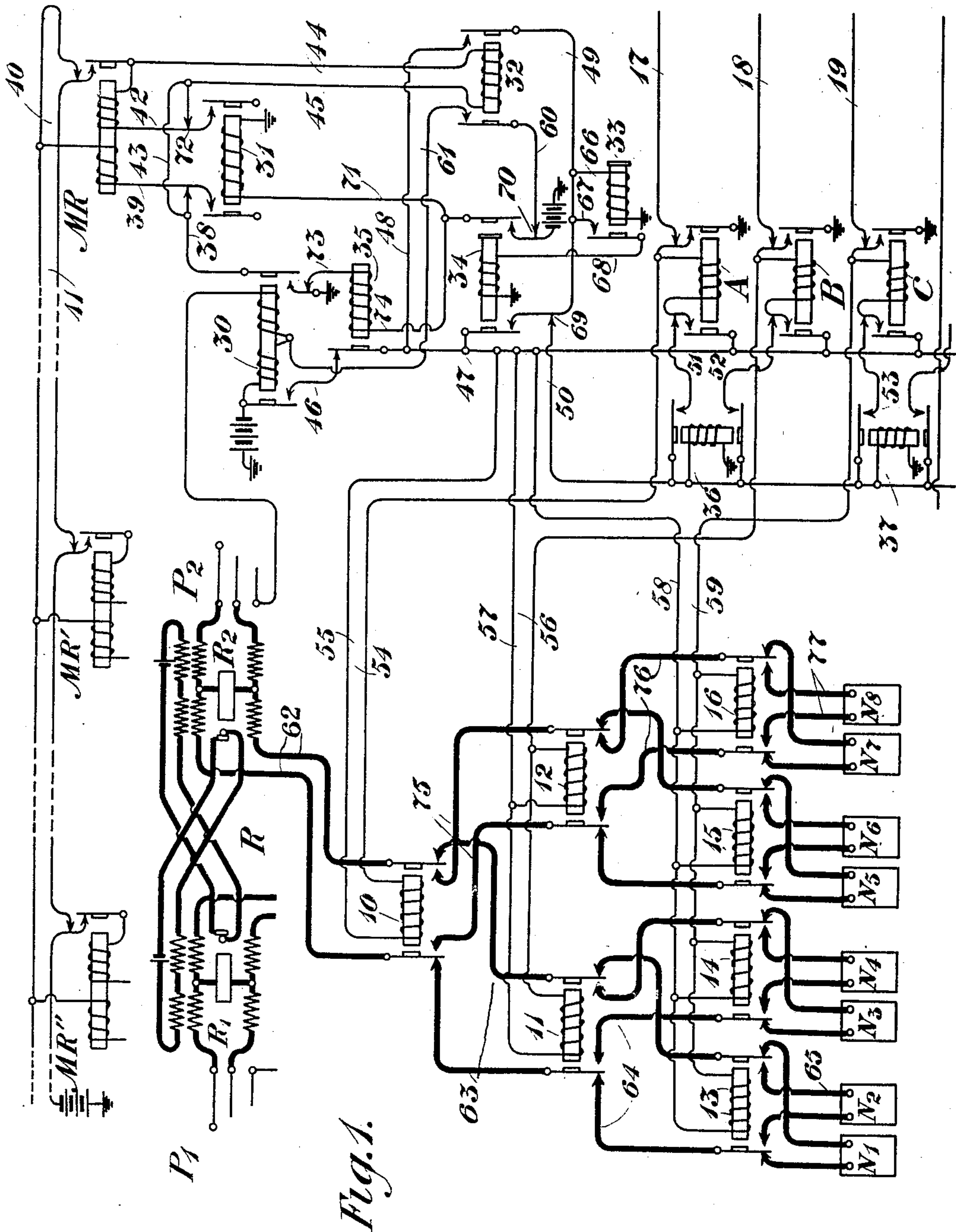


Fig. 1.

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 NETWORK SELECTING DEVICE.
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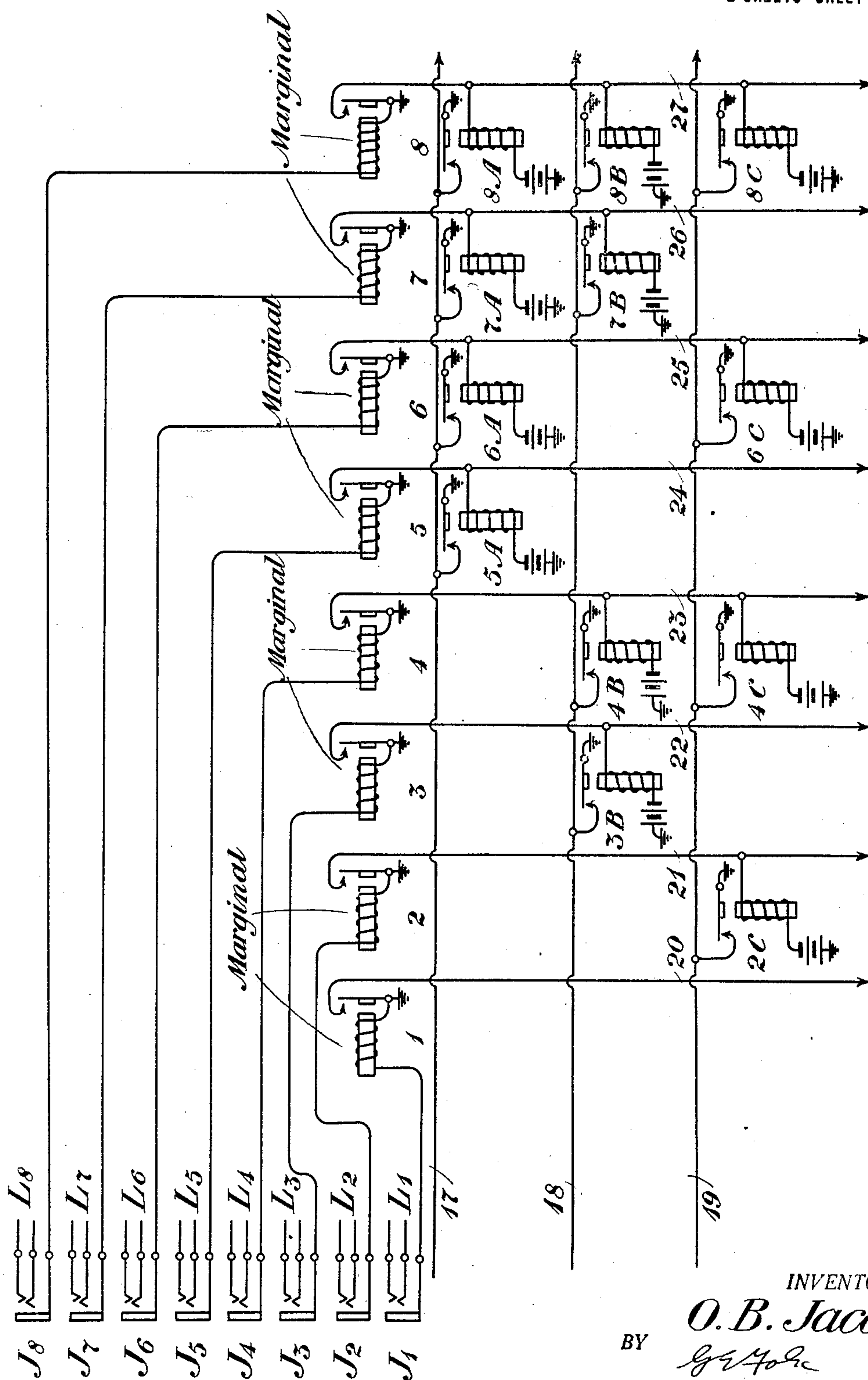


Fig. 2

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NETWORK-SELECTING DEVICE.

1,355,147.

Specification of Letters Patent.

Patented Oct. 12, 1920.

Application filed May 17, 1919. Serial No. 297,865.

To all whom it may concern:

Be it known that I, OLIVER B. JACOBS, residing at East Orange, in the county of Essex and State of New Jersey, have invented certain Improvements in Network-Selecting Devices, of which the following is a specification.

This invention relates to telephone repeaters and more particularly to a means for automatically selecting a suitable artificial line or network for balancing a line or trunk with which a repeater may be associated.

It is one of the objects of the invention to provide a repeater which is suitable for making connections with any one of a number of transmission lines although the impedance of such lines be widely different. Another object consists in equipping a repeater with a plurality of balancing networks or artificial lines of different impedance characteristics, and providing means whereby any one of said networks may be connected to the repeater. Another object consists in the provision of means for automatically selecting the proper network to be connected to the repeater when the repeater is associated with a transmission line. A further object consists in the provision of means for preventing false selection and for preventing other repeater apparatus from interfering with the network selecting process while it is in operation. Other and further objects of the invention will be clear from the detailed description to be given later.

It has heretofore been customary when a connection is made between two transmission circuits through a repeater, to provide a balancing artificial line or network for each circuit. In some cases these networks are associated with the repeater circuit and in others with the transmission circuits. In the first case, if the repeater circuit is used with other types of transmission circuits having different characteristics, the networks normally associated with the repeater must be replaced, by manual means, with others having the proper characteristics. In the second case, when the repeater is connected to different transmission circuits, the proper network which is associated with each transmission circuit is connected to the repeater at the same time the connection is made to the transmission cir-

cuit. This latter arrangement has the disadvantage of requiring two switchboard jacks for each transmission circuit, one for the transmission circuit itself, the other for the network, together with a twin plug associated with the repeater whereby the connection is made to both the transmission circuit and the network by one operation. It has the further disadvantage of requiring as many networks as there are transmission circuits to which the repeater circuit may be connected. It is proposed by the present invention to provide automatic means, which shall operate when a repeater is associated with a given transmission circuit to associate with the repeater a network of a type suitable for balancing such transmission circuit, which will not possess the above disadvantages.

There is associated with the cord circuit repeater of this invention a plurality of types of artificial lines or networks of different impedance characteristics, each of said networks being suitable to balance one of the types of transmission lines with which a connection may be desired. These networks are associated with the repeater windings by conductors which branch off from each other at the front and back contacts of several parallel series of network relays. Associated with the repeater are a series of controlling relays and controlling conductors which serve to place the network relays in a condition to operate and select, which selection will take place upon the actuation of other relays associated with the controlling conductors and individual to the line with which the repeater may be associated. The entire selecting process and the operation of the relays associated with the repeater is under the control of a master relay which is associated with other similar master relays at other repeaters and which may only be actuated when the selecting apparatus at the other repeater is not functioning. By the above means a suitable network may be automatically selected and connected to the repeater cord circuit to balance the transmission line with which a connection is made, and the selecting process will be free from interference with the selecting apparatus of other repeaters.

The invention may now be more fully understood with reference to the accompanying drawing, Figures 1 and 2 of which,

when placed side by side, illustrate diagrammatically the circuit arrangements of the preferred form of the invention. The cord circuit repeater R through which a connection may be desired includes the answering and calling plugs P_1 and P_2 , respectively, and the repeater elements R_1 and R_2 . The repeater elements R_1 and R_2 are herein illustrated as of the mechanical type although any other well known type such as the vacuum bulb repeater may be employed. Adapted to cooperate with the plug P_2 are shown the jacks $J_1, J_2, J_3, J_4, J_5, J_6, J_7$ and J_8 , at which terminate the transmission lines $L_1, L_2, L_3, L_4, L_5, L_6, L_7$ and L_8 respectively. As the impedance characteristics of these transmission lines with which connections may be desired may differ widely, there is provided in the apparatus associated with the cord circuit repeater R a plurality of balancing artificial lines or networks $N_1, N_2, N_3, N_4, N_5, N_6, N_7$ and N_8 , each one of said networks being adapted to suitably balance one of said transmission lines. The networks $N_1, N_2, N_3, N_4, N_5, N_6, N_7$ and N_8 , are connected to the network side of the repeater R_2 by means of conductors branching off therefrom at the front and back contacts of the relay 10, and at the front and back contacts of relays 11 and 12 and at the front and back contacts of relays 13, 14, 15 and 16.

Connected to the conductor terminating in the sleeve of the plug P_2 is shown the relay 30 which has a high and a low resistance winding and which becomes energized whenever the plug P_2 is inserted in one of the jacks $J_1, J_2, J_3, J_4, J_5, J_6, J_7$ and J_8 . Associated with relay 30 is a master relay MR. Similar master relays MR' and MR'' etc., are provided for other repeaters. In order that a repeater such as R may select networks, the corresponding master relay MR must be energized and remain energized until the networks are selected for both ends of the repeater. The circuits of these master relays are so arranged that when the master relay of one repeater is energized, no other master relay can be operated until the master relay which is energized is restored to normal at the end of a process of selecting networks. Consequently, but one repeater may select networks at any given instant. Controlled by the master relay MR is the relay 32 and the slow acting relays 33 and 34. The relay 32 serves to place the relays A, B and C and the network selecting relays 10, 11, 12, 13, 14, 15 and 16 which are connected in parallel therewith in a condition to be operated. Connected to conductors terminating at the sleeve contacts of the jacks $J_1, J_2, J_3, J_4, J_5, J_6, J_7$ and J_8 are the marginal relays 1, 2, 3, 4, 5, 6, 7 and 8 respectively. The operation of these relays is dependent upon

the actuation of relay 32 and the subsequent short circuiting of the high resistance winding of relay 30.

Under the control of each of these marginal relays is a separate series of selecting relays, as, for example, under control of relay 2 is the relay 2C, under the control of relay 4 are the relays 4B and 4C, and under the control of relay 8 are the relays 8A, 8B and 8C. Whenever one of the relays 5A, 6A, 7A or 8A is caused to be energized by the operation of its marginal relay, a ground will be connected to the controlling conductor 17, and a circuit will be completed through the windings of relay A, and such network controlling relays as are connected in parallel therewith. Whenever one of the relays 3B, 4B, 7B or 8B is caused to be energized by the operation of its controlling relay, a ground will be connected to the controlling conductor 18 and a circuit will be completed through the windings of relay B, and the network selecting relays which are connected in parallel thereto. Whenever one of the relays 2C, 4C, 6C or 8C is caused to be energized by the operation of its controlling relay, a ground will be connected to the controlling conductor 19 and a circuit completed through the windings of relay C and the network controlling relays connected in parallel thereto.

The artificial lines $N_1, N_2, N_3, N_4, N_5, N_6, N_7$ and N_8 are adapted to balance other transmission lines similar in type to the lines illustrated as $L_1, L_2, L_3, L_4, L_5, L_6, L_7$ and L_8 . Connected to each of the jacks at which such lines might terminate would be a relay similar to the relays 1, 2, 3, 4, 5, 6, 7 and 8. The relays connected to lines of the same type, for example, as the line L_2 , would have their contacts connected in parallel with those of relay 2 to the conductor 21. The relays connected to lines of the same type, for example, as the line L_6 , would have their contacts connected in parallel with those of the relay 6 to the conductor 25. By employing such arrangements the cord circuit repeater of this invention will not be limited to use with only one transmission line of each type shown but may be employed to make connections with a plurality of transmission lines of each type.

The invention may now be more fully understood from the following description of its operation: If a connection is desired through the cord circuit repeater R with one of the transmission lines, such for example as the transmission line L_2 , the plug P_2 is inserted in the jack J_2 and the following circuit is closed: from ground and battery, high and low resistance windings of relay 30, sleeve conductor of plug P_2 , sleeve contacts of plug P_2 and jack J_2 , sleeve conductor of jack J_2 , winding of marginal relay 2

to ground. The closing of this circuit will energize relay 30, but as the circuit includes the high resistance winding of relay 30 the marginal relay 2 will not be energized.

5 The operation of relay 30 closes the following circuit; from ground, right hand contact of relay 30, conductors 38 and 39, left hand winding of master relay MR, over conductor 40, contacts of relay MR, and over
10 conductor 41 including the contacts of other master relays of other repeaters, such as relays MR' and MR'' etc., to battery and ground. The closing of this circuit will energize relay MR which will in turn open the
15 above described circuit at its right hand contact and will become locked up as follows; from ground and battery, conductor 41 including contacts of relays such as MR' and MR', contact and armature of relay MR,
20 right hand winding of relay MR, conductors 42, 43 and 38, armature and contact of relay 30, to ground. Upon the energization of relay MR the process of network selection for repeater R may be started. It will be seen
25 however, that if another repeater was engaged at the same time in selecting networks and the master relay of that repeater, such for example as relay MR', was energized the above described circuit through relay MR
30 would be held open at the contacts of relay MR' and relay MR could not be energized and the network selecting process could not be started until the completion of the network selecting of the other repeater and the
35 subsequent deenergization of the relay MR'. By this means but one network selecting process may take place at a time and interference and false selection is obviated.

Upon the operation of the master relay
40 MR the process of selecting a suitable network to balance a line such for example as L_2 is started by the closing of the following circuit; from ground and battery, conductor 41, contact and armature of relay MR, conductor 44, winding of relay 32, conductors
45 45, 43, and 38, armature and contact of relay 30, to ground. This operates the relay 32 and closes the following circuit; from ground and battery, left hand armature and
50 contact of relay 30, conductor 46, contact of relay 35, conductors 47 and 48, right hand contact and armature of relay 32, conductors 49 and 50, and thence through the windings of relays 36 and 37 and to ground, thereby
55 operating relays 36 and 37. Relays 36 and 37 pull up their armatures and a potential is thereby applied from conductor 50, over the contacts of relays 36 and 37, and over conductors 51, 52 and 53, to the windings of
60 relays A, B and C, and to the controlling conductors 17, 18 and 19. As relay 10 is connected in parallel with relay A by means of conductors 54, 55 and 47, and as relays 11 and 12 are connected in parallel with re-
65 lay B by means of conductors 56, 57 and 47,

and as relays 13, 14, 15 and 16, are connected in parallel with relay C by means of conductors 58, 59 and 47, a potential will at the same time be applied to the relays 10, 11, 12, 13, 14, 15 and 16. The operation of relay 70 32 also closes the following circuit; from ground and battery, conductor 60, left hand armature and contact of relay 32, conductor 61, low resistance winding of relay 30, sleeve conductor of plug P_2 , sleeve contacts of plug
75 P_2 and jack J_2 , sleeve conductor of jack J_2 , winding of marginal relay 2, to ground. As this circuit short circuits the high resistance winding of relay 30 the marginal relay 2 will now be operated and the following circuit closed; from ground and battery, wind-
80 ing of relay 2C, conductor 21, contact and armature of marginal relay 2, to ground. This will operate relay 2C which will pull up its armature and thereby apply ground
85 to its contact and to the controlling conductor 19. As has been previously pointed out a potential has been applied to the controlling conductor 19 and to the relay C and the network relays 13, 14, 15 and 16 connected
90 in parallel therewith. Consequently the operation of relay 2C and the connection of ground to controlling conductor 19 will complete the circuit through relays C, 13, 14, 15 and 16, and will cause them to become ener-
95 gized. Upon the operation of relay 13 the network N_2 suitable for balancing the line L_2 will be connected to repeater R by means of conductors 65, front contacts of relay 13, conductors 64, back contacts of relay 11,
100 conductors 63, back contacts of relay 10. The relay C and the relay 13 connected in parallel therewith, are maintained in an energized condition while the repeater R is associated with the line L_2 by means of the
105 following locking circuit; from ground, right hand armature and contact of relay C, winding of relay C, left hand contact and armature of relay C, conductor 47, armature and contact of relay 35, conductor 46, contact
110 and armature of relay 30, to battery and ground.

After the proper network has been selected and associated with the repeater R the apparatus is restored to normal as fol-
115 lows; connected to conductor 49 of the previously described circuit closed through relays 36 and 37 is the conductor 66 and the slow operating relay 33, which will function at an interval after the completion of
120 the above mentioned circuit through relays 36 and 37. The operation of relay 33 closes a circuit from conductor 49, over conductor 67, contact and armature of relay 33, conductor 68, winding of slow operat-
125 ing relay 34 to ground. The closing of this circuit will cause the slow operating relay 34 to function at an interval after the functioning of relay 33. The operation of relay 34, opens at contact point 69 the above men-
130

tioned circuit closed through relays 36 and 37 and thereby releases said relays. The operation of relay 34 by attracting its right hand armature opens at contact point 70 the previously described short circuit about the high resistance winding of relay 30 and thereby deenergizes the marginal relay 2 in the sleeve circuit of the line L_2 and causes the deenergization of relay 2C. The operation of relay 34 also closes the following circuit; from ground and battery, right hand contact and armature of relay 34, conductor 71, winding of relay 31, to ground. This operates relay 31 which pulls up its armature and opens at contact point 72 the previously described circuits closed about relay MR and relay 32, thereby deenergizing said relays. When the connection is completed and the plug P_2 is withdrawn from the line the relay 30 is deenergized and opens at its left hand contact the previously traced locking circuit for the relay C and the relays 13, 14, 15 and 16 connected in parallel therewith, thereby restoring said relays to normal. Should the plug P_2 be inserted in a line jack again within a short interval and should the relay 34 be slow in releasing, the relay 34 might remain continuously operated. Accordingly when the plug P_2 is withdrawn from the line and the relay 30 is deenergized the following circuit is completed; from ground, right hand contact of relay 30, conductor 73, winding of relay 35, conductor 74, armature and contact of relay 34, to battery and ground. The closing of this circuit operates relay 35 which holds open at its contact the previously traced circuit from battery about the winding of relay 34, and thus prevents the continuous operation of that relay.

If a connection is desired through the cord circuit repeater R with another of the lines, such for purposes of illustration as the line L_8 , the plug P_2 is inserted in the jack J_8 and the operation will be substantially similar to that previously described in detail for a connection with the line L_2 . In the same manner as previously pointed out the master relay MR and its associated relays will function and a potential will be applied to relays A, B and C, and the network selecting relays 10, 11, 12, 13, 14, 15 and 16, connected in parallel therewith and to controlling conductors 17, 18 and 19. The marginal relay 8 in the sleeve circuit of line L_8 will be operated in a manner similar to the operation of marginal relay 2 and will serve to operate relays 8A, 8B and 8C, in a manner similar to the operation of relay 2C. The operation of relays 8A, 8B and 8C will connect ground over their contacts to the controlling conductors 17, 18 and 19 and thus complete circuits for relays A, B and C, and the relays 10, 11, 12, 13, 14, 15 and 16 and all of these relays

will be energized and locked up in a manner previously pointed out with respect to relay C and relays 13, 14, 15 and 16. The proper network N_8 to balance line L_8 will now be connected to repeater R over conductors 62, front contacts of relay 10, conductors 75, front contacts of relay 12, conductors 76, front contacts of relay 16, and over conductors 77.

When a connection is desired with any one of the other transmission lines and the plug P_2 is inserted in the jack at which said line terminates, it will be seen that in a similar manner the proper network to suitably balance said transmission line will be automatically selected and connected to the cord circuit repeater. The apparatus will be restored to normal upon the completion of the process of network selection and upon the completion of a connection in the same manner as pointed out for a connection with the line L_2 .

It is pointed out that other repeater cord circuits, such as those associated with the relays MR' and MR'', may be connected with the lines L_1 to L_8 inclusive. In such instances the network selecting arrangements such as the series of parallel relays associated with said repeaters will be controlled by the relay arrangements associated with the lines L_1 to L_8 in a manner similar to that already described. To accomplish this the controlling conductors 17, 18 and 19 are extended to be connected to the windings at the repeater cord circuits of relays similar to the relays A, B and C. The extension of these controlling conductors for this purpose is illustrated by the arrowheads at the extreme right of Fig. 2.

While the invention has been disclosed as embodied in certain specific arrangements which have been deemed desirable, it will be understood that it may be embodied in many and widely varied forms without departing from the spirit of the invention as defined in the appended claims.

What is claimed is:

1. A plurality of transmission lines, a repeater for making connections therewith, a plurality of balancing artificial lines associated with said repeater, a plurality of series of relays connected in parallel controlling the connection of said artificial lines to said repeater, and means associated with the terminal arrangements of said transmission lines for operating various combinations of said series of relays connected in parallel, the connection of said artificial lines to said repeater being effected over the contacts of one of the relays of each of said series of parallel relays.

2. A plurality of transmission lines, a repeater for making connections therewith, a plurality of balancing artificial lines associated with said repeater, a plurality of re-

lays connected in parallel controlling the connection of said artificial lines with said repeater, means for applying a potential to the normally open circuits including the windings of said series of relays connected in parallel, and means associated with the terminal arrangements of said transmission lines for closing various combinations of said normally open circuits.

3. A plurality of transmission lines, a repeater for making connections therewith, a plurality of balancing artificial lines associated with said repeater, a plurality of series of relays connected in parallel controlling the connection of said artificial lines to said repeater, a normally open circuit for each of said series of relays connected in parallel, a controlling conductor connected to each of said circuits, means for applying a potential to all of said circuits, and means for connecting a ground to various combinations of said controlling conductors.

4. A plurality of transmission lines, a repeater for making connections therewith, a plurality of balancing artificial lines associated with said repeater, a plurality of series of relays connected in parallel controlling the connection of said artificial lines to said repeater, a normally open circuit for each of said series of relays connected in parallel, a controlling conductor connected to each of said circuits, means operative upon the connection of the repeater to any of said transmission lines for applying a potential to all of said circuits, a source of electrical energy associated with said repeater, a separate relay connected to each of the terminal arrangements of said transmission lines, the relay associated with each of said transmission lines responding when the repeater is associated with said line, and means under the control of said last mentioned relays for connecting a ground to various combinations of said controlling conductors.

5. A plurality of transmission lines, a repeater for making connections therewith, a plurality of series of relays connected in parallel, conductors leading from the repeater to the armatures of a relay included in one of said series of relays connected in parallel, conductors leading from the front and back contacts of said last mentioned relay to the armatures of relays included in another of said series of relays connected in parallel, conductors leading from the front and back contacts of said last mentioned relays to the armatures of relays included in another of said series of relays connected in parallel, conductors leading from the front and back contacts of said last mentioned relays, artificial lines associated with said last mentioned conductors, and means to operate various combinations of said series of parallel relays for selecting

and connecting an artificial line to said repeater.

6. A plurality of transmission lines, a plurality of repeaters for making connections therewith, a plurality of artificial lines associated with each repeater, a plurality of series of relays connected in parallel associated with each repeater for controlling the selection and connection to said repeater of one of the artificial lines associated therewith, a plurality of controlling conductors, each controlling conductor being associated with a certain of said series of relays connected in parallel of each repeater, means associated with each repeater whereby when a repeater is connected with a line the plurality of series of relays connected in parallel associated with that repeater are conditioned for operation, and means individual to the line for operating the relays of said repeater associated with a controlling conductor.

7. A plurality of transmission lines, a plurality of repeaters for making connections therewith, a plurality of artificial lines associated with each repeater, a plurality of series of relays connected in parallel associated with each repeater for controlling the selection and connection to said repeater of one of the artificial lines associated therewith, a plurality of controlling conductors, each controlling conductor being associated with certain of said series of relays connected in parallel of each repeater, means associated with each repeater whereby when a repeater is connected with a line the plurality of series of relays connected in parallel associated with that repeater are conditioned for operation, and means individual to the line for operating the relays of said repeater associated with a plurality of said controlling conductors.

8. In a signaling system, a plurality of lines of different types, repeaters for interconnecting said lines, balancing networks for each type of line, a plurality of selecting relays for each repeater, controlling relays for said selecting relays associated with each repeater, means responsive to the association of a repeater with a line to cause said controlling relays of that repeater to prepare circuits for all of the selecting relays of that repeater, means determined by the line with which the repeater is associated for completing a circuit for a selecting relay, and means responsive to the actuation of said selecting relay to associate a balancing network with the repeater, and means to hold open the circuits of said controlling relays after the selection has been completed.

9. In a signaling system, a plurality of lines of different types, repeaters for interconnecting said lines, balancing networks for each type of line, a plurality of selecting relays for each repeater, controlling relays

for said selecting relays associated with each repeater, means responsive to the association of a repeater with a line to cause said controlling relays of that repeater to prepare circuits for all of the selecting relays of that repeater, means determined by the line with which the repeater is associated for completing circuits for a combination of the selecting relays, and means responsive to the actuation of said selecting relays to associate a balancing network with the repeater.

10. In a signaling system, a plurality of lines of different types, repeaters for interconnecting said lines, balancing networks for each type of line, a plurality of selecting relays for each repeater, controlling relays for said selecting relays associated with each repeater, means responsive to the association of a repeater with a line to cause said controlling relays of that repeater to prepare circuits for all of the selecting relays of that repeater, means determined by the line with which the repeater is associated for completing a circuit for a selecting relay, means responsive to the actuation of said selecting relay to associate a balancing network with the repeater, and means to lock up said selecting relay.

11. In a signaling system, a plurality of lines of different types, repeaters for interconnecting said lines, balancing networks for each type of line, and a relay individual to each repeater, operative when the corresponding repeater is used for interconnecting lines, to cause the selection of balancing networks for the lines and to prevent the selection of networks by other repeaters while that repeater is selecting.

12. In a signaling system, a plurality of lines of different types, repeaters for interconnecting said lines, balancing networks for each type of line, and a relay individual to each repeater, operative when the corresponding repeater is used for connecting lines, to cause the selection of balancing net-

works for the lines, the circuits of said relays for the several repeaters being so arranged that when the relay of one repeater is energized during the process of network selection, the circuits of the relays of other repeaters will be held open until the process of selection for that repeater is completed.

13. In a telephone repeater system, in combination, two telephone lines, a plurality of balancing lines, two repeaters for use in establishing independent telephone connections, means for associating the repeaters with the respective telephone lines, means for selecting and associating one of the balancing lines with each repeater for balancing the respective associated line, means operative upon the association of the repeaters with the telephone lines for rendering the selecting means effective for selecting a balancing line for one repeater, and means operative after such selection for rendering the selecting means effective for selecting another balancing line for the other repeater.

14. In a telephone repeater system, in combination, two telephone lines, a plurality of balancing lines, two repeaters for use in establishing independent telephone connections, means for associating the repeaters with the respective telephone lines, means for selecting and associating a balancing line with each repeater for balancing the respective associated lines, a switching relay operating upon the association of the repeaters with both lines for causing the selecting means to select and associate a balancing line with one repeater, and a switching relay rendered effective upon the selection of the one balancing line for causing the selecting means to select and connect with the other repeater another balancing line.

In testimony whereof, I have signed my name to this specification this 15th day of May, 1919.

OLIVER B. JACOBS.